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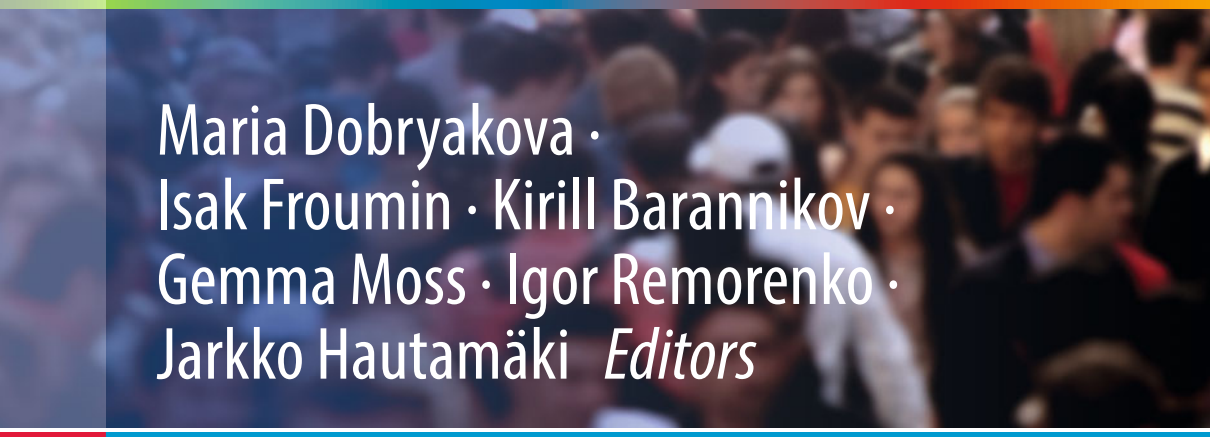

Maria Dobryakova · Isak Froumin · Kirill Barannikov · Gemma Moss · Igor Remorenko · Jarkko Hautamäki *Editors*

Key Competences and New Literacies

From Slogans to School Reality

UNIVERSITÀ DEGLI STUDI DI PALERMO

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Introduction

Maria Dobryakova and Isak Froumin

P. P. S.
As we were writing this "pandemic" post-scriptum, Russia invaded Ukraine.

These words sound impossible. It is a tragedy beyond words.

Yet we now have to find ourselves in this upside-down reality.

Education is a key to global peace. Unfortunately, it can take root only very slowly.

We have been too slow to change it.

March 9, 2022

Post-scriptum. Key Competences and New Literacies in the Face of the Pandemic

This volume results from a project which brought together eight countries and sought to explore how national systems of education respond to the pressure to foster twenty-first-century skills in mass education. This pressure had been coming mostly from business and international agencies. One of their key arguments was the rapid social and technological change we are now facing: it requires an enhanced adaptability to uncertainty and unforeseen challenges. When we were launching the project, we could not envisage that we would be able to see such a rapid change from within—to see education systems in times of crisis.

The pandemic of COVID-19 has shattered many of our usual practices, including teaching and learning. Instead of talking face-to-face, we now often have to switch to Zoom and other conferencing platforms. Countries are providing data on the educational loss caused by the pandemic [5, 6]. What is it in this change of the mode

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of communication that makes learning so difficult for many children? Why were we not ready, what could have helped us to prepare better?

Ironically, the pandemic is exactly an example of the rapidly changing world—the VUCA world, with its inherent risk of bringing violent, unexpected challenges to individuals and social systems, as if to test their resilience and adaptivity. It is in the effort to prepare people to live in such a world that the whole agenda of key competences was first launched by UNESCO back in 1972 in the Faure report [4].

Learning under the pandemic constraints was and still is a most painful experience for so many families and schools. Yet, it may have revealed the already existing problems otherwise hidden behind the brick walls of schools. It may have made them visible to a most important stakeholder: school children and their parents.

Formally, in many countries, including Russia, key competences and new literacies are now in the curriculum. They are meant to enhance disciplinary learning, to help school graduates to become independent life-long learners, who can transfer knowledge between different contexts and collaboratively find solutions to complex open-ended problems. The intended curriculum does aim at creativity, communication, collaboration, and self-regulated learning skills, which, under these or other names, make part of any twenty-first-century skills framework. We can easily trace them in such descriptions of learning outcomes as: "uses imagination", "is able to express ideas and feelings", "masters methods of creative problem-solving", "sets learning objectives," etc.

However, if, like in Russia, a sustainable methodological link between intentions and implementation has not been established, the whole construction is vulnerable. Using bitter evidence from Russia, we claim that, in the absence of such a link, teachers have no habit of integrating key competences into their practice and do not see how the latter can support disciplinary learning or general learning dispositions. School practice tends to focus on disciplinary knowledge, described in detail, which must be memorized and reproduced. Teachers encourage obedience and discipline (for instance, in Russia, children are seldom expected to ask questions during lessons and are often shy to do so). Teaching relies heavily on textbooks; homework in history, geography, and biology would often include reading and reciting a paragraph from a textbook. All in all, many children find their studies boring and stressful (at least in many of the subjects)—they need an external enforcement to keep going.

Thus, the usual framing [1] (12) of traditional schooling—like that in Russia—remains very strong: learning experience is organized by bells, textbooks, and homework, in which there is no room for learner's agency [3]. Children learn how to master a method and how to behave in a very stable environment—but they are not expected to make even minor choices or to act independently. Metaphorically, children are pulled through their learning by teachers.

Pedagogical approaches which encourage the development of key competences and literacies are essentially different (see Chap. 12). They rely on meaningful learning which requires a weaker framing allowing more room for the learner. Among other things, meaningful learning fosters internal motivation—there is usually no need to be pulling a curious, internally motivated child.

When the pandemic hit and schools had to switch to streaming their lessons, the Russian team, as part of another international consortium,[1] conducted an ethnographic survey of families with children learning from home [2]. Strikingly, the findings took us back to the issue of key competences in the implemented curriculum.

It is obvious that internet connection, available electronic devices, and spare rooms are crucial for distance learning and may cause severe inequality between families. However, our qualitative study helped us also investigate some of the more subtle underlying causes of the difficulties that families were facing.

Complaints coming from the families about their experience of distance learning (apart from those related to technical issues and lack of devices) fall into three major groups:

1. Lack of skills in self-regulated learning, including planning one's time and setting priorities ("My son couldn't do anything without me, I had to keep reminding and assisting," an average mother would share with us);
2. Lack of teacher's guidance in the presentation, explanation, or revision of the disciplinary knowledge ("We were left on our own, no support whatsoever, content was not delivered," many parents lamented);
3. A mismatch between learners and their textbooks ("Textbooks are too difficult to comprehend, I cannot grasp what the main idea is" was a recurrent complaint even from avid readers).

Thus, the strong framing gave a crack: it failed to follow children into their homes.

What was there to reach out for children to keep them learning? It could either be activities triggered by their internal motivation or an alternative enforcement of framing. In most cases, neither textbooks nor learning tasks offered by the teachers were engaging (just like in usual schooling). Many children could not even understand textbooks (i.e., informational texts) and did not know how to use the internet at large for educational tasks. In the absence of children's internal motivation, many parents had to provide an alternative enforcement of framing—it is not surprising that many of them found it exhausting and unfair.

The disruptions revealed by the pandemic demonstrate that the macro national idea of the curriculum [14] has not reached schools and families, that families are easily left behind. When separated physically from their teachers, many children are not able to learn, and their parents do not know how to support them, even if they want to. They feel however that something is wrong with the schooling.

It is not unlikely that the pressure to change the curriculum and/or school practice will now be coming not only at the supra-macro level but also from the nano-level of families with school children. At the same time, from a longer term perspective, sustainable solutions should look deeper than access to the internet and the number of electronic devices per family (which are crucial but not sufficient). Sustainable solutions should also aim at:

[1] International Consortium on Families and Community in the Time of Covid-19 (the ICO-FACT project) led by University College London.

1. Internal coherence of disciplinary knowledge in the curriculum (through concept-based learning);
2. Self-regulated learning skills and compatible learning tasks (through pedagogical approaches involving principles of inquiry-based learning);
3. Literacy skills for various kinds of texts and modes of representation;
4. The quality of texts that schools are offering;
5. Room for learner's agency to make learning meaningful and trigger internal motivation.

Our results suggest that at least some of the problems that families encountered in home-based learning are not new. They are rooted in the strong framing of schooling, which largely remains focused on rote memorization of disciplinary knowledge, does not integrate conceptual learning enhanced by key competences and literacies, and as such provides little or no room for the learner. A weaker framing offering room for learner's agency through competences would allow children to own their learning, be guided by authentic inquiry questions and strive for a conceptual understanding—would stimulate internal motivation, no enforcement would be needed.

1.1 A Global Debate on New Learning Objectives

For decades, governments and the general public have been concerned about the adequacy and quality of education with regard to the demands of a well-functioning society, as well as the economic and social payoffs of public educational expenditures. These discussions have produced a relative consensus as to the goals of education policy in developed countries [7, 10, 12, 13, 17]. An illustrative list of these goals is reflected in the European Policy Cooperation framework [8][2]:

- Making lifelong learning and mobility a reality.
- Improving the quality and efficiency of education and training.
- Promoting equity, social cohesion, and active citizenship.
- Enhancing creativity and innovation.

To date, there are three major educational approaches to meet these needs. The first one consists in developing applied professional skills and mastering specific tools (fostering "a skillful person"). The second approach focuses on acquiring essential *knowledge, information, and cultural products* ("a knowledgeable person"). Finally, the third one centers around general competences (with an emphasis on thinking), values and social skills ("a generally capable person"). All the three approaches have existed for ages and have been implemented together in various proportions, as it is impossible to achieve deep knowledge without being able to use it or without general cognitive abilities; similarly, it is impossible to solve professional problems without special knowledge or social skills. However, most of the time, knowledge-based

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Aef0016 [Accessed October 30, 2018].

approach was dominant in school education. What is the bulk of knowledge that every pupil should possess? For centuries, scholars and teachers have polished the body of essential knowledge for every child. It led to a profound mainstream consensus around the essential knowledge that has been achieved by the mid-twentieth century.

It should be stressed that, as a matter of fact, mass schools normally combined both approaches, but it is knowledge, not competences, that was considered absolutely necessary for all graduates. In most education systems, necessary skills were limited to the three Rs: Reading, wRiting and aRithmetic. Any other "general" capabilities were not specifically attended to. The assumption was that they would develop naturally as the level of complexity in learning tasks would be increasing.

Tectonic changes in culture, social and economic order in the second half of the twentieth century led to heated discussions about the content of school education. First, the competence-based approach became more prominent pleading to teach children how to use their knowledge. "Application of knowledge" became a new mandatory minimum for school education. Second, traditional understanding of "necessary knowledge and skills" was challenged by industry, scientists, and politicians. The argument had to do not only with the doubts pertaining to the traditional set of "subject" knowledge but also to the new balance between domain-specific and domain-general knowledge and skills.[3] In other words, "general skills" became part of mandatory learning expectations.

Education was bound to change, and this pressure was growing. This pressure is well described in thousands of policy documents issued by national governments and international organizations. The following statement by the Ministry of Education of Singapore illustrates this sense of urgency:

> Globalisation, changing demographics and technological advancements are some of the key driving forces of the future. Our students will have to be prepared to face these challenges and seize the opportunities brought about by these forces. … To help our students thrive in a fast-changing world…[4]

Parents and teachers tried to resist. They considered the sacred and eternal collection of facts and skills as the foundation for social cohesion, national unity, and intergenerational communication. This is why school practice and curriculum theory did not lead the process of changes. Teachers reacted to the external pressure and signals by fragmented and inconsistent attempts to change the curriculum and practices of learning while keeping the "essential knowledge and skills" intact. It led to a "conceptual mess" in educational policy, school practices, theory of curriculum and schooling. The global consensus fell apart. It turned out that in different countries diverse approaches to disciplinary curriculum are supported, and each approach relies on its own idea of learning outcomes (i.e., their taxonomy and inner structure). The words "competencies", "competences", "twenty-first century skills", "soft skills", "transversal skills" and "new literacy" have become used interchangeably,

[3] This is, in fact, where the debate on the balance between hard skills and soft skills stems from.

[4] https://www.moe.gov.sg/education/education-system/21st-century-competencies.

without convincing efforts to match the terms on some common theoretical or practical grounds. This conceptual mess was further aggravated by voices from business urging to revise the list of skills necessary for the innovative economy (e.g., see [9]).

It is only relatively recently that researchers in education and human capital admitted the problem of the conceptual mess. The Organisation for Economic Co-operation and Development (OECD) Definition and Selection of Competences (DeSeCo) project [11] was the first attempt to put the field in order. It was an important attempt but it did not succeed as many countries continued to transform their curricula at a very high speed. They did not have time to reflect and talk to researchers.

Since then, the landscape has changed. The discourse of the rapid technological developments undermining the existing social order, as multiplied by global challenges—which places us in an increasingly changing and unpredictable world—has gained pace. On the one hand, business consultants and educational researchers have been trying to clarify the conceptual picture. Quite a few seminal reports have been published. Influential publications by brilliant authors, individual and institutional, have addressed the issue of competences. Findings of the reports on new competences are becoming more and more coherent [15–19].

Advancements have not been purely theoretical. Many countries have implemented significant curriculum reforms aimed to the development of new competences. There has been a vast array of practical attempts at different levels and of varied scales, stemming from and initiated by both industrial HR departments and school communities, governmental policies, and parents' concerns. A thoughtful analysis of these practices also helps get a deeper understanding of the shift in perceptions of learning outcomes, curriculum, key competences, and new literacy.

Yet, the existing analytical and research literature tends to divorce theoretical concepts from practical experience. Most often, it comes up with new terms, instead of attempting to synthetize available theoretical approaches. Another unresolved issue has to do with the fact that the discussion about the "knowledge" ("subject-specific," "disciplinary," etc.) aspect of the curriculum largely remains on the periphery of these considerations. This is why they do not actually help overcome the problem of conceptual mess and formulate clear guidelines pertaining to curriculum development.

It is this deficit that our report seeks to recoup.

1.2 Acknowledgements

This report would not have appeared if it were not for Herman Gref's, CEO and Chairman of the Executive Board of Sberbank, visionary desire to advance education, to strive for excellence at the global level and engage others in forward-looking strategies. We express our most sincere gratitude to him and Sberbank's Charitable Foundation "Investment to the Future" for their courageous decision to launch this 2-year project, and for their invariable attention and support. Yulia Chechet, Executive

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We express our most sincere gratitude to the heads of schools (faculties) in education at Bejing University, Toronto University, the University College London, Helsinki University, Seoul National University, Boston College, and the Evidence Institute (Poland), for their willingness to join the consortium and for engaging best experts from three continents.

1.3 Report Framework

This project was initiated by the Charitable Foundation "Investment to the Future" of Sberbank, the largest bank in the Russian Republic, which was not only for the Russian audience. The foundation realized that it cannot borrow from good international practices to improve the Russian school curriculum unless "the twenty-first century skills" discussion acquires a greater conceptual clarity. Having discovered the conceptual mess, the foundation offered an interesting task for our international team of researchers—to develop a clear curriculum framework which reflects the most progressive practices and theoretical assumptions.

An international consortium was established toward this goal. It brought together experts from world-leading research centers, namely: Bejing University, Toronto University, the University College London, Helsinki University, Seoul National University, Boston College, and the Evidence Institute (Poland), as well as two top-tier education think tanks from Russia—the Moscow City University and the National Research University Higher School of Economics (which coordinated the project). The consortium had two major partners: Education-2030 Programme by the OECD and the World Bank Department on Education.

This allowed to focus our efforts not on inventing a new approach from scratch, but on a thorough attempt to systematize the enormous experience already existing worldwide. This report provides a theoretical and practical framework for curriculum and school practices' transformation, designed to ensure that each school graduate is successful in our technologically and culturally changing world.

This report is intended mainly for professional audience—policymakers and education leaders who are already familiar with various attempts to balance the existing deficits and the foreseen changes of the labor market, on the one hand, and individuals' lifelong overall well-being associated with the opportunities provided by education, on the other. It is also a road map for school leadership who feel a responsibility to make a difference and who may, thus, welcome some general guidelines. Last, but by no means the least, it is a foundation for developing practical guides for teachers and parents who want to see the bigger picture of where today's education is heading or should be heading—for these key stakeholders to be able to set expectations and make informed decisions concerning their choice of pedagogical practices and learning environment for their children.

We draw our findings and recommendations not only from theoretical research and recent international analytical publications but also from a comparative analysis of education policies and curricula in eight countries and jurisdictions: China, England (UK), Finland, North Carolina (US), Poland, Ontario (Canada), Russia, and South Korea. Such a comparative perspective allowed us to identify common features of successful curriculum transformations and likely traps to trip over. In this advancement, we were able to challenge and unravel the "conceptual mist" hovering the topic of competences. We do not mix various approaches trying to pick the most appealing elements—instead, we are trying to disentangle the main concepts tangled together, while also not breaking coherent concepts into counterproductive small pieces.

In our work, we differentiate between key competences (as a set of general skills) and "new literacy." Speaking about "new literacy," we single out new mandatory knowledge (domain-specific literacy) and "true" literacy as a complex domain-general skill.

1.3.1 What Makes This Report Different

A reader may wonder what the added value is of yet another report. It lies not only in the synthetic framework we have developed but also in resisting certain temptations.

No shuffling of terms. Since the topic of competences made it to the top of employability and personal life chances' agenda, a wide variety of lists and frameworks of competences has been produced by industries and educational agencies, i.e., by experts who are in a position to seek for a qualification (embodied in an employee or student), to develop and to assess it. To make sense of the field, one naturally starts with comparing the lists and trying to see why, say, in one case, experts mention "creativity", in another case they prefer "creative thinking," and in still another case, they choose "creativity and innovation." A table would seem the best way to visualize the variety of lists by the multiple sources and to compare what they have in common and in what they differ.

Who would resist the temptation of laying out the elements of various frameworks into neat columns? However, we do not perform an item-by-item analysis. We have tried it and, for our purpose, it did not work. We found such an exercise visually exciting and convincing in the short run—yet futile and misleading if we try to see a longer perspective. First, there is the problem of synonyms and overlapping terms. Second, even if we control for this, we still will not be on a solid ground to justify why we pick these very items and why we pack them this very way. And the resulting framework is neither scalable nor sustainable. Nevertheless, we admit the convincing attractiveness of such a comparative layout and, in this respect, recommend the recent European Commission document comparing national and international frameworks.[5]

In the study of competences, not being confined to psychology only. In the discussions of competences and literacies, the latter are often ascribed to individuals as autonomous actors and are treated from mostly psychological and psychometric perspectives, that is, as isolated personal qualities not rooted in their specific social context. This trend is naturally supported by assessment approaches. However, we also address competences and literacies' social dimension. This allows us to draw upon sociological academic traditions and helps us to get a broader picture of an activity denoted by a competence label. This approach proved especially useful in the area of literacy studies helping us to structure the difference between, say, digital literacy and financial literacy.

No noncritical reliance on employers' choice. Lists of "future skills" often come from companies describing their current deficits. We fully acknowledge this as a reliable and extremely important voice to be taken into account when developing education policy. But we cannot rely on it blindly. One caveat needs to be considered: companies tend to convey their current deficits—whereas schools offer education, which the now first-graders will start using in real life (professional and every day) in about 15 years and then for their lifelong well-being. If the development of a professional competence framework can be "a pragmatic process engaging a broad cross-section of stakeholders who prioritise competence inclusion based upon

[5] Commission staff working document accompanying the document *Proposal for a Council Recommendation on Key Competences for Life Long Learning*. SWD(2018) 14 final. January 2018. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0024.

industry knowledge and experience,"[6] an attempt to develop a competence model for education should rest on a more durable ground. It means that when considering employers' laments, we should concentrate on their vision—on the major drivers and trends that will be dominating the scenery and shaping it. These include both technological trends and "grand challenges" we, as the planet, are now facing.

1.3.2 Structure of the Report

The report opens with setting the scene (Chap. 2): a brief overview of global trends relevant to education. In the area of foresight studies, there is a vast literature on long-term trends related to development of technologies, society, and nature. We highlight those with greater implications for education and then proceed to describe key educational trends which develop as a reaction to them. We pay special attention to the change in perceptions of learning expectations.

In Chap. 3, we present our framework of competences (a "thinking grid") to do the puzzle of abundant and overlapping lists of twenty-first-century skills. We look into the nature of key competences and explore the concept of literacy trying to pin down the abundance of adjectives: information, mathematical, digital, financial, health, visual, environmental, scientific, technological, cultural, global, and so on. We also pay special attention to the high-frequency concepts—digital literacy, information literacy, data literacy, computational literacy/thinking, and health literacy—describing how they fit into the framework. We also describe how this new literacy can be integrated into the curriculum. (On computational literacy see also Chap. 13, and on environmental literacy see Chap. 14).

Then we explore the country cases (Chaps. 4–11), trying to answer the main question: how to make twenty-first-century skills a sustainable school reality (while also preserving the disciplinary core of education). The selection of countries is meant to provide a diversity of approaches and experiences. Among the top-10 Programme for International Student Assessment (PISA) countries and territories,[7] Canada (Ontario) and Finland present examples of a coherent sustainable education policy rooted in Western philosophy, while China and Korea bring vivid examples from the East. Poland, with its PISA scores going up so impressively, is an important case to analyze efficient education policy. The cases of the United Kingdom (England) and the United States, with their renowned educational institutions, let us look into more patchy approaches, with controversial turns, yet rich in islands of educational innovation going further than is generally implied by the state policy.

Each country case follows the same overall structure, with exceptions needed to clarify country-specific matters.

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[6] European e-Competence Framework 3.0. P. 5. http://www.ecompetences.eu/wp-content/uploads/2014/02/European-e-Competence-Framework-3.0_CEN_CWA_16234-1_2014.pdf.

[7] Average Score of PISA Mathematics, Science and Reading. http://factsmaps.com/pisa-worldwide-ranking-average-score-of-math-science-reading/.

- Some background to the curriculum transformation, describing the transition to a curriculum with a stronger emphasis on twenty-first-century skills and new literacy agenda along with the role of different stakeholders.
- The conceptual framework underlying the transition and how it is/was translated into practical matters: educational standards, teaching techniques and guidelines, textbooks and teaching materials, learning experience, and learning environment.
- How is the task of developing key competences and new literacies implemented at schools? Are there any special courses or is this task seamlessly integrated into disciplinary courses? How does this task unfold/evolve from preschool to high school; how does it change with the age of pupils? Is it implemented mostly within formal education at schools or balanced between formal and informal education?
- How is the development of key competences and new literacies assessed and measured; what tests and other measures are used?
- How was teacher retraining organized, if at all, and how is teachers' ability to teach key competences assessed?
- How was the transition communicated to the stakeholders, including schoolteachers, and how did they react?

In Chap. 12, we present pedagogical and school practices, which have demonstrated their potential with respect to twenty-first-century skills and which, to varying degrees, are used in the countries under discussion.

In Chaps. 13 and 14, we explore two essentially different types of literacy: domain-general (tool-based) information literacy (discussing computational literacy as an example) and subject-specific literacy (taking environmental literacy as an example).

Chapter 13 offers a detailed analysis of computational literacy and coding in school education. This chapter was prepared by the World Bank on the basis of our theoretical framework (see Chap. 2) and describes the best global and Russian practices in fostering computational literacy in children.

Environmental literacy discussed in Chap. 14 helps us demonstrate how disciplinary curriculum can be saturated with up-to-date vital topics, which require certain subject knowledge and imply certain behavioral attitudes—without aggravating curriculum overload.

Finally, in Chap. 15, we offer a summary of the country cases focusing on their transition to new learning outcomes. Here, we also offer a section on how to blend disciplinary of knowledge, competences, and new literacy in the curriculum.

1.3.3 Main Takeaways

1. We have analyzed over 180 competence frameworks, including industrial and business ones, trying to align them with influential theories of cognition, development, language, personality, and learning. We argue—supporting some of the earlier attempts in this area—that all key competences (we can also use the word

"skills") that are used in different frameworks fall into one of the three core mega-competences:

- Thinking competence (competence to use thinking skills to solve intellectual (cognitive) problems).
- Interaction with others (interpersonal competence).
- Interaction "with self" (intrapersonal competence).

Each key competence reflects the individual's holistic ability to act in a certain way in a given situation. Each key competence is underpinned by constituent skills (combined with knowledge and attitudes), which are mobilized in an individual's behavior when the competence is at work (though a mechanical addition of these constituent skills does not necessarily lead to a competence either). We identify the three core competences but deliberately do not constrain their internal structure by a finite set of skills—we do mention some to provide a context but those mentioned are not intended to be exhaustive, and this is a distinctive advantage of our framework, reflecting the nature of a competence.

It is not a hierarchical list either, with some domains having priority over others. The implication is that a learning situation—just like a real-life problem—should be designed in a way which requires bringing together relevant skills and attitudes from all the domain-general competences.

At the same time, we are aware that such a general theoretical framework may cause significant misunderstanding in practical implementation and monitoring the development of competences. As an attempt to mitigate such risks, we have worked out a detailed "map of key competences" (see Appex 1 to the report).

2. As far as literacy is concerned, we argue that what has become known as "literacy" ultimately falls into one of the two major categories:

   - Domain-general, tool-mediated literacy, which involves one's ability to use sign systems and related communication tools;
   - Domain-specific (content-specific and context-bound) literacy, which involves practical factual knowledge of specific areas of contemporary life.

3. Currently, the new model for school education has not taken shape to be recognized globally and universally. However, it has already become clear that it is not so much a revision of the disciplinary content and not even special courses to develop key competences, which make up the core of the ongoing transformations. Rather, it is a fundamental and comprehensive change of approaches to teaching and assessment—and to overall school practices. A major question is finding a new balance between subject (disciplinary) knowledge and skills, on the one hand, and domain-general key competences, on the other. The most important observation is that the effort to integrate key competences in the curriculum does not renounce the previous model of education—rather, it enriches it. The list of mandatory learning outcomes nowadays embraces both disciplinary knowledge, its practical application skills and also domain-general competences, values, and attitudes. The quality of getting knowledge itself is changing: when it is coupled

with key competences and they both work together, knowledge becomes a source of strength in most diverse personal and professional situations.

4. Following this general vector, each country beats its own path around twists and turns of its unique circumstances—cultural, historic, demographic, and economic. Nevertheless, an analysis of national strategies and their sociopolitical context makes it possible to highlight common features and factors of success—we highlight them below.

   - Competences and literacies that a country has adopted as most important should be presented as a clear, coherent, and concise list or framework;
   - Development of key competences should be integrated into disciplinary learning;
   - Regulatory efforts focus on intended learning outcomes defined as "what students will be able to do (demonstrate, produce) as a result of engaging in the learning process";
   - Summative assessment includes assessment of general competences.

1.3.4 How This Report Was Written and Who Are the Authors

For Russian education, this project was unparalleled in its international coverage. The international research team (20 people) met seven times in six countries to discuss the drafts and explore each country's particular experience. Every working meeting included school visits, as well as conversations with practitioners and academics. Preliminary results of the project were presented at various conferences and forums.

Postgraduate and master's students were involved in the research and helped a lot with data collection. But the project would not be possible without the leading role of our key co-authors from eight countries:

Michele Peterson-Badali, Elisabeth Rees-Johnstone, Evelyn Wilson (Toronto University, Canada),
Xiaoyu Chen, Lin, Xiaoying, Xia Huanhuan (Bejing University, China),
Gemma Moss, Ann Hodgson, Susan Cousin (University College London, UK),
Norbert Seel (Freiburg Univerisity, Germany),
Junehee Yoo, Euichang Choi (Seoul National University, Korea),
Jarkko Hautamäki, Risto Hotulainen, Sirkku Kupiainen, Marja Tamm (Helsinki University, Finland),
Maciej Jakubowski, Jerzy Wisnewski (Evidence Institute, Poland),
Michael Russell, Henry Braun (Boston College, USA),
Igor Remorenko, Kirill Barannikov (Moscow City University, Russia).

It is entirely the fault of the editors of this report if some of the ideas discussed together with the co-authors have not been captured accurately.

We continue our work and hope to have new collaborative projects and publications.

Maria Dobryakova, Isak Froumin

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Chapter 2
The World Is Changing, and Education Is Changing with It

Maria Dobryakova and Isak Froumin

Abstract In this chapter, we will discuss global challenges and trends which may not seem directly related to education, but nonetheless have important implications for it. We will look at changes in the labor market, as well as the changing environment for child development, both of which have a direct impact on education. We then proceed with a brief overview of the many attempts to identify a set of knowledge, skills, and personal traits that help face the challenges. In the concluding section of the chapter, we describe how education has responded to these challenges and trends. Highlighting the transition to complex professional and everyday tasks—which can no longer be reduced to "subject" knowledge—we argue that many questions, such as the definition and selection of foundational knowledge, as well as the assessment of key competences, have yet to be resolved.

Keywords Global challenges · Grand challenges · Megatrends affecting the future of education

Globalization, technological change, a deeper understanding of social relations, and of the nature of community engagement—all affect how today's society understands the idea of learning. The change is so profound that it is described as disruptive innovations [5]. In this chapter, we discuss major trends which may seem to have no bearing on education, although in fact, they do have important implications for it. We also address changes in the labor market and changes associated with the context of child development, as these make the key trends with immediate effects on education. We proceed with a brief overview of numerous attempts to identify the set of knowledge, skills, and personal traits that help face the challenges. In the

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concluding section of the chapter, we describe how education has reacted to these challenges and trends.

2.1 Megatrends

In foresight studies, trends are often clustered in six dimensions: social, technological, economic, ecological, political trends, and public values (STEEPV). Technology is not only the factor of change but also surely a major factor accelerating the pace and adoption of new phenomena.

The literature on global trends and megatrends is vast [e.g., 7, 10, 14, 20, 24] but tends to emphasize, to a varying degree and in various aspects, the same trends. We briefly outline them here paying attention only to the aspects, which require a reaction from education systems.

1. Aging world, growing social and demographic disproportions: world population is growing, but mainly in the poorer economies; population is aging and life expectancy is increasing; there is a high level of social inequality at the global and national levels.

The implications for industry are augmenting the call for lifelong learning/reskilling. Governments are needing to address social services gaps. Even in countries within the Middle East and North Africa regions experiencing higher birth rates, the world is expected to have a talent/human capital shortage. At the same time, population in sub-Saharan Africa is expected to grow.

2. Rapid Urbanization. It has the potential to improve societal well-being. Although only around half the world's population live in cities today, they generate more than 80% of GDP (and by 2050, 2/3 of our global population will be in urban centers). However, if the rate of urbanization is very high, it may impoverish some parts of the population and exacerbate economic disparities and unsanitary conditions.

3. Economic shifts with a global capacity imbalance. Data as a new raw material to be mined. The creation of wealth is shifting. The abundance of information is changing the nature of consumption and production: the amount of data registered (from humans, from sensors) and used as value-added information is growing. Information has become a new type of raw material, it has brought about a new business model—"platform capitalism" [28]. There is a growing gap between mature/developed markets focusing on quality and new/emerging markets producing quantity.

4. Convergence of new technologies—nano-, bio-, info-, and cognitive (NBIC): At the level of research (disciplines that had developed apart from each other, now work together and lead to qualitatively new results); at the level of development of new products and in the area of production; at the level of implementation of technologies into social and technological systems (e.g. logistics in healthcare, food security) [18, 26].

5. Technological developments may push us to reconsider our ethical frameworks: new technologies (genetic engineering, transplantation, reproduction technologies, prolongation of life) often spill over conventional ethical norms and require that we reconsider them in terms of philosophy (and religion) and law. Artificial intelligence brings about new agents that we will have to deal with—personally and legally. The way companies deal with information raises new ethical questions (e.g., see Zuckerberg's Senate hearing, April 2018) [9, 32].

6. The model of interaction between the state and its citizens is changing: Individuals get new tools to interact directly with each other, without intermediaries, and become more independent from the state—politically, economically, and technologically. This challenges the key functions of the state, including such functions as maintenance of territorial integrity, law enforcement, taxation, circulation of money, production of public goods, etc.

7. Family changes dramatically. The number of children raised in extended families consisting of several generations of people, with lots of siblings, is declining.

These and other "**grand challenges**"—climate change, depletion of natural resources and biodiversity, threats to security—require global action and coordination, and compel to bring about education change.

2.2 The Changing Labor Market

There is a growing gap between skills available and skills required by the economy, job, and wage polarization is growing. Labor mobility and competition are no longer constrained by national borders, people can now communicate professionally when physically they are far away from each other.

New technologies transform the labor market, new professions appear and the essence of traditional professions is changing [3, 15, 16, 19]. The share of non-routine tasks, including those which require collaborative problem-solving, is growing; demand for routine non-manual labor is decreasing (Fig. 2.1) [1, 2, 6, 17].

Presently, there are widely divergent analyses of what the labor market might do in the future. Uncertainty is inevitable, since many forces affect the labor market. Technology is one disrupting factor sometimes inciting extensive and rapid changes in the working world in a short period of time or revolutionary changes over a longer period, such as the decline of employment in agriculture. Additionally, environmental, social, and political factors have the potential to create changes including migration of large numbers of people looking for work, urbanization, an aging population, and the changing role of women and their increased participation in the labor force. In the new economy, the role of individual entrepreneurs and freelancers is growing significantly, but it requires greater social and self-organization skills.

The World Economic Forum considers that we may be entering "*the Fourth Industrial Age*", with workers operating in a more digital, technological, automated, and outsourced workplace [27, 29, 32]. Traditional jobs in areas such as manufacturing (moving offshore), and primary industries such as farming, forestry, and mining are

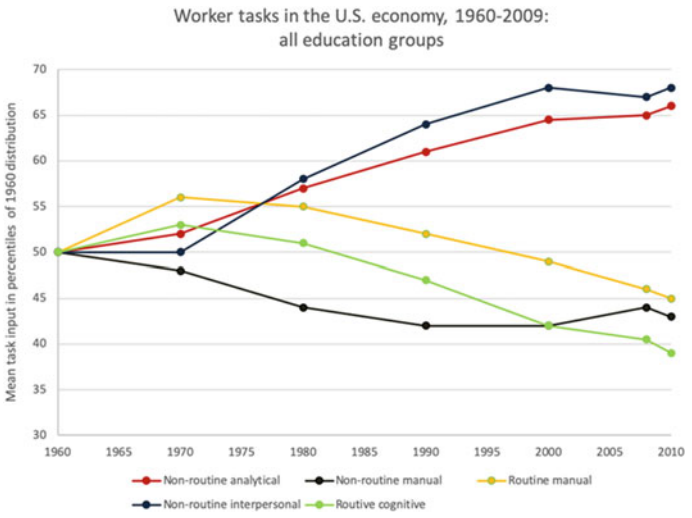

Fig. 2.1 Worker tasks in the U.S. economy, 1960–2009: all education groups. *Source* Autor and Price ([1], p. 5)

disappearing in the interconnected "knowledge economy." This calls for a thorough revision of what was considered mandatory knowledge in the twentieth century.

These changes may result in structural part-time employment and unemployment [31]. Some of the challenges mentioned could be mitigated through an increased supply of high-skilled, well-educated labor force. In OECD countries, highly skilled adults across the OECD are twice as likely to be employed, and three times as likely to earn above the median income as low-skilled adults. Highly skilled adults are more likely to be healthier, vote, volunteer and be productive citizens [21]. High-skilled workers also tend to be in better health, more often participate in the political process and volunteer activities—and, in general, they are more productive citizens. For education, it means a significant shift in the threshold for functional literacy necessary for a person to function successfully in today's society and economy.

In its 2017 report, *OECD Skills Outlook*, the OECD notes the opportunities and challenges presented by increasing globalization. The interlocking global economic networks mean that workers in different countries may potentially contribute to the design, creation, marketing, and sales of the same product(s). More companies are transnational and more jobs/occupations are outsourced. A racially and linguistically diverse workforce requires different social skills to communicate, collaborate, collectively solve problems, and achieve goals. These cross-functional skills include collaboration, social and cultural awareness, people management, flexibility, empathy, and effective communication, including active listening. All link to social and emotional learning or SEL [23, 31].

Business and international organizations are trying to systematize the new demands for skills and, more generally, personal traits. Various aspects may be

emphasized, although common features are easily traced. A nice summary can be found in a recent UNESCO report ([30], p. 20):

- Creativity, communication, critical thinking, problem-solving, curiosity, and metacognition;
- Digital, technology, and ICTs skills;
- Basic, media, information, financial, scientific literacies, and numeracy;
- Cross-cultural skills, leadership, and global awareness;
- Initiative, self-direction, perseverance, responsibility, accountability, and adaptability; and
- Knowledge of disciplines and STEM mindset.

2.3 Refraction of Global Trends in Education

Schools suited for the industrial age cannot meet the needs of today's knowledge society. By the 1950s, developed countries with a similar technological order (irrespective of their political and economic order)—following the model of industrial economy with its mass production and assembly lines (born in the second industrial revolution)—had established a model of school whose overall goal was to support this order. This model implied mass education with uniform disciplinary contents for all students. Compulsory 8–11 years of studies for every child. This school lost its liberty to dismiss underachieving children. Starting from the 1960s, mass education according to this model led to a general improvement of the quality of human capital suited for industrial economy—and posed new challenges to education.

First, as mass compulsory school was trying to provide a minimal kit of knowledge and skills for every student, it became evident that there is a prerequisite without which these knowledge and skills cannot be really mastered and digested: every student should have learning-to-learn and self-organization skills, be able to think critically and collaborate. Without these qualities (i.e., competences), any meaningful education turned out to be impossible.

This is why, in the 1960s, education specialists began to draw attention to the essential insufficiency of disciplinary knowledge and to the need to interpret the goals of mass education in a broader way. The international approach to this issue is well formulated in the influential Faure report by UNESCO [11]. As a result, by the 1980s, most developed countries had extended their traditional curricula to include tasks to foster higher order thinking and critical thinking, in particular. All this, however, has never required a radical change in the structure of disciplinary learning and even in educational technologies. Rather it implied a change in the nature of learning tasks and assessment of learning outcomes. At the same time, communication skills, self-organization skills, and creativity—as contrasted to thinking skills—remained at the periphery of mass compulsory education, which often resulted in academic underachievement among a significant number of students and in an imitation (a *faire-semblant* style) of universal schooling.

Second, as we have already mentioned, the industrial community—experiencing a change in technologies and labor market transformations associated with the third industrial revolution, the decentralization and democratization of production it brought about [25]—set forth new requirements for workers and, consequently, to education these workers should get in their youth. The decreasing share of routine labor means that thinking and communication skills should be fostered already at school. The importance of self-organization, communication, cooperation, collaborative problem-solving and decision-making skills has become emphasized not only for adult labor force but also as desirable for school graduates.

Developed counties began to respond to these demands in the 1980s, whereas post-socialist and developing countries followed this path later, in the late 1990s. According to CEDEFOP, more than 50% of countries have included in 2014 key competences in the level descriptors of their national qualification frameworks.[1]

Third, the steady extension of obligatory schooling resulted in a situation, when school leavers may enter labor market right after they have graduated, or join vocational education programs which require them to apply their school knowledge. The possibility of such a leap (from school to professional employment) implies that every schoolchild should not only have some basic knowledge but also should be able to apply it in various real-life contexts. The PISA survey with its focus on practical abilities to apply knowledge is a reflection of this trend. Since 2002, the number of counties participating in PISA has tripled, and results demonstrated by different countries have spurred a profound revision of disciplinary contents, and teaching methods in mass education.

Fourth, the increasing uncertainty of the future called for different outcomes of school education—it is becoming but a stage, one among many others during the life course, and it requires the skill of learning to learn and adapt to new circumstances. The industrial model welcomes accurate, obedient workers performing predictable tasks. While the current VUCA world poses complex problems. Living in a world of uncertainty means solving an infinite number of unknown problems and shifting between multiple, fuzzy, and dynamically changing goals and conditions [33].

"Complex problem solving expects the efficient interaction between the problem-solving person and situational conditions that depend on the task. It demands the use of cognitive, emotional, and social resources as well as knowledge" [2]. In such a world, we can't learn everything by heart in advance and thus get ready for the unknown—we have to update our skills, grasp new opportunities, and avert new risks. However, prior to the mid-1990s, fostering learning to learn skills was not among the objectives of school education.

And **fifth**, by the beginning of the twenty-first century, it became evident that school disciplinary knowledge, which had mostly been packed half a century ago, was outdated. Professional and public associations insisted: school mandatory knowledge should be extended to integrate knowledge about the modern world. The curriculum was swelling causing a severe overload for students.

[1] P. 8. https://ec.europa.eu/education/sites/education/files/swd-recommendation-key-competences-lifelong-learning.pdf.

The new knowledge was called and the new literacy, which implied its compulsory character for everyone. By the 2010s, the list of new literacies had inflated up to more than 50 items and included financial, health, digital, legal, environmental, and other "literacies". Even the global context we live in is becoming an aspect of new literacy. "*Global Competency for an Inclusive World*" is an OECD report for the PISA-2018 assessment. It will assess "the extent students have developed and can apply intercultural and global issues to the following set of knowledge and skills: knowledge and understanding of global issues, intercultural knowledge and understanding, and analytical and critical thinking" [22, p. 5].

At the same time, the conception of tradition literacy was extended to include one's ability to comprehend and communicate information in various formats (textual and visual, in natural and formal languages, etc.). Fluency with processing information has become a prerequisite for lifelong learning and a ticket to opportunities of participation in social and economic life.

2.4 How Does Education React to These Trends and Demands?

What are the skills and knowledge required by today's learners for tomorrow's rapidly changing, diverse, interconnected, and digital world to be global citizens? What are the twenty-first-century global competencies? What are the strategies, programs, and services required that build these competencies? How can learners demonstrate learning outcomes or the mastery of these competencies in terms of what they know and are able to do as evidence? These are essential questions of any education policy today.

As a reaction to the trends described, many national education systems started to integrate new topics and even courses in their curricula—without any profound systemic changes to prevent curriculum overload. However, the rate of global change is much greater than the rate of school curriculum and teachers' training programs upgrade. A step-by-step revision of disciplinary content, in effort to catch up with technological and socioeconomic change, is no longer efficient: there is a great chance that such knowledge will become outdated when a school graduate enters the labor market.

At the turn of the twenty-first century, international organizations (UNESCO, OECD, World Bank) and leading national education systems were clear: the modern world calls for a profound curriculum transformation. It will not allow a replication of best practices and models of the past—rather it demands an orientation to the future.

It was possible to integrate new topics and even new subjects into the existing curriculum and traditional pedagogies. However, the new learning outcomes associated with one's ability to apply knowledge for professional and everyday problem-solving required a different approach, which later was called competence-based learning.

Countries with a fast-growing innovative economy (Finland and Australia, some of the US states and Canadian provinces, South Korea, Singapore, Scotland, and Ireland) were the first to start their transition toward competence-based curriculum in the late 1990s–early 2000s. They were developing:

– their own frameworks of key competences and lists of "new literacies";
– indications of their level of development and assessment tools;
– methods to foster competences.

Somewhat later other countries also joined this movement: China, Japan, Germany, the Netherlands, post-socialist European countries, and Latin American countries [8].

There is no universally acknowledged model so far, but it is clear: the transformation focuses on a systemic transformation of pedagogical practices and assessment of learning outcomes—and not on a revision of outdated knowledge or development of specialized courses to foster twenty-first-century skills [e.g., 3, 13]. At the same time, new ways to structure disciplinary knowledge have been developed: it is necessary to lighten curriculum overload and to provide that the general curriculum framework is both sustainable over time and at the same time flexible enough to welcome the unexpected demands of the changing world.

Some of the common features can be identified which allow a country to travel successfully on the road taken.

- Intentional programming to prepare students for work/education/life after high school: fostering professional and "general" skills, as well as abilities to apply knowledge.
- Intentionally evolving educational initiatives to align with the changed world of work, including more opportunities for apprenticeship, authentic project-based learning, and experiential opportunities within the community.
- Increasing digital literacy and expertise with digital-enabled independent work.
- Provision of entrepreneurial opportunities within the formal and informal curriculum.
- More flipped schools/classrooms and consideration of robotic influences within the classrooms.
- Greater emphasis on developing and sustaining interpersonal and intrapersonal competencies.
- Drilling deeper into student achievement data to include sociocultural profiles and data to inform policy development and to target interventions for underserved cohorts.
- Aligning teacher pre-service and ongoing professional learning with twenty-first-century skills/competences.

- Learning from and with others through new types of learning/training opportunities.

Thus, the general route for changes is clear: it is a transition to more complex tasks which embrace not only "subject" knowledge but also key competences, personal traits and the ability to apply knowledge in real-life situations. Yet, many questions remain to be answered, such as the definition and selection of foundational knowledge, as well as the assessment of key competences.

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Chapter 3
A Framework of Key Competences and New Literacies

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Abstract This chapter presents the authors' attempt to develop a conceptual framework of key competences and new literacies. We aspire to identify theoretical roots underpinning most of the other frameworks of the twenty-first century skills and, thus, offer a clue to their diversity. We analyzed over 180 national and international frameworks of key competences, trying to align them with seminal theories of cognition, development, language, personality, and learning. First, we learn to differentiate between synonyms and conceptually different elements in the frameworks, sorting out competences and literacies. Second, we divide the pool of new literacies into two fundamentally different sets: domain-general and domain-specific literacies (this lets us explain the substantive difference between, e.g., digital literacy and health literacy). Finally, we discuss the structural place of such influential concepts as problem-solving, decision-making, and learning-to-learn. The resulting framework accommodates the thinking and reasoning competence, the interpersonal competence, and the intrapersonal competence. Together with the instrumental (tool-mediated) kind of literacies (i.e., the wide use of communication tools based on

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sign systems), they are nested under the domain-general umbrella. Other new literacies belong to specific domains and require domain-specific knowledge, as well as domain-general competences and literacies as their prerequisites.

Keywords Key competences · Critical thinking · Creativity · Creative thinking · Cooperation · Communication · Literacy · New literacies · Domain-general skills · Domain-specific skills · Problem-solving · Learning-to-learn · Decision-making · Digital literacy · Twenty-first century skills

The motto *non scholæ sed vitæ discimus* is over two thousand years old. The whole history of education and pedagogical thought has been permeated with questions about how "school" knowledge and "everyday" knowledge are related. This debate was exacerbated at the end of the twentieth century, when school education in most countries had become truly universal and comprehensive (at least 7 years of studies) and changes in the labor market were unfolding at an unparalleled pace.

It is not surprising that a strong signal calling for a competence-based education came from industry. The idea of this transition is simple: efficiency of school education is to be measured by a new criterion, namely by one's ability (skills) to solve real-life professional and everyday problems. It is obvious that such problems and tasks stem from new labor market demands. These demands are articulated in all sorts of reports first by industrial groups of employers, then by national associations, and finally by influential international organizations. Unfortunately, in their description of necessary skills, these reports tend to remain rather shallow. Emphasizing the importance of certain skills and personal traits for career, business consultants rarely take time for a theoretical reflection. The resulting lists of "skills for the future" reproduce the catching words dropped by charismatic opinion-makers but often fall short of conceptual and, thus, logical coherence. Moreover, it is impossible to just copy these ideas about averaged qualities of adult labor force and paste them straight into education, as they ignore the logic of human development and cultural learning. Taken as such, claims from business reports are not suitable for schools—first they need to be considered critically against the frameworks of social sciences and humanities, pedagogics, and developmental psychology. Business reports are absolutely useful, because they set the horizon. But before they are brought to school curricula, it is necessary to make out: what exactly is the meaning and the context of the catchy words? How do the traits they denote manifest themselves in observed behavior? and what do psychology, sociology, linguistics, philosophy and pedagogics already know about it?

The widely cited World Economic Forum report [1] emphasizes three groups of skills: (a) foundational literacies (literacy, numeracy, scientific literacy; ICT literacy; financial literacy; cultural and civic literacy); (b) competencies (critical thinking/problem-solving, creativity, communication, collaboration); (c) character qualities (curiosity; initiative; persistence/grit, adaptability, leadership, social and cultural awareness). However, the authors of the report do not explain the difference

between literacy and competency. Moreover, elements in each group seem to need a refinement: how is "cultural literacy" different from "cultural awareness?" how is "leadership" possible without "communication" and "collaboration?" how is "collaboration" possible without "communication?" why is "problem solving" a synonym of "critical thinking" but does not require "creativity?" Definitions provided in annex 1 to the report [1, p. 23] do not answer these questions.

A recent report by Deloitte[1] focuses on "enduring human capabilities." The authors' definition of such "capabilities" in essence coincides with the idea of "competency": "observable human attributes that are demonstrated independent of context". They argue that "capabilities" can be innate (imagination, empathy, curiosity, resilience and creativity) or developed (adaptive and critical thinking, sense-making, social intelligence, emotional intelligence and teaming). The authors admit that "innate capabilities" can be fostered and amplified, and that this is not "an exhaustive list of possible important human capabilities". But questions remain. What is the underlying logic of this differentiation? Why is empathy separated from social and emotional intelligence? Why are creativity and imagination mentioned as two independent innate capabilities not related to each other? What is "adaptive thinking" (one might recall that in the WEF report "adaptivity" was presented as a personal trait)?

Education is trying to react to this bountiful diversity of lists and frameworks (a conceptual mess, as some outspoken experts have called it) helplessly absorbing and diffusing the new words, which oftentimes camouflage outdated practices. Therefore, the uneasy task of ordering the words and concepts tossed in discussions about the new curriculum should be addressed urgently.

3.1 Competence Frameworks: An Overview of Approaches

We have analyzed over 180 national and international frameworks of competences and "twenty-first century skills", including specialized reports by the European Commission, OECD, UNESCO, World Economic Forum, ATC21S, P21, EnGauge and others, as well as comparative reviews [2, 3, 4, 5]. We were trying to align them with influential theories of cognition, development, language, personality, and learning (N. Chomsky, B. Bernstein, D. Dewey, H. Gardner, J. Habermas, D. Kahneman, A. Leontiev, U. Maturana and F. Varela, J. Piaget, B. Skinner, L. Vygotsky, and many others).

The exact words used in the frameworks often overlap but seldom fully coincide; the many synonyms cause a conceptual mess. The most recurring examples, as summarized in a recent UNESCO publication [6], include:

- Creativity, communication, critical thinking, problem-solving, curiosity, and metacognition;

[1] 30 August 2019. Skills change, but capabilities endure. https://www2.deloitte.com/us/en/insights/focus/technology-and-the-future-of-work/future-of-work-human-capabilities.html.

- Digital, technology, and ICTs skills;
- Basic, media, information, financial, scientific literacies, and numeracy;
- Cross-cultural skills, leadership, and global awareness;
- Initiative, self-direction, perseverance, responsibility, accountability, and adaptability;
- Knowledge of disciplines and STEM mindset.

To try and make sense of this overwhelming richness, we took three steps.

First, we examined whether any significant differences are implied when different words are picked to denote "twenty-first century skills": key/core competencies and competences, transversal skills, transferal skills, and soft skills. Our answer is no.

The plurality of the terms refers to the general universality of a capacity, which is not limited by a specific type of task or situation. The subtle nuances are discussed in academic papers, but get blurred in professional and policy frameworks. These differences in wording are not really relevant for our practical purposes, as all the plurality of terms tends to describe the same thing: qualities which (a) everyone needs and which (b) can be applied in different contexts. Therefore, throughout this book, we use the term "key competences" as it is used more or less consistently in major European policy papers.

What is a *key* competence? It is a competence which is necessary to be successful and happy in a certain society. To clarify the idea of key competences and their social embeddedness we borrow the following description from a recent European document on competences for lifelong learning.

> **Key competences** are those which all individuals need for personal fulfilment and development, employability, social inclusion, and active citizenship. They are developed in a lifelong learning perspective, from early childhood throughout adult life, and through formal, non-formal, and informal learning.
>
> The key competences are all considered equally important; each of them contributes to a successful life in society. Competences can be applied in many different contexts and in a variety of combinations. They overlap and interlock; aspects essential to one domain will support competence in another. Skills such as critical thinking, problem-solving, teamwork, communication and negotiation skills, analytical skills, creativity, and intercultural skills are embedded throughout the key competences [7].

Second, we looked into the variety of adjectives accompanying these "universal capacities" (key competences and literacies): financial, civic, mathematical, computational, legal, environmental, cultural, informational, digital, entrepreneurial, physical, emotional, etc., and tried to answer two questions:

– is "literacy" a synonym of "competence"? Our answer is no.
– is "digital literacy" a fundamentally new type of literacy? Our answer is no.

Third, we tried to get to grips with the important concepts that did not really fit after we had completed the first two steps: problem-solving, decision-making and learning to learn. Should they be singled out as competences in their own right? Our answer is no.

To proceed with steps 2 and 3, we need to define competence irrespective of its "twenty-first century" prefix and to disentangle it from literacy. Often a distinction is made between job-related professional *competencies* and *competences* in a broader sense in everyday life (e.g., [8, 9, 10]). From a psychological point of view, such a distinction doesn't matter because there is a general consensus that competenc(i)es cover knowledge, skills, and attitudes. Therefore, in this book, we do not differentiate between competency (= qualification) and competence but rather consider both terms as equivalent.

There are multiple conceptualizations of competence, and scholars usually single out three major approaches: the behaviorist (the emphasis is on performance), the generic (focuses on common abilities to explain the variance in performance), and the cognitive (highlights mental–intellectual–resources to achieve a mastery level of performance). All agree, however, that it is *a capacity to act in a certain way and achieve a certain goal (to solve a problem)*, and this capacity is underpinned by related knowledge, skills, and attitudes.

Competence is a set of an individual's integrated capabilities composed of clusters of knowledge, skills, attitudes, and values that are mobilized in a particular context to meet the requirements of a given task or problem (cf. [11]), where

(a) knowledge is composed of the facts and figures, concepts, ideas, and theories which are already established and support the understanding of a certain area or subject;
(b) skills are defined as the ability and capacity to carry out processes and use the existing knowledge to achieve results;
(c) attitudes describe the disposition and mindsets to act or react to ideas, persons or situations [12].

Some experts also consider values and motivation as part of a competence; but in our operational definition, we follow the approach supported by a majority of experts: competence is associated with a trainable ability to solve certain tasks, rather than with personal traits and interests.

Literacy also implies action, but of a specific scope: it is mediated by language presented in oral or written form.

Literacy in its narrow sense refers to the acquisition and usage of the abilities of *R*eading, w*R*iting, and a*R*ithmetic, the so-called 3Rs. This narrow interpretation of literacy implies one's ability to communicate with social world and to decipher its signals, to process information.

As such, literacy becomes a foundation for learning and developing new competences. A number of expert organizations extend this understanding of literacy to denote the capacity of individuals to analyze, reason, and communicate effectively as they pose, solve, and interpret problems in everyday life and a variety of subject matter areas [13].

For us, literacy is inextricably linked with illiteracy—a barrier forbidding any efficient action in the modern world. This is why we stick with the narrow understanding of literacy which focuses, primarily, on the fundamental ability to start an action.

Let us stress: our understanding of literacy does not incorporate any of the new "mandatory" knowledge which are now often presented as "new literacies" (see below for an explanation).

All frameworks of twenty-first-century skills include various combinations of key competences, their essential skills, attitudes, and values, accompanied also by literacies—and all imply or clearly aim at holistic education. However, we can highlight two distinctive approaches to making such a framework: a list and a grid.

In **a list**, as the name suggests, all the components are listed one by one and are presented in a non-hierarchical order. There are plenty of examples to illustrate this approach: European Key Competences for Lifelong Learning [7]; The Economist framework commissioned by Google [14]; Pan-Canadian and Ontario Frameworks of 21st-Century Competences [15] and most of the other national frameworks. The listing approach is very widespread.

A grid is essentially different: it offers sockets for broad categories of competences, together with their core skills, and focuses on the distinctive nature of the categories, not on the exact list of their nested components; some of the underlying skills may belong to more than one competence. The few existing examples of grid frameworks have been very influential: The DeSeCo Project's conceptual framework for key competencies [13], ATC21S [16]; the Faure report and the Delors report by UNESCO [17, 18] and the recent framework by IBE UNESCO [19]; the National Research Council framework [4] which is used in RAND [20], the Asia Society [21] publications, in the Harvard *Global Education Innovation Initiative*[2] and its comparative volume from six nations [22], and others. The recent framework presented by

[2] https://globaled.gse.harvard.edu/21st-century-education.

the World Bank [23] also follows this approach. Among national curriculum frameworks, the recent Norwegian approach could be mentioned [24]. At the same time, almost all the frameworks mentioned yield a confusion of universal (domain-general) and disciplinary ways of action and literacy (see the box below).

Influential Frameworks of Competences developed in the logic of grids (for references, see above)

Delors UNESCO:

- learning to know,
- learning to do,
- learning to be, and
- learning to live together.

IBE UNESCO

- lifelong learning (curiosity, creativity, critical thinking…);
- self-agency (initiative/drive/motivation, endurance/grit/resilience, responsibility…);
- interactively using diverse tools and resources (impactful use of resources, efficient use of resources, responsible consumption…);
- interacting with others (teamwork, collaboration, negotiation…);
- interacting in and with the world (being local and global, balancing rights with privileges, balancing freedoms with respect…);
- trans-disciplinarity (STEM, humanities, and social sciences…);
- multi-literateness (reading & writing, numeracy, digital…)

DeSeCo

- interact in heterogeneous groups,
- use tools interactively (e.g., language, technology),
- act autonomously.

ATC21S

- Ways of thinking (creativity and innovation; critical thinking, problem-solving, and decision-making; learning to learn and metacognition),
- Ways of working (communication; collaboration and teamwork),
- Tools for working (information literacy; information technology and communication literacy),
- Living in the world (life and career; personal and social responsibility).

World Bank

- (A) Cognitive skills
  Foundational skills

- general academic (literacy, numeracy)
- general cognitive

Higher-order

- (B) Socioemotional skills (Self-awareness; Self-management; Social awareness; Relationship skills)
- (C) Technical skills (Entrepreneurial; Digital)

With problem-solving and organizational skills emerging at the intersection of the three broad categories A + B + C.

RAND, Asia Society (based on the National Research Council)

- cognitive (including critical thinking, information literacy, reasoning and argumentation, and innovation),
- interpersonal (including communication, collaboration, responsibility, and conflict resolution), and
- intrapersonal (including flexibility, initiative, appreciation for diversity, and the ability to reflect on one's own learning).

There are also seminal frameworks which we would classify as mixed, as they involve some formal features of a grid but essentially rely to a considerable extent on the list approach. Thus, the World Economic Forum [1, 25] lists 16 skills essential to the twenty-first-century workforce grouped into three categories (foundational literacies, competences, character qualities ("how students approach their changing environment")—curiosity, initiative, persistence/grit, adaptability, leadership, social and cultural awareness. This framework apparently covers all the dimensions of 21st-century skills; however, to bring this framework to education, one would need to answer tricky questions like those we mentioned at the beginning of this chapter: how is "cultural literacy" different from "cultural awareness" or how is "leadership" related to "collaboration."

Another influential framework of a mixed type is Partnership for 21st-Century Learning (P21)[3] featuring the following components:

- Key subjects—3Rs and 21st-century themes (global awareness; financial, economic, business and entrepreneurial literacy; civic literacy; health literacy; environmental literacy);
- learning and innovation skills (critical thinking, communication, collaboration, and creativity);
- information, media, and technology skills (information literacy; media literacy; ICT literacy);
- life and career skills (flexibility and adaptability; initiative and self-direction; social and cross-cultural skills; productivity and accountability; leadership and responsibility).

[3] http://www.p21.org/our-work/p21-framework.

This framework designed for education is widely used (see Chap. 10 about the US in this report). We refer to it as a mixed type because some of the skills although mentioned under their umbrella category seem to overlap and make recurrent lists. Thus, collaboration and communication are not to be easily separated from social and cross-cultural skills; the 3Rs are also inherent in information, media, and technology skills.

In the "grid versus list" race, we are not backing either of the approaches in favour of the other. We believe that lists, with their finite number of clearly named components, are easier to communicate to the end user, and this is a truly convincing advantage. However, grids are scaleable, more adaptable, and sustainable, which makes them more suited for longer term policies in our fast-changing world.

3.2 How a Combination of Knowledge, Skills, and Attitudes Develops into a Competence

Each key competence reflects an individual's holistic ability to act in a certain way in a given situation. Each key competence is underpinned by constituent essential skills (combined with knowledge and attitudes), which are mobilized in an individual's behavior when the competence is at work. A mechanical addition of these constituent skills does not necessarily lead to a competence either). Thus, *competence* implies a sense of agency, action, and value. One can't communicate competencies: they have to be developed.

$$\text{Competence} = \text{knowledge} + \text{skills} + \text{attitudes} \rightarrow \text{action}$$

([26, 27]).

(a) *Knowledge*

It is clear that domain-specific **knowledge** is a major source of "power" in complex tasks (e.g., [28], among many others). However, in cognitive psychology, a distinction is usually made between declarative knowledge and procedural knowledge. *Declarative knowledge* is the knowledge of facts, which a person has memorized and can retrieve from semantic long-term memory. The concept of declarative knowledge became closely related to *knowing that something is the case*. In contrast, *procedural knowledge* corresponds to *knowing how to do something*, and consists of operations available in the operator (or procedural) memory that make a person capable of carrying out complex cognitive processes without having to control consciously the individual components of these processes [29]. In cognitive psychology, *procedural learning* (i.e., the acquisition of procedural knowledge) often is the same as *skill acquisition*, for which three stages can be distinguished (cf. [30]).

Stages of procedural learning

1. The *cognitive stage* focuses on interpreting a problem—i.e., on seeing a situation as a problem to be solved, which involves choosing a suitable strategy and resources. It involves an interpretation of the information available in the declarative form—e.g., as written or spoken instructions, or as a sample problem. At this stage, one creates a mental representation of that what is known/available and what must be done to solve the problem.
2. At the *stage of knowledge compilation*, numerous repetitions of part-skills eventually lead to a proceduralization of one's declarative knowledge of actions. This may be described as a process of skill-specific fine-tuning, during which information about the problem (which is often insufficient) is systematically corrected and errors are weeded out. Through practice, the learner connects individual part-skills into a holistic procedure, which can be used as an algorithm to solve the problem.
3. The *autonomous stage* implies routine execution of the algorithm acquired in the previous stage. The learner accomplishes this by automating the skills he or she has acquired. This makes their execution faster and more exact, reduces the number of errors and, as a result, the amount of necessary attention and control.

The stages presented are not rigid, of course. Numerous variations are possible depending on particular learning situations.

Thus, procedural knowledge results from the proceduralization of declarative knowledge but the relationship between declarative and procedural knowledge is reciprocal: declarative knowledge about how (and under which circumstances) an action should be carried out becomes procedural knowledge, which in turn, includes declarative knowledge about the procedures to be performed.

Some competences emphasize declarative knowledge, others rely mostly on procedural knowledge (cf. [31]), and there are competences that combine both (cf. [32]). Both declarative and procedural knowledge can be taught. At the same time, neither declarative nor procedural knowledge mean competence by default—one has to be able to apply this knowledge to practical situations.

For our purpose of bringing the competence framework into school reality, it is important to mention that there is also *tacit knowledge*, which results from one's ability to learn and then apply what has never been taught explicitly. This knowledge is a key element of practical intelligence in occupational settings (cf. [33]). There is no doubt that competences comprise more than just taught knowledge, which makes the issue of learning environment very important.

(b) *Skills*

Skills are the second major constituent of any competence. The Concise Oxford English Dictionary defines *skill as the ability to do something well*. This ability comes from one's knowledge, practice, aptitude, etc. Put briefly, *skills are the "know-hows"* required in a person's life. Lots of skills are mentioned in everyday communication and academic literature (manual skills, mechanical skills, professional skills, occupational skills, social skills, emotional skills, mathematical skills, reasoning skills, problem-solving skills, etc.)

It is widely recognized that:

- skills are malleable;
- "they can be developed through practice and reinforced through daily experiences" ([24], p. 18);
- skills imply an ability and capacity to perform a task easily, smoothly, and adaptively.

Thus, the term "skill" refers to a level of *performance*, in the sense of accuracy and speed in performing a particular task.

(c) *Attitudes*

Various influential papers (e.g., [13, 24]) emphasize the importance of **attitudes** as a third major constituent of competences. From a psychological perspective, *attitudes are a manner thinking, feeling or behaving* that reflects a disposition or a state of mind (cf. [34]), "a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon an individual's response to all objects and situations with which it is related" ([35], p. 810, see also [36], p. 409).

Everything with which an individual has a personal relation can be the object of an attitude. Accordingly, OECD papers emphasize attitudes toward self, learning and working as well as attitudes toward mathematics or problem-solving. In psychological literature, three components of attitudes are usually distinguished: (a) the *cognitive* component embracing beliefs and opinions, (b) the *affective* component focusing on feelings toward something and (c) the *conative* component with behavioral intentions. All the three form the so-called the *CAC-model of attitudes* (cf. [37, 38]).

Our framework operates with a *three-component model of competence* including knowledge, skills, and attitudes but mainly it centers on *skills* as a major component of competences. We argue that it is efficient to systematically train skills by means of extensive deliberate practice [39, 40]. Therefore, in our operational framework, the systematic training of skills constitutes the fundamental basis for the development of competences.

However, the development of competences additionally depends on enduring personal characteristics, which are the constant aspects of a person's individuality and are relatively stable over time. We consider aptitudes, personality, and motivational traits as personal characteristics that correlate with a person's competences (cf. [41]).

Personality traits are distinguishable features of a person's nature that demonstrate consistency across situations and over time. Currently, the Five Factor Model of Personality traits is, without doubt, the most popular approach in research on personality (cf. [42]). Because a person's behavior is strongly influenced by motivation that channels, energizes, and sustains behavior over time [43], motivational traits have been added to personality traits. Some researchers (e.g., [44]) argue that motivational traits affect performance through task-specific self-regulatory processes, such as motivation control, emotion management, staying focused on the task and metacognition. Thus, motivational traits are expected to affect competences through task-specific motivation and self-regulation variables, and manifest in intra- and interpersonal competences. Yet, we do not include personality traits in our framework of competences, primarily because it remains unlikely that they can be practiced and trained.

(d) *Skilled performance and mastery learning*

A skill is acquired or developed through training or experience. However, simple practice is not enough to gain a skill. The practice must be intentional and repetitious, aimed at improving performance, designed for current skill levels and combined with immediate feedback. This implies deliberate practice as a highly structured activity aimed at improving performance. Four essential components of deliberate practice have been identified [45]: (1) the learner must be motivated to attend to the task and exert effort to improve performance; (2) the design of the task should take into account the learner's pre-existing knowledge so that the task can be correctly understood after a brief period of instruction; (3) the learner should receive immediate informative feedback and knowledge of results of the performance, and (4) the learner should repeatedly perform the same or similar tasks.

Successful deliberate practice results in skilled performance (which can be defined as procedural knowledge acquired through deliberate practice) (cf. [46]). The quality of performance is determined by knowledge, skills, and attitudes. Observation of somebody's skilled performance fosters motivation and nurtures a positive attitude toward the competence. This brings us to the distinction between competence and performance.

Competence is, by nature, a theoretical construct, that cannot be observed but serves as a "useful notion" to explain directly observable behaviors. For example, it is relatively easy to observe the overt behaviour in solving a puzzle but it is a much more difficult task to understand what accounts for this behavior. Thus, psychologists (e.g., [47]) argue that it is the performance of an individual to solve consistently and successfully particular tasks and problems that makes an underlying competence visible. For example, if a student consistently and effectively solves quadratic equations in a variety of tests we attribute this overt behavior (= performance) to a presumed mathematical competence. Accordingly, we define **competence as mastery in performing particular skills**. Improvements in performance result from deliberate practice, which continues until performance reaches a level that can be considered as expertise [48]. This corresponds with [49] approach of mastery learning which involves a set of teaching and learning strategies based on the premise that

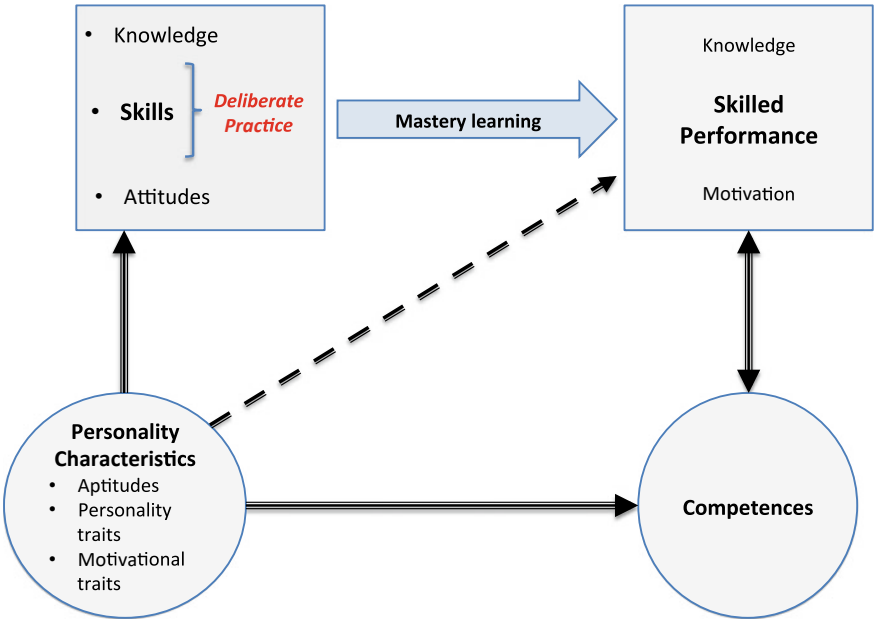


Fig. 3.1 Development of competences

students will achieve a high level of competence in a given domain if they are given enough time for deliberate practice.

The interplay of components leading to the development of a competence is depicted as a path model in Fig. 3.1.

Such a path model is useful, because, first, it illustrates the (causal) relations between variables of interest. In general, path models are read from left to right, with the independent variables on the left predicting the outcomes (dependent variables) on the right. Second, it distinguishes between *endogenous factors*, such as traits, competences, and literacies, and *exogenous factors*, such as instructional interventions (e.g., deliberate practice), skilled performance and the use of tools in order to solve problems in everyday life. Finally, the path model can be applied as a template for regression analyzes.

Skilled performance and competence can be general (applied in a variety of contexts) and context-dependent (cf. [50, 51, 10]). We focus on general competences that are applied to multiple areas of life and, thus, should bring benefits in a wide spectrum of contexts.

3.3 Our Framework: The Components

Our book proposes a framework of competences constructed as a grid: it identifies major distinctive clusters of skills but does not limit the number of their subcomponents to a fixed list.

The framework centers around domain-general key competences, i.e., abilities to act in specific situations irrespective of their disciplinary domain. Such competences may be called "soft skills" or "transversal skills." The idea is that they remain domain-general in the complex sphere of human activity and serve as a key to enter any domain. Our emphasis on these competences does not in any way downgrade domain-specific (professional) competences or personality traits. However, in the current curriculum debate, key competences need to be urgently attended to, because it is key competences that cause so much conceptual mess and an increasing gap between slogans and reality.

3.3.1 Key Competences

We endorse the grid approach toward a framework and argue that all the child processes within the broader generic competence parent umbrella can be consistently classified into one of three core domains, each of which brings together knowledge, skills, and attitudes:

– thinking and reasoning competence;
– interaction with other people (interpersonal competence);
– interaction "with self" (intrapersonal competence).

Competences: the framework.

(1) **Competence of thinking and reasoning:**

- to understand, analyze, and interpret a problem or task, search and identify patterns and trends in an array of facts; to identify implicit properties of objects and processes, to identify hidden resources needed to solve a problem or perform a task; relate causes to the effects they produce, also in complex branching and forking; apply formal logic in situations of insufficient information; identify, differentiate, and classify primary and secondary factors, contradictions and similarities…;
- creative thinking, inventive thinking, innovative thinking (including subjective and objective creativity); generating and exploring ideas; efficient decision-making in new and uncertain situations, in situations of insufficient information…;
- systemic thinking, integrative thinking, recognition, and interpretation of patterns, their limitations and universality; simulation and modeling of complex processes and phenomena (registration of relevant factors,

decision-making in unstable environments, including network-based; risk-management, compensation for system's failures and maintaining system's sustainability; balancing between familiar solution algorithms and adaptability to changing conditions)…;
- to choose ways to solve complex problems, including open-ended tasks with more than one solution, to generate multiple solutions…

(2) **Interaction with other people (intrapersonal competence):**
- to cooperate and collaborate, to establish, develop and maintain social relationships, to network, both as a leader and as part of a team, to take and distribute responsibility, to coordinate teamwork…;
- to negotiate (being able to convince other people, to justify one's position, to acknowledge other peoples' interests, taking into account social and cultural diversity), to resolve conflicts, to acknowledge the possibility of objective conflicts of interest between different social groups;
- to support strong and weak ties with people [52].

(3) **Interaction "with self" (intrapersonal competence):**
- self-regulation, self-control, including emotional recognition and regulation;
- self-organization (being able to act reflexively and intentionally, to mobilize oneself to perform a task, to choose insistence or flexibility.)

We identify the three core domains of competence but deliberately do not constrain their internal structure by a finite set of essential skills.[4] We do mention some, to provide a context, but those mentioned are not intended to be exhaustive, and this is a distinctive advantage of our framework reflecting the nature of a competence.

This grouping into three domains does not imply a hierarchy, with some domains having a priority over others. The implication is that a learning situation—just like a real-life problem—should be designed in a way which requires the bringing together of knowledge, skills and attitudes from all the core domains.

Historically, education system has not focused on these competences deliberately, leaving them to extracurricular environment (primarily, to the family). Development of these three key competences is an important task of mass education today, an extension to its traditional goals.

[4] To be specific, it is all the three components: knowledge + skills + attitudes. However, we deliberately highlight skills here, as it is the major component of a competence. Systematic training of skills constitutes the fundamental basis for the development of competences. See Sect. 2 for more detail.

3.3.2 Literacy

3.3.2.1 Two Kinds of Literacy

We now turn to the concept of literacy trying to organize the diverse array of adjectives associated with it: information, mathematical, digital, financial, health, visual, environmental, scientific, technological, cultural, global, etc. Ultimately, in its very essence, literacy is the foundation of communication: a person is able to understand what someone (be that a person or an institution) tries to communicate to him or her, and also communicate something that others can understand. This communication takes place in various forms, spheres, and domains. As these spheres change their language and tools (due to whatever reasons) the person needs to update their ability to communicate in them.

In a diverse and changing world, it's not enough to treat literacy as a purely cognitive skill one masters and applies narrowly to specific tools—rather, we have to embed it into its social and cultural context.[5] "As society and technology change, so does literacy" [53]. The plurality of literacies stems from the plurality of their social and communicative contexts.

We argue that what has become known as "literacy" ultimately falls into one of the two major categories:

- domain-general, tool-mediated instrumental literacy based on the use of signs and symbols (sign systems) and communication tools in various situations and contexts. Without a minimal level of instrumental literacy, it is impossible for a human being to function adequately in the modern civilization. Instrumental literacy is not confined to any specific area of life and is, thus, domain-general[6];
- domain-specific (or content and context-specific) literacy as practical factual knowledge of specific areas of contemporary life, without which human functioning in the modern civilization is also either impossible or severely impeded.

To explain this distinction, we first discuss the evolution of the traditional 3Rs literacy and its new dimensions in today's world, and then, by the example of health literacy, demonstrate the knowledge-specific focus of other "literacies".

3.3.2.2 Literacy in the Digital and Information Age

The term literacy has been commonly used to refer to the acquisition and usage of the basic competences of *r*eading, (w)*r*iting, and (a)*r*ithmetic, the so-called 3Rs, which are dichotomized into literacy and numeracy. Ironically, for social reality, the phenomenon of illiteracy seems to be more powerful and meaningful, as it divides

[5] This is where the notion of domain-specific literacy stems from. It is essential to understand not only specific symbols but also to make sense of texts (broadly understood) which describe both one's practical experience, and complex contemporary reality.

[6] Just like the three key competences we single out.

people into those who are able to communicate with the broader society and those who experience social deprivation due to their disability to communicate (e.g., see UNESCO[7] or National Literacy Trust[8] documents).

More recently, "literacy" has been defined as the ability to identify, understand, interpret, create, communicate, and compute, using printed and written materials associated with varying contexts [54, 55]. Today, this definition is extended to embrace the digital form for communication of information [56]. The idea of numeracy, traditionally defined as the ability to reason and interpret information encoded in mathematical symbols, is also extended to the ability to apply mathematical concepts in everyday life [57]. Both literacy and numeracy are considered as catalysts for successful participation in social, cultural, political, and economic activities, and for learning throughout life.

As new technologies spread, the term literacy obtained a broader meaning, and a large number of "new literacies" were introduced. The shift from a literacy limited to reading and writing to a plurality of literacies [55] reflects *a move away from thinking about literacy as a purely cognitive phenomenon*, made up of a technical set of processing skills that the individual either has or does not have, *to understanding literacy as a social practice shaped by the context in which it occurs.* The former is described as an autonomous model of literacy, in which the benefits of literacy are imagined to automatically follow from the acquisition of the skill [58]. It is contrasted with an ideological model of literacy, which recognizes that reading and writing are social acts shaped by the cultural and social contexts in which they happen. An ideological model entails "the recognition of multiple literacies, varying according to time and space, but also contested in relations of power" [59]. Pedagogies, which are informed by this perspective, emphasize an awareness of larger sociocultural patterns and tend to be more inclusive of practices that are considered part of the wider social and cultural literacy environment but which may not necessarily be recognized in formal education.

Digital literacy

The digital age poses new communication challenges. As the means of communicating written information become more diversified and include print, nonprint, multimedia, hypertext, internet web pages, RSS feeds and social networking, some researchers suggest that making meaning from multiple information sources denotes a new form of literacy, which involves locating, evaluating and using diverse sources of information, digital as well as printed, for the purpose of constructing an integrated, meaningful mental representation of a particular issue, topic or situation (e.g., [56]). Other literacy researchers remain skeptical, however, and argue that not enough is understood about whether traditional reading and writing practices, on the one hand, and their digital form, on the other, make cognitively different demands on the learner (see also in [56]). We believe *that the new "digital literacy" is cognitively*

[7] https://en.unesco.org/themes/literacy.

[8] https://literacytrust.org.uk/information/what-is-literacy/.

similar to traditional forms and is most accessible to individuals who have mastered traditional literacy skills.

The difference between traditional written (printed) literacy and its newer digital self lies rather with the growing abundance of sources, on the one hand, and their greater accessibility, on the other. This combination of abundance and accessibility, enhanced by IT technologies, blurs the boundaries between the author (producer) and the reader (consumer) of information.[9] The increased accessibility of authorship and production results in a less evident authority of information. However, this is not something entirely new for democratic cultures based on the plurality of voices.

Clearly, there is a difference in the dynamics of face-to-face and online communication and there is also a difference in the dynamics of using traditional printed texts and digital texts: unlike traditional printed texts, digital text is not linear, it is rich in hyperlinks that bring the reader from one part to another, and allow us to easily leave the original text and go explore further and further. This is perhaps the fundamental difference between print and digital reading: the latter rests more heavily on readers' ability to mentally represent the information "space"—and this has been found to explain the imperfect correlation between one's performance in print and digital tasks[10] [60, 56]). To navigate among hyperlinks, one has to sieve piles of excessive information—which requires critical thinking. What, in this respect, would be efficient search strategies? They would involve the ability to formulate the gist: being able to put it in such a way that it is differentiated from alternative meanings. To use digital texts productively, one should reduce their complexity, on the one hand, and to keep room for creative solutions, on the other. Cognitively, however, this is also not a new task, as the best shortcut to the answer has always cut you off from browsing alternative sources, and this is the paradoxical marriage of having to be efficient and creative at once (it's difficult to be creative if "full of care, we have no time to stand and stare," but standing and staring is not an efficient shortcut).

This shift from print to digital may also be interpreted as a shift from text-type to image-type representations (cf. [61]), which means that digital reading would normally imply a greater emphasis on one's fluency with visual formats ([60, 56]).

> The implicit question posed by representation in speech and writing:
>
> What happened and in what order? *(the logic of time)*
>
> The implicit question posed by representation in image:
>
> What are the salient features of the world and in what relation do they stand to each other? *(the logic of space)*
>
> ([61], p. 25–29)

So, is digital literacy a fundamentally new kind of literacy? Our answer is no.

[9] This point is also addressed in [56], p. 33.

[10] We thank J.-F. Rouet for this comment.

"Old" literacy (the 3 Rs) in digital environments faces a diversity of tools, purposes, and contexts. It becomes multi-tool, multi-purpose, and multi-context but fundamentally it remains unchanged. Traditional written literacy is acquiring a new dimension in digital environments, but this does not automatically imply a cognitive shift to a new type of literacy of a different nature. Differences apply mostly at the behavioral level. At the same time, it raises new dilemmas of safety issues: a greater exposure makes a person susceptible to more risks.

Moreover, though digitalization may not bring about a fundamental cognitive change in itself, it does influence pedagogical and school practices: "Combining inquiry and technology opens the door to powerful new teaching and assessment practices that result in documented benefits for learners" [62]. Leveraging digital, as stated in Michael Fullan's global research project, *New Pedagogies for Deeper Learning* (NPDL),[11] "accelerates access to knowledge beyond the classroom and cultivates student driven deep learning." For some instances of practical implementation see Chap. 4. on Ontario (Canada) and Chap. 10 on South Carolina (US), in this book.

Information literacy

When we make rational decisions, we rely on information. In many cases, this information contains some data to illustrate or to justify the argument. "We use data every day—to choose medications or health practices, to decide on a place to live, or to make judgments about education policy and practice. The newspapers and TV news are full of data about nutrition, side effects of popular drugs, and polls for current elections. Undoubtedly there is valuable information here, but how do you judge the reliability of what you read, see, or hear? This is no trivial skill—and we are not preparing students to make these critical and subtle distinctions" ([63], p. 22).

The digital world provides not only the possibility of accessing and manipulating massive amounts of data (including the so-called "big data" feeding artificial intelligence, governmental and commercial decision-making and practices) but also changes the information behavior of users in their daily life, and in particular in information-sharing and collaboration made possible by network technologies (cf. [64, 65, 66]).

When people use the word data, they are often referring to information that is stored as text, statistics, tables or charts. However, there is a subtle difference between data and information.

> Data are processed into an answer to an enquiry [67]. When this happens, data become "information." Data itself is of no value until it is transformed into a relevant form. In this sense, information represents data.

The difference between data and information is functional: *data are simply facts or figures—bits* of information, but not information itself. When data are processed,

[11] http://npdl.global/making-it-happen/new-pedagogies/.

interpreted, organized, structured or presented so as to make them meaningful or useful, they are called information. Information provides context and wiggle room for data. For example, a list of numbers (182, 179, 149, 165) is meaningless without the information that the numbers correspond with the tape-measured body length of people—"*The numbers have no way of speaking for themselves. We speak for them. We imbue them with meaning*" ([68], p. 13).

Data literacy is the ability to read, work with, analyze and argue with data. It is "understanding what data mean, including how to read charts appropriately, draw correct conclusions from data and recognize when data are being used in misleading or inappropriate ways" ([69], p. 634). Put briefly, *data literacy is the ability to derive meaningful information from data*, just as literacy is the ability to derive information (make meaning) from written words. Data literacy focuses on both the technical and social aspects of data. It encompasses practically all activities related to data management, including data curation, data citation, and fostering of data quality (cf. [70, 71]).

> "Data literacy must [...] include the ability to do something with raw information – to process it in some way. [...] we must have basic statistical literacy and fluency in the tools that allow us to make sense out of numerical data, not just words and ideas [...] Data literacy also means the ability to communicate and exchange information with others" ([72], p. 83)

In addition to data literacy, the digital world, with its informational abundance and accessibility, strongly requires *information literacy* which "empowers people …to seek, evaluate, use and create information effectively to achieve their personal, social, occupational and educational goals" ([73], p. 3). Information literacy is usually defined as "*the ability to search for, select, critically evaluate and use information for solving problems in various contexts*" ([74], p. 96). It enables people to interpret and make informed judgments as users of information sources, as well as to become producers of information in their own right.

According to the *Alexandria Proclamation of 2005,* the empowerment of people through information literacy is an important prerequisite for fostering equitable access to information provided by media and information systems. *Information literacy* and lifelong learning are seen as the "beacons of the information society" that comprise "the competencies to recognize information needs and to locate, evaluate, apply and create information within cultural and social contexts […], extends beyond current technologies to encompass learning, critical thinking and interpretative skills across professional boundaries and empowers individuals and communities" ([73], p. 3).

The current discussion about twenty-first-century teaching emphasizes the importance of data and information literacy for students' future life, and thus, postulates that school education should equip students with the necessary data and information literacy skills to succeed in the information-driven economy and society (cf. [75,

76]). Students who are able to collect, analyze, and draw conclusions from data are also well prepared to further their academic achievement. This argument, however, contradicts the observation that only few students graduate with the ability to understand and analyze data effectively (cf. [77, 78]), and likewise, many students lack a sound understanding of information literacy although they use the Internet extensively (cf. [79]). Why is this so? Scholars trace the roots back to the lack of statistical literacy—which is yet another layer of data literacy.

Basically, *statistical literacy is the ability to understand and reason with statistics and data* "that permeate our daily lives—coupled with the ability to appreciate the contribution that statistical thinking can make in public and private, professional and personal decisions" ([80], p. 1). Most people are not skilled in *statistical literacy* [81, 82] although in most industrial countries the teaching of statistics is an inherent part of the mathematics curriculum (e.g., [83, 84, 85, 86]). Statistical literacy is needed by everyone in order to make sense of the statistical information which pervades everyday life—in newspapers, television, and the Internet. Whenever people are confronted with risky decisions (e.g., in healthcare) statistical literacy can be crucial for "reading between the numbers" [87].

However, "why is it so difficult for us to think statistically? We easily think associatively, we think metaphorically, we think causally, but statistics requires thinking about many things at once, which is something that [intuition] is not designed to do" ([88], p. 13). This ability to think "about many things at once" is not naturally associated with "time-based" modes of representations (such as texts), which unfold successively ([61], p. 25–29). Statistics in this sense is similar to visual, space-based modes of representation, which "spring" on you as one piece.

The incompetence of most people to think statistically inflates into a *collective statistical illiteracy,* i.e., "the widespread inability to understand the meaning of numbers" ([89], p. 53). Statistical illiteracy is a widespread phenomenon among most citizens, as well as in the media [89, 90]. Because current statistics curricula appear to be fairly ineffective in equipping students as prospective citizens to understand and accept statistical reasoning, some authors advocate a curriculum reform designed to require students to reason from complex data (e.g., [82, 91]).

Data literacy (with its cousin layers of information and statistical literacy) is related to critical thinking with its major sub-elements of analysis and evaluation (see esp. [92]). Information literacy is also intrinsically associated with practices and critical thinking in technology-enhanced environments (cf. [93, 94, 95]).

3.3.2.3 The Two Types of Literacy: Domain-General (Instrumental Literacy) and Context-Specific Literacies

From literature, it is common to encounter an extensive array of literacies, often totalling 20 or more—from "civic literacy" to "visual literacy." This variety of literacies encompasses a broad range of knowledge, skills and attitudes that are in some cases domain-specific and in other cases make a tool-mediated and

sign/symbol-based foundation for any other knowledge or its application in everyday life.

We argue that traditional literacy (reading, writing) and numeracy, also as extended in the data literacy dimension and diversified in the contemporary digital environment, form the *know-how* (tools) type of literacy. We contend that such variations of literacy as visual, data, media, information, ICT, etc., are but particular cases of the general-domain tool/sign-mediated literacies applied to diversely organized texts and images.

In contrast, the bundle (or rather a diverse assortment) of various domain-specific literacies such as financial, entrepreneurial, health, cultural, ecological or civic literacy all belong to the "know-that" type and are standing on the shoulders of key competences and domain-general tool/sign-mediated literacies.

Let us illustrate it through the example of **health literacy**.

As a longitudinal study demonstrates [96], mortality in older adults is positively correlated with low health literacy. Lower health literacy is associated with less *knowledge* of chronic disease processes, poorer mental and physical health, limited use of preventive services and higher rates of hospital admissions (see also [97]). What is health literacy?

Based on its basic understanding of health ("a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"[12]), the World Health Organization defines health literacy as the ability of individuals to gain access to, understand and use information in ways which promote and maintain good health. In more practical terms, health literacy is the capacity to make sound health decisions in the context of everyday life [98]. Health literacy can be defined as a wide range of skills that people develop to seek out, comprehend, evaluate and use health *information and concepts* to make informed choices, reduce health risks and increase their quality of life ([99], p. 12, see also [100]).

Similar examples can be given to illustrate the nature of financial, environmental, or any other kind of context-specific "literacy" (environmental literacy is discussed in more detail in Chap. 13).

It should be specified that the mechanism of the development of context-specific "literacies" is mainly the same, as with key competences: deliberate practice of health-related—to continue with the health literacy example—knowledge and attitudes, as well as of cognitive and noncognitive skills results in *skilled performance*, which in turn constitutes the fundamental basis of a substantial transfer of health-related knowledge, attitudes and skills to various situations of everyday life. Moreover, despite their context specificity, such "literacies" rely heavily on key competences and domain-general literacy (cf. [101, 100, 113]).

Literacy: the framework

Domain-general tool-mediated literacy is based on one's ability to use sign/symbol systems and related communication tools. It involves the transformation of the 3Rs (*R*eading, w*R*iting and a*R*ithmetic) in modern technological contexts, taking

[12] 1946 WHO constitution.

into account the existing formats of "human to human" and "human to machine" communication and information exchange.

- literacy (reading, writing, speaking) is the ability to make meaning and create information in natural languages in various textual and visual formats, including in digital environments (*literacy + digital literacy*);
- numeracy (including data literacy) is the ability use mathematical tools, reasoning and modeling in everyday life, including in digital environments (*numeracy + data literacy + digital literacy*);
- computational literacy is the ability to comprehend, reformulate and generate information in formal languages, to create algorithms and to code information.

Domain-specific "literacy" as practical factual knowledge of specific areas of contemporary life. We keep the word "literacy" because such combinations of words have become well established and it is important that they remain recognizable; however, we add quotation marks, because it is in fact about elementary knowledge of specific areas of life and skills of applying it. Such "literacy" is derivative from key competences and tool-mediated literacy, and the latter is a prerequisite for it. The list of "literacies" provided below is not exhaustive. Several dozen such "literacies" are to be found in academic literature and policy papers. The following "literacies" are most frequent:

- civic "literacy",
- financial "literacy",
- legal "literacy",
- environmental "literacy",
- science and technological "literacy" and
- health "literacy".

So far, there is no consensus among experts as to whether literacy is developed gradually and can reach various levels, or whether it has only two states: literacy and illiteracy. We believe that domain-general instrumental literacy can be developed and refined infinitely. Yet, as far as content-specific "literacy" is concerned, it would make sense to agree on a threshold of (il)literacy, with public education being responsible for every child to move beyond it.

3.4 The "Big Picture" of Our Framework

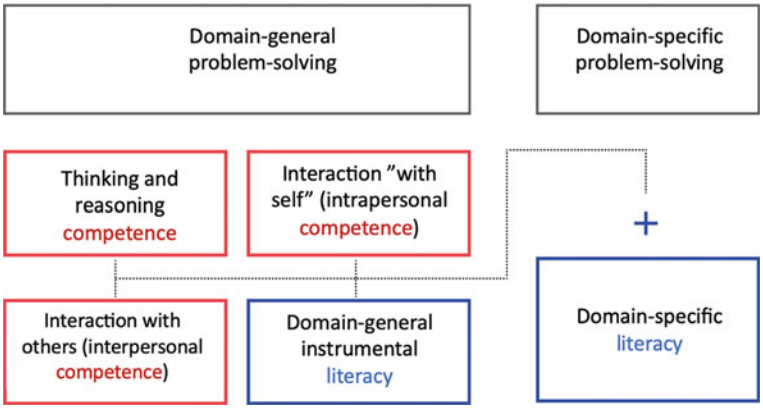
These three key competences (thinking and reasoning; interaction with other people (interpersonal); interaction "with self" (intrapersonal) and two kinds of literacy (general instrumental; content-specific) combine into the grid framework

we present. Four of the components are domain-general and ultimately aimed at problem-solving.[13]

Why does the framework not mention problem-solving, decision-making, and learning to learn as key competences and domain-general literacies?

The answer is simple: problem-solving is ultimately the process of proceeding toward a certain goal; to achieve the desirable result, various components of key competences and literacy are brought to the fore. In other words, problem-solving is a path which shapes the motivation and logics for the application of competencies and literacies. In contemporary literature, three stages of problem-solving are singled out: planning, performance, and reflection. Similar stages are associated with learning to learn (in academic literature, it is also called self-regulated learning). At each stage, various components of competences and literacies are at work, and their combination allows to solve the problem: to interpret a situation as a problem, to evaluate available resources, to choose an adequate solution, to implement it, and to reflect on the result.

This is why we argue that the popular constructs—problem-solving, decision-making, and learning to learn—reveal how people perceive a situation and how they choose to act in this situation. At the same time, they are not new competences in their own right, but rather emerge as a combination of various components of key competences, ordered in a way to solve the problem in question successfully.



We argue that such a framework is advantageous in the transformation of learning content and teaching practice because it can help:

- evaluate the progress of key competences' development;
- clarify the priority areas in which learning content needs to be revised;
- develop basic skills of processing information in multiple formats;
- integrate students' learning experience, otherwise fragmented between separate subjects, into a coherent learning activity—which fosters systemic understanding

[13] Domain-general problem-solving …touches on several cognitive and noncognitive skills such as information processing, representation and evaluation of knowledge, reasoning, self-regulation, metastrategic thinking, proactive planning and decision-making [102].

of practical situations and, therefore, stimulates one's ability to make decisions taking into account the complex interplay of relevant factors;
- involve cross-disciplinary approaches to design learning situations—which balances the status of different subjects (e.g., the status of mathematics vs music or physical education) and motivates students to engage fully with the intended curriculum, not pragmatically reducing it to the subjects which "I need or like most";
- design *learning situations* in which all the main components of real life problem-solving are mobilized;
- develop and offer *assessment tasks*, which assess not only separate skills but also the complex ability to act in certain situations and solve certain problems.

This framework places disciplinary knowledge into practical situations of everyday and professional tasks and, with appropriate teaching methods, stimulates students' motivation for learning, including lifelong learning. Such a school would bring forth students who can make decisions, act and solve everyday problems and who can learn independently, adapting to new challenging situations.

We realize that such a broad theoretical framework may need further detalization for a practical implementation. We have developed a tentative map of competences which demonstrates how each of the three competences unfolds across stages of problem-solving and levels of task complexity (please contact corresponding author). It can be used to design learning situations, lists of observation in formative assessment and to formulate learning outcomes.

Concluding this chapter, we should stress: the framework presented focuses entirely on key competences and new literacies. It does not aim to encompass the entire curriculum or replace disciplinary contents. We believe that mandatory outcomes of mass education should include both key competences and instrumental literacy, as well as disciplinary knowledge and skills, non-cognitive (personal) traits and values. For the framework to be effectively integrated in school education, it should be aligned with disciplinary knowledge and school-specific learning design. This would require additional research, developments and experiments, taking into account national contexts.

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Chapter 4
Canada (Ontario): A Unifying Theme for Canadian Education Is Equity

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Abstract Canada has one of the most successful education systems in the world, as evidenced by continuous high performance on various international assessments. Within Canada, Ontario has produced major improvements in the last 20 years in Elementary school literacy and in Secondary school graduation rates. These improvements extend across a large, diverse and complex education system. This chapter provides a brief description of the Canadian and Ontario school systems, outlining

Evelyn Wilson passed away in 2021.

A note from the editors

The Province of Ontario in Canada is one of the most successful examples of transforming education with a focus on key competencies. Back in the 1990s, a deep and progressive philosophy of learning outcomes was born here, developed in the works of the Ontario Institute of Studies in Education (OISE) at the University of Toronto, and, above all, in the works of the outstanding scholar Michael Fullan [14]. This culture of reform has come in handy in the last decade for the implementation of a framework of key competences and new literacies in the province. The chapter was written by OISE scholars and practitioners.

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some of the main strategies used. It describes the approach Ontario is taking toward defining, developing, implementing, monitoring, assessing and extending global competencies and skills. The Ontario effort is serious and multi-faceted, involving many aspects of the system: curriculum, pedagogy, leadership, technology, assessment and community engagement. Moving to twenty-first century skills and competencies makes the transitions complicated, contextual, and contingent. For sustainable improvement to occur, many instances must happen in a mutually reinforcing manner, which can be challenging to implement in a large system. We continue to benefit from and contribute to the steady development of international knowledge about effective schools and school change. Accordingly, this chapter is presented with a mixture of pride, optimism, curiosity, caution and realism.

Keywords Twenty-first century skills · Key competences · Critical thinking · Creativity · Cognitive skills · Social skills · Entrepreneurial attitudes · Multiculturalism · Global citizenship · Sustainability commitment · Stakeholder engagement · Learning to learn · Measuring and assessing twenty-first century competences · Teacher professional learning

Highlights

- The Ontario effort is serious and multifaceted, involving many aspects of the system: curriculum, pedagogy, leadership, technology, assessment, and community engagement.
- Canada's frameworks of key competences demonstrate a distinctive emphasis on social traits and attitudes: multiculturalism, global responsibility, sustainability commitment—the Canadian society feels an urgent need for these qualities in the form of both knowledge and skills.
- Along with creativity, entrepreneurial attitudes are emphasized in the frameworks.
- The competences/skills spiral through the K-12 curriculum. Literacy training is integrated into various subjects of the curriculum.
- Involving cognitive and social skills, as well as personality traits, competences help students achieve deeper disciplinary understanding, grip interdisciplinary concepts, and apply knowledge in new situations.
- Ontario: teachers and education leaders continually learn from each other.
- Ontario: stakeholder engagement has been a source of strength and support. Parents are essential partners.
- Tests and data are to be used to support improvement, not to make judgments.
- Effective change requires three to seven years of intentional implementation, targeted and intentional support, and monitoring.
- Experience in Canada and elsewhere has clearly shown that systems that try to be too directive create greater alienation and resistance at the local level, and in the end, achieve less effective implementation. A combination of intelligent pressure and ongoing job-embedded professional support is applied.

4.1 Introduction

Canada has one of the most successful education systems in the world, as evidenced by continuous high performance on the recent Programme for International Student Assessment (PISA) and other international assessments. Within Canada, Ontario has produced major improvements in the last 10–15 years in elementary school literacy and secondary school graduation rates. These improvements extend across a large, diverse, and complex education system.

This chapter provides a brief description of the Canadian and Ontario school systems, outlining some of the main strategies used. It describes the approach Ontario is taking toward defining, developing, implementing, monitoring, assessing, and extending twenty-first-century competences and skills. The Ontario effort is serious and multifaceted, involving many aspects of the system: curriculum, pedagogy, leadership, technology, assessment, and community engagement.

4.2 State of Education in Canada

Canada has been identified as one of seven nations/economies where 90% of 15-year-olds master the baseline proficiency in science, reading, and mathematics as measured by PISA.[1] Based on PISA analysis, Canadian students are considered "high performers in science" [35, p. 34]. On PISA 2015, "only three countries achieved higher results than Canada in science, one in reading, and six in mathematics" ([4], p. 13). Students' financial literacy knowledge and skills formed the basis of PISA's 2015 assessment of the financial literacy component.[2] Eighty-seven percent of Canadian students met the baseline for financial literacy, as compared to 78% for the Organisation for Economic Co-operation and Development (OECD) average. Twenty-two percent of students scored at level 5 or high achievement, as compared to 12% for the OECD. Canada remained a top performer among the participating jurisdictions. Within Canada, Ontario remains a high-performing jurisdiction balancing excellence and equity [3]. Canada is one of a very few countries where students born outside the country do as well, on average, as students born in the country.

Intentional policies, programs, and interventions support positive academic outcomes for underserved and traditionally underperforming learners, based on the economic, social, and cultural status (ESCS)[3] index. Ontario promotes "inclusive and equitable quality education" as described in Sustainable Development Goal (SDG)

[1] According to PISA 2015, 510,000 students completed the assessment representing 29 million 15-year-olds in 72 participating countries/economies.

[2] In 2015, 15 countries and economies involving 137,000 students participated representing 11 million students. Ontario was one of the seven participating provinces.

[3] Students in the bottom quarter of the index are classified as disadvantaged in terms of learners and schools.

4. To prepare students for increasing complex challenges, school systems are being asked to implement twenty-first-century skills and competences within their formal and informal curricula.

There is no national structure for education across Canada. Education falls within the jurisdictional responsibilities of the individual departments/ministries of education for each of the provinces and territories. The exceptions are for First Nations Peoples living on reserves and the children of employees of the Armed Forces, which remain under federal jurisdiction. Additionally, the federal government provides funding for minority languages[4] and some aspects of research, training, and higher education. The OECD has described the role of the federal government in education as "limited and sometimes non-existent;" however, its academic outcomes, as measured by international assessments, remain stellar [8].

4.3 How Does Canadian Education Work?

Canada comprises ten provinces and three territories in a federated structure and is a member of the British Commonwealth of Nations. Canada is the second-largest country by area in the world (9,984,670 km^2) with a population of approximately 37 million. The country's population density is less than four people per square kilometer. The small population given the large land mass affects education in rural and remote areas.

Most Canadians live in urban areas and 45% of the population lives in six metropolitan areas. Ontario is Canada's most populous province at 13.9 million, with 38.5% of the country's total population [59].

Canada is the only nation in the developed world without a national education policy or ministry/department of education. Canada's 1867 Constitution Act[5] mandated that "for each province the legislature may exclusively make Laws in relation to Education."[6] The federal government plays a minor role in education, acting through voluntary collaboration. When describing educational transitions, for Canada the process is collaborative, because each jurisdiction sets its own parameters. Ontario's context is presented in Sect. 4.3.

The various departments/ministers of education across Canada cooperate with the Council of Ministers of Education, Canada (CMEC), which is the intergovernmental organization for education, founded in 1967. The CMEC:[7]

- Provides leadership on education at national and international levels;
- Serves as a national forum for policy and education-related issues;
- Offers a mechanism to direct research;

[4] English in Quebec and French in the other jurisdictions.

[5] Originally the British North America Act—http://laws-lois.justice.gc.ca/eng/Const/.

[6] Constitutional Act, 1867, http://laws-lois.justice.gc.ca/eng/Const/page-1.html.

[7] CMEC website: www.cmec.ca.

- Supports recognition and portability of educational and occupational qualifications; and
- Administers the official language programs for French and English.

In 2017, CMEC launched a multiyear strategic plan promoting pan-Canadian excellence and equity in education to maintain its "world-class" results. The plan for change was negotiated within the national frame for education based on research and provincial/territorial student achievement data. Key components of the plan for more effective K-12 education include

- Promoting more effective transitions from secondary school through post-secondary;
- Supporting approaches in indigenizing education, ensuring cultural responsive opportunities for First Nation, Metis, and Inuit (FNMI) learners;
- Ensuring students are equipped for the digital world by integrating technology and developing twenty-first-century skills;
- Improving mathematical skills, knowledge, practices, and opportunities so that Canadian learners acquire CMEC's six global competences: critical thinking and problem solving; innovation; creativity and entrepreneurship; learning to learn; collaboration, communication, and global citizenship; and sustainability; and
- Supporting student well-being.

The provinces/territories act as agents for transitioning educational change, in terms of policies, processes, focus, and resources, including implementing CMEC's six global competences.

An elected member of the provincial/territorial legislature, who is appointed to the education portfolio, acts as the Minister for Education. This person heads the department/ministry, which may represent elementary/secondary and/or post-secondary education. Despite provincial/territorial jurisdictions, there is equity in education across Canada.[8]

Local governance is in the purview of school boards, divisions, districts, or district education councils. Locally elected (three- to four-year terms) in most provinces, they provide local governance, hire teachers and administrators, allocate programs to schools, budget for individual schools, and own and operate school buildings. Almost all provinces/territories fund schools/systems; local contributions through local property taxes are now minor or nonexistent. This provides more centralized control. Administrative structures vary across the country with an appointed superintendent and/or director of education leading K-12 school systems.[9] They select a variety of system- and school-based staff, depending on the size of the school system.[10] A principal leads a school, and in the case of larger schools, vice/assistant principals are appointed to meet specific qualifications and requirements. The trustees or members of the board that govern local education are elected by public ballot.

[8] Quebec has only 11 years of school instead of 12 in the other provinces and a 2-year college system that provides academic programs for university and/or technical training.

[9] These individuals are required to have teaching qualifications.

[10] Range from 3,000,000 pupils in Toronto to less than 1,000 in rural/remote parts of the country.

Canada spends 8% of the gross domestic product on education. Education funding with centralized control is more equitable. Curriculum is established by the individual province/territory. Teachers and administrators are required to meet specific qualifications, and all provinces administer some degree of accountability through assessments. Teachers and most support staff members are unionized and bargaining may be at the district and/or provincial/territorial level. Most schools have a form of mandated parent/community council that provides local advice to the school/district.

Canada focuses on maintaining the excellence and equity inherent in the system. Provinces and territories offer different curricula, prerequisites, and qualifications.[11]

- All jurisdictions offer a form of noncompulsory, **pre-Grade 1 schooling**, such as kindergarten and/or preschool education. The impact of effective early years' education is increasingly refocusing governmental agendas on improving the quality of the programming. On a pan-Canadian level, 95% of five-year-olds and over 40% of four-year-olds attend school. Programs vary from half days to all day, every day (Ontario).
- There are approximately 5 million students enrolled in over 15,000 public **elementary and secondary schools** across Canada. Public education is provided free of charge to all Canadians who meet various age and residency requirements.
- The age of compulsory Grade 1 education varies across jurisdictions. Most students begin at age six, and some at age five. Elementary education covers Grade 1 to Grade 8. Over 98% of students go on to attend secondary school (Grades 9 through 12). Compulsory schooling lasts through secondary school between 16 and 18 years of age.
- Students enroll in public education or private/independent/faith-based schools, which are regulated by the relevant jurisdiction. According to the Fraser Institute, 6.8% of Canadian students attend private schools. Some provinces and territories provide partial private school tuition, but Ontario, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland/Labrador do not. In Ontario, due to historic constitutional factors, Catholic education is fully subsidized from kindergarten through Grade 12.
- Most students attend their local school; however, there is some choice built into the system for Francophone (French as a first language) schools, magnet programs,[12] and providing specialized services and programs to students with special needs. Integration of students with special needs is the placement of choice.
- Canada is officially bilingual (French and English). Eighty-five percent of French first-language Canadians reside in Quebec, which has language laws in education to promote and protect French as the first official language of the province. French first-language students living outside of Quebec have their language rights and access to French first-language education, as protected by the Canadian Charter of Rights and Freedoms.[13]

[11] Further information regarding each province/territory's education system can be found at https://www.cicic.ca/1301/Ministries-Departments-responsible-for-education-in-Canada/index.canada.

[12] Arts, sports, and gifted programming.

[13] Canadian Charter of Rights and Freedoms: http://laws-lois.justice.gc.ca/eng/Const/page-15.html.

- 400,000 are enrolled in French immersion programs, which is the fastest-growing education program across Canada.
- Canada has the highest percentage of adults holding tertiary qualifications among OECD countries. Twenty-five percent of Canadians ages 25–64 have a college diploma[14] as their highest level of education, a proportion higher than any OECD country.

4.3.1 Diversity

Canada, except for the FNMI peoples, is a land of immigrants. All immigrants add to the rich diversity of Canada and Ontario. Canada and Ontario welcome newcomers; according to [60], 22% of the total population are immigrants. Close to 30% of Ontario's population is foreign-born and more than 30% of young adults are from families where both parents immigrated to Canada from other countries. PISA 2015 provides evidence of Canada's consistent performance on equity in terms of narrowing educational outcomes due to the impact of social background, between advantaged and disadvantaged students. Canadian and Ontario students demonstrate more resilience overall.[15] In Canada, the SECS gap was 9% compared with over 20% for the OECD. Canada's immigrant students perform better than most OECD economies/nations, even when social factors are excluded. Closing this academic gap has shown improvement since 2006. A unifying theme for Canadian education, according to the OECD, is equity (OECD, Canada Country Overview, 2015). Canadians honor a sense of fairness and equal access for all students.

Creating culturally responsive and supportive structures to increase educational outcomes is a focus of Canada's educational systems. Diversity has been reported to add to economic prosperity: "viewed across all sectors, one percent increase in ethno-cultural diversity was associated with an average 2.4% increase in revenue and a 0.5% increase in workplace productivity" [30, p. 1]. Diverse peoples wish to live in diverse cities that reflect their backgrounds and shared experiences. This cultural responsiveness extends to schools and the workplace, where "cultural fluency" is being nurtured [30, p. 15].

A recent British Broadcasting Corporation (BBC) article applauded Canada's ability to lower the achievement gap between immigrant and advantaged students, ensuring more equitable outcomes [8]. Although Canada currently performs well on the OECD's index of well-being, the country is committed to providing targeted opportunities for growth and inclusivity, through education and retraining to prepare for the twenty-first-century workplace [36–38].

[14] College refers to both colleges and polytechnics.

[15] Students who perform well on PISA despite disadvantaged backgrounds.

4.4 State of Education in Ontario

Ontario's education system is internationally recognized as a high-achieving, equitable, and continuously improving education system [2, 31]. Education in Ontario is continuing its improvement journey, focused on deeper learning, additional twenty-first-century skill development, and wellness. Ontario is preparing its students to be personally successful, economically productive, and engaged citizens of the world, which, it believes, will in turn provide for the province's success in the decades to come.

It is one of the most diverse provinces, with 2.1 million students in four different publicly funded school systems (English Public, English Catholic, French Public, and French Catholic). Currently, 20.7% of Ontario students have a first language other than English or French. There are approximately 73,700 elementary school teachers and 41,300 secondary school teachers, represented by four different teacher unions. Education is delivered in almost 4,000 elementary schools and 900 secondary schools, each under the jurisdiction of a district school board. There are 60 English language and 12 French language school districts that range in size, from a few hundred students in rural areas to 250,000 students in the Toronto District School Board (one of the largest urban districts in North America). Approximately 95% of all students in the province attend publicly funded schools. The remaining students are homeschooled or attend private schools or federally funded First Nations schools. While indigenous pupils living on reserves generally attend federally operated schools, over 70% of First Nations students attend provincially operated schools in Ontario.

Formal education in Ontario begins at age four with all-day, everyday junior and senior kindergarten (two years). While attendance in kindergarten is optional, over 90% of Ontario's four- and five-year-olds are enrolled. Compulsory enrolment begins in Grade 1 at age six and students are legally required to remain in school until age 18 or graduation from secondary school. Kindergarten to Grade 8 classes are traditionally offered in elementary schools, while Grades 9 to 12 are found in secondary schools.

4.4.1 Educational Improvement Processes

In 2003, concern was raised over student performance results based on annual province-wide curriculum-based assessments of literacy and numeracy in Grades 3 and 6.[16] The newly elected provincial government announced that educational improvement is its top priority.

[16] The Education Quality and Accountability Office (EQAO) designs, administers, and reports on the provincial assessments for Grades 3, 6, 9 and 10 http://www.eqao.com/en.

The government established three goals:

(a) To raise the bar for student achievement, specifically to increase the percentage of children in Grades 3 and 6 who met or exceeded the province's literacy and numeracy standards from 54% in 2003 to 75%, and to increase the rate of secondary school graduation from 68 to 85%[17]
(b) To narrow the gap for students who have historically faced challenges to their success in school
(c) To build public confidence in publicly funded education

By the 2015–2016 school year, these critical foundational measurements of students' readiness to succeed had improved to 72 and 86.5%, respectively. Ontario also significantly narrowed the achievement gap for students experiencing challenges to their learning. For example, the performance gap on the Grade 6 writing test for students learning English as a second language narrowed from 30% in 2003 to 3% in 2015. The performance on the same test by students with special needs rose from 12 to 46% (integration of students with special needs into regular classes is the preferred approach across the province). The province also saw dramatic reductions in the numbers of low-performing elementary schools (usually schools in areas of poverty and/or high immigration), from over 700 in 2003 to less than 70 in 2015–2016.[18]

This transformation was achieved through a partnership between the government and the school districts' leaders and teachers. Progress was made through eight overall strategies and conditions identified to support system-wide change:

(a) A small number of ambitious goals
(b) A guiding coalition of leadership
(c) High standards and expectations
(d) Investment in leadership and capacity building related to pedagogy (professional learning)
(e) Mobilizing data and effective practices as a strategy for improvement
(f) Intervention in a nonpunitive manner
(g) Being vigilant about distractors
(h) Being transparent, relentless, and increasingly challenging

4.4.2 Provincial Standards for Improving Student Skills

Provincial standards set very high expectations for students. Higher-order thinking skills, critical thinking, problem solving and analysis, and collaboration and communications skills are all part of Ontario's curriculum. Students must demonstrate these skills to meet the provincial standards. To assist teachers in improving instruction to

[17] The rate is established for all students entering Grade 9 who complete their secondary school studies within 5 years.

[18] These results were tracked and supported by the Ministry's Literacy and Numeracy Secretariat.

meet these ambitious standards, the ministry produced two reports that describe high-quality literacy instruction: The Early Reading Strategy in 2003 and the Expert Panel on Literacy in Grades 4 to 6 in Ontario in 2004. The government established curricular expectations for the content that students were to learn and shared research-informed teaching strategies that had proven to be successful. Teachers selected their pedagogical approaches after learning together about the range of teaching approaches that can be most effective for different contexts.

The 2004 literacy report defined literacy as:

> …the ability to use language and images in rich and varied forms to read, write, listen, speak, view, represent, and think critically about ideas. It enables us to share information, to interact with others, and to make meaning. Literacy is a complex process that involves building on prior knowledge, culture, and experiences in order to develop new knowledge and deeper understanding. It connects individuals and communities, and is an essential tool for personal growth and active participation in a democratic society ([45], p. 5).

This report, and other documents by the ministry, established effective instruction as

- The use of assessment to guide instruction;
- Differentiating instruction to address student needs;
- A gradual release of responsibility for learning from teacher to student; and
- Integrating literacy instruction across various curriculum areas.

Support in literacy, mathematics, and secondary school improvement was also provided through a new division of the ministry: the Student Achievement Division.[19] It was staffed by a combination of ministry staff members and educators seconded from the school system to lead the initiative to improve student learning. Districts and schools were expected to produce improved student learning outcomes and were provided increasing support to realize success. They submitted improvement plans[20] with measurable targets and strategies/actions on how to meet their targets. This holds school boards/districts accountable for their student achievement results.

Having seen the efficacy of these approaches in improving learning in measurable ways, the same philosophy and approaches are informing Ontario's commitment to additional twenty-first-century skills. In 2014, over 50% of school boards had independently identified twenty-first-century competences as a focus for their systems; currently all 72 have incorporated some form of twenty-first-century skills/competences [46–52].

Successful change occurs through knowledgeable leadership and relationship development, knowledge building and innovation, and transparent accountability throughout the system. Educators in Ontario understand their power to improve learning for all students. They are now involved in collaborative inquiry and action research in their classrooms, as well as working together to increase learning outcomes for students and staff.

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[19] Ministry of Education staff: http://edu.gov.on.ca/eng/about/whoweare.html.

[20] Board Improvement Plans for Student Achievement (BIPSA) and schools submitted to the school system School Improvement Plans (SIPs).

4.5 Twenty-First Century Competences

4.5.1 Pan-Canadian Competency Frame

In 2016, the CMEC adapted a pan-Canadian frame for global competences, including definitions and detailed descriptors of what students are to know, understand, and demonstrate to prepare them for the rapid socially, technologically, economically, and culturally changing world. Previous research and discussion resources from the Conference Board of Canada, C21, and OECD informed the CMEC's six global competences:

- Critical thinking and problem solving
- Innovation, creativity, and entrepreneurship
- Learning to learn/self-awareness and self-direction
- Collaboration
- Communication
- Global citizenship and sustainability

These six components were developed to meet the 2030 SDG4 on the education of the United Nations Educational, Scientific, and Cultural Organization (UNESCO), promoting global citizenship and sustainable development. They were refined with input from business and the corporate sectors to ensure that they align with changing workforce demands. A brief synopsis is depicted in Table 4.1.

Awareness of financial literacy is another component for informed citizens operating in the twenty-first century and is implied, although not directly addressed, within the CMEC model. **Financial literacy**, according to Canada's Task Force on Financial Literacy (2010), is having the knowledge, skills, and confidence to make responsible decisions.

Within this framework, each province and territory will decide how best to embed the six CMEC competences in their curricula and resources to teach and measure students' ability to master the competences required to become informed and productive citizens.

The CMEC recognizes that educational policy direction regarding twenty-first-century skills/competences comes from provincial/territorial governments and may include any or all of the following:

- Changes in official curricula
- Guidance to school districts on how to conduct various activities
- Changes in time allocations for the school day or year
- Professional development for school leaders and teachers
- Pilot projects or resources of various kinds for use by schools and teachers
- Public education intended to inform parents and others about changing ideas about schooling

Table 4.1 Pan-Canadian frame of competences

Component	Definition	Descriptors
Critical thinking and problem-solving	Acquiring, processing, analyzing, and interpreting information to make informed judgments and decisions	Solve meaningful, real-life, complex problems, engage in inquiry, see patterns
Innovation, creativity, and entrepreneurship	Ability to move from idea to action to meet community needs, enhance, improve concepts, ideas, products	Formulate and express insightful questions and opinions, contribute solutions to complex, economic, social, and environmental problems
Learning to learn/self-awareness and self-direction	Becoming aware, demonstrating agency, development of motivation, perseverance, resilience and self-regulation, growth mindset	Use metacognition, goal setting, independence, self-regulate to be lifelong learners
Collaboration	Interplay of cognitive, interpersonal, and intrapersonal competences	Develop positive and respectful relationships, learn from and contribute to others
Communication	Receiving and expressing meaning, understanding local and global perspectives, positive digital literacy	Communicate effectively in oral and written form using appropriate tools
Global citizenship and sustainability	Acquisition of skills for engaged citizenship, local and global, appreciation for diversity	Understand diverse and interconnected forces, discrimination, engage, and contribute positively

Once such guidance is given, school districts normally have a reasonable degree of flexibility in how they adopt such measures, depending on local priorities. Even when provinces provide clear policy direction, they are generally reluctant to supervise too closely or intervene too forcefully, preferring to allow local districts to guide changes. Similarly, districts may give individual schools a fair amount of autonomy in deciding how to follow or interpret various policy guidance. While this decentralized system may seem "soft" in terms of implementing new approaches, experience in Canada and elsewhere has clearly shown that systems that try to be too directive create greater alienation and resistance at the local level, and in the end, achieve less effective implementation. A combination of intelligent pressure and ongoing job-embedded professional support is applied.

Table 4.2 Ontario C model

Character	Citizenship	Collaboration	Communication	Creativity and Imagination	Critical thinking
Honesty, self-regulation, empathy, perseverance	Global knowledge, sensitivity and respect for others, active involvement	Working in teams, social networking, learn from and contribute to others	Communicate effectively—oral, writing, in a variety of forms—use digital tools, active listening	Economic and social entrepreneurship, leadership for action pursue novel ideas	Thinking critically, solve problems, effective decision making

4.5.2 Ontario 6C Model

Ontario similar to other provinces is attempting to prepare students, "for success in a dynamic, technologically intensive and increasingly connected 21st-century world" [46–52] with the goal of becoming "world leaders in higher-order skills such as critical thinking and problem solving, which will allow Ontario to thrive in the increasingly competitive marketplace" by 2025 [46, p. 9].

The 6Cs or six competences are described in Table 4.2. These became the agenda for Ontario's focus on transitioning to twenty-first-century learning and deepening students' learning. The aim was to operationalize the competences and assess for them.

In the fall of 2013, individuals and organizations across the province consulted on a renewed vision for education. Embedded into the four goals of "Achieving Excellence: A Renewed Vision for Education in Ontario"[21] were recommendations for twenty-first century/global competences, and previous models informed their design. Ontario's frame for twenty-first-century/global competences aligns with the pan-Canadian vision, reflects Ontario's unique context, and is evidence informed.

The province explored the implications for policy and practice. The six competences allow Ontario's students to go deeper, involve cognitive, interpersonal, and intrapersonal learning domains, and transfer/apply these to new and challenging experiences. The twenty-first-century competences support learning in and across the discipline areas in Ontario's K-12 education system (Table 4.3).

These components reflect Ontario's emphasis on equity and diversity, as well as the focus on achieving excellence for all. The twenty-first-century/global competences are woven within teaching and learning, indigenous education, education for sustainable development, early education and development, wellness and mental health, experiential learning, and assessment. The aim is to create global citizens prepared to live and thrive in the twenty-first century.[22]

[21] Achieving Excellence, Ensuring Equity, Promoting Well-Being, Enhancing Public Confidence.

[22] About 21st Century Learning in Ontario: http://www.edugains.ca/newsite/21stCenturyLearning/about_learning_in_ontario.html.

Table 4.3 Ontario's twenty-first-century global competences/skills

Component	Descriptors
Critical thinking and problem-solving	Solves meaningful, real-life complex problems; takes concrete steps to address issues; designs and manages projects; acquires, processes, interprets, and analyzes information to make informed decisions; engages in inquiry; makes connections; transfers learning
Innovation, creativity, and entrepreneurship	Contributes to complex problems; enhances a concept, idea, or product; takes risks in thinking and creating; makes discoveries through inquiry research; pursues new ideas; leads and motivates with an ethical entrepreneurial spirit
Learning to learn/self-aware and self-directed learning	Learns the process of learning, believes in a grow mind-set, perseveres and overcomes challenges to reach a goal, self-regulates, reflects on learning, cultivates emotional intelligence, adapts to change, manages various aspects of life
Collaboration	Participates in teams; establishes positive relationships; learns from and contributes to others' learning; co-constructs knowledge, meaning, and content; assumes a variety of roles within a team; manages conflict; networks; respects a diversity of perspectives
Communication	Communicates effectively in different contexts in oral and written form in English and/or French, asks effective questions, communicates using a variety of media, selects appropriate digital tools, listens to understand, gains knowledge about a variety of languages, voices opinions, and advocates for ideas
Global citizenship	Contributes to society and the culture of the local, global, and digital community in a responsible, accountable, and ethical manner, engages in local and global initiatives, learns from and with a diverse people, interacts safely and responsibly within a variety of communities, creates a positive digital footprint, relates to the environment, and is mindful of the importance of all living things

4.6 Competences Applied

The competences/skills spiral through the K-12 curriculum. There is a "21st Century Learning Unit" in the Ontario Ministry of Education's Curriculum and Assessment Policy Branch. As curriculum documents and policies are revised, these twenty-first-century skills are included in the updates and revisions.[23]

For instance, the 2016 Kindergarten Program begins with a preface entitled "Elementary Schools for the Twenty-First Century," "today and in the future, children need to be critically literate in order to synthesize information, make informed decisions, communicate effectively and thrive in an ever-changing global community" ([51], p. 4).

This message repeats in the revisions to all curriculum policy documents from kindergarten through Grade 12. The Ministry of Education's student achievement officers and school board educators participated in 45 experimental learning projects to apply experiential learning and create video pedagogical documentation of innovative practices ([47], p. 27).

4.6.1 Competences in Kindergarten and Elementary Schools

The kindergarten curriculum is included as part of the elementary listings. The optional kindergarten, two-year, play-based learning program uses targeted strategies and inquiry to begin to close academic gaps for traditionally underachieving students, including those from backgrounds of generational poverty, new immigrants, and refugees.

The elementary curriculum policy documents are listed both by grade and by subject area. The most recent curriculum revisions are in Health and Physical Education (2015), Social Sciences (2013), and French as a Second Language (2013). The older documents such as Language (2006) and Mathematics (2005) contain fewer references to global competences and critical and creative thinking. The new Health and Physical Education Curriculum document[24] includes references to the challenges for positive, lifelong physical and mental health, as well as personal and collective wellness.[25]

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[23] The Ontario Early Years program is operating a 6-week school readiness preparation program for students entering kindergarten. The program "School's Cool" is targeted at children from low income or vulnerable communities. In Ontario, kindergarten is voluntary; however, students may begin the September they will turn 4 if before January 1 or if eligible will begin at 3 years and 9 months.

[24] Health and Physical Education Curriculum Document: http://edu.gov.on.ca/eng/curriculum/elementary/health1to8.pdf.

[25] "A variety of factors, known as the "determinants of health" have been shown to affect a person's overall state of well-being. Some of these are income, education and literacy, gender and culture, physical and social environment, personal health practices and coping skills, and availability of health services" (Health and Physical Education Document 2015, 4).

Pedagogy in the elementary grades focuses on inquiry and creating opportunities for students to collaboratively and creatively solve problems. A K-12 career-planning resource document, "Creating Pathways to Success," was developed in 2013 to "ensure that students develop the knowledge and skills they need to make informed education and career/life choices through the effective application of a four-step inquiry process" (p. 3).

In 2016, the ministry released a resource document on financial literacy for Grades 4–8: "the goal is to help students acquire the knowledge and skills that will enable them to understand and respond to complex issues regarding their personal finances, as well as to develop an understanding of local and global effects of world economic forces and the social, environmental, and ethical implications of their own choices as consumers" (2016, p. 3).

In 2017, a resource document on environmental education[26] was developed. The directions and messages from these more recent revisions to curriculum resource documents and policy align with the global competences and enable implementation within the learning process. It is a model of how global competences can be infused across the curriculum as educators identify subject-specific expectations that can be paired with global competences in engaging ways. This is an example of how emerging trends and needs are identified and then aligned to competency development.

4.6.2 Competences in Secondary Schools

As is the case with elementary education, the curriculum policy documents for secondary education are accessible by subject and grade. The pattern of curricular revisions mirrors the elementary revisions. The achievement charts used for gathering evidence of learning assess evidence of knowledge and understanding, thinking, communication, and application in each of the subject-specific areas.[27]

Relevance and deeper understanding to build global competences are integrated aims. The following is an example from the "Canada and World Studies" curriculum document (2013): "examining current events helps students analyze controversial issues, understand diverse perspectives, develop informed opinions, and build a deeper understanding of the world in which they live" (p. 40). As mathematics and science curricula are updated through revisions, these skills will be included throughout the grades and subjects.

The Grade 9 and 10 Canadian and World Studies curriculum, particularly in the compulsory "Civics and Citizenship" course in Grade 10, provides students with

[26] Environmental Education: Scope and Sequence of Expectations. The Ontario Curriculum, Grades 1–8, and the Kindergarten Program. 2017 Edition. http://www.edu.gov.on.ca/eng/curriculum/elementary/environmental_ed_kto8_eng.pdf.

[27] An example of a secondary school achievement chart is found on pages 36–37 of the [5]: http://edu.gov.on.ca/eng/curriculum/secondary/canworld910curr2013.pdf.

opportunities to learn about what it means to be a responsible, active citizen in the community of the classroom and the diverse communities to which they belong within and outside of school. It is important for students to understand that they belong to many communities and that, ultimately, they are all citizens of the global community. The "Framework for Citizenship Education" (p. 10) is published in the Grade 9 and 10 Canadian and World Studies curriculum (2013) and demonstrates how the global competences are seamlessly integrated into the curriculum.

Additionally, the revisions updating the various curriculum policy documents added a section on twenty-first-century skills/competences for program considerations. This section contains common and key messaging in terms of education for

- Instructional programming;
- Students with special needs;
- Students whose maternal languages are other than English/French and are English language learners (ELLs);
- Equity;
- Financial literacy;
- Mathematical and language literacy;
- Inquiry skills within mathematics and language literacy;
- Critical thinking and critical literacy; and
- Information and communications technology.

Box 4.1

Two examples from common messages demonstrate how these are fundamental to building and applying global competences within the curriculum:

(a) "The Ontario equity and inclusive education strategy focuses on respecting diversity, promoting inclusive education, and identifying and eliminating discriminatory biases, systemic barriers, and power dynamics that limit the ability of students to learn, grow, and contribute to society …. Diversity is valued, and all members of the school community feel safe, comfortable, and accepted." (2013, p. 49)

(b) Information Literacy and Research Skills, students will:

- "access, select, gather, process, critically evaluate, create, and communicate information;
- use the information obtained to explore and investigate issues, solve problems, make decisions, build knowledge, create personal meaning, and enrich their lives;
- communicate their findings to different audiences, using a variety of formats and technologies; and

- use information and research with understanding, responsibility, and imagination." (2013, p. 54)

Global skills/competences are also embedded explicitly in all careers and guidance courses in Grades 9–12, where students focus on the development of the nine essential skills that have been identified by the Government of Canada and other national and international agencies as necessary for success in any occupation. The nine essential skills for career and guidance courses are as follows:

- Reading text
- Document use
- Writing
- Numeracy
- Oral communication
- Thinking skills
- Working with others
- Computer use
- Continuous learning

Students learn about the importance and transferability of the essential skills and become actively involved in developing and applying them in preparation for future work.

4.6.3 Specialist High Skills Major (Grades 11 and 12)

Ontario emphasized increased graduation rates as one of its priorities. One of the strategies that allows the application of global competences and alternative pathways is the Specialist High Skills Major (SHSM) program,[28] which allows senior students to focus on a career path while fulfilling the requirements for their high school diploma. The pathways encompass the workplace, apprenticeship, college, and university, and the SHSM program allows students to explore career options and gain important workplace skills, sector certification, and global competences.

The SHSM programs preparing students for the twenty-first-century workplace are available in a variety of sectors, from agriculture and manufacturing to nonprofit and environment.

Innovation is embedded in the Grade 9–12 courses, including technological education, science, and computer studies and linked to every SHSM program. A clear example found in the Ontario curriculum is the "13 Fundamental Technological Education" concepts aligned throughout the Grade 9–12 curriculum for technological education (2009), including transportation technology, construction, manufacturing,

[28] Specialist High Skills Major Program: http://www.edu.gov.on.ca/morestudentsuccess/SHSM.html.

design technology, health care, green industries, and communications technology. "Innovation" is listed as its own stand-alone fundamental concept.

Similar to the elementary curriculum, there is a range of policy and other resource documents that support and enhance students' learning[29] including "First Nations, Metis and Inuit Connections Perspectives" (2016), "Financial Literacy" (2016), and "Growing Success" (2010). These reflect Ontario's continued commitment to excellence and equity. To support the implementation of twenty-first-century competences/skills, the ministry established an Innovation Learning Fund, managed through the Council of Ontario Directors of Education.[30]

4.6.4 Informal Education

In terms of informal education, schools and school systems are encouraged to develop student leadership and voice as outlined in the "School Effectiveness Framework" (2013). The Student Achievement Division[31] addresses issues ranging from student success, leadership, program implementation, and professional development among others. Schools and school districts organize a variety of cocurricular opportunities including teams, clubs, and events (arts, athletics, and IT) for students where they can collaborate and practice global competences. In terms of leadership roles, students are elected by other students to school councils. At a system level, they provide input as student trustees on the Board of Education.

4.6.5 Special Education

Special education is included within the ministry's Equity and Inclusion Strategy. Students who require support beyond those ordinarily received due to behavioral, communicational, intellectual, and physical or multiple exceptionalities may be identified as students with special needs through an Individual Education Plan (IEP).

An inclusionary placement in a regular classroom is the placement of first choice. Depending on the severity of the exceptionality and impact on learning needs, students may be placed in a small class setting with dedicated programming and services as outlined by an Identification, Placement, and Review Committee (IPRC). Approximately 12–15% of all Ontario students are identified with special needs. The most frequent exceptionality designated are learning disabilities. The Education Act

[29] Ontario Secondary Policy and Resource Documents: http://edu.gov.on.ca/eng/curriculum/secondary/commontwo.html.

[30] Invitation for the 21st Century Teaching and Learning Roundtable Event: http://www.edu.gov.on.ca/eng/policyfunding/memos/jan2016/2016round_table.pdf.

[31] Ministry of Education Organizational Chart: http://edu.gov.on.ca/eng/general/edu_chart.html.

mandates programs and services for identified students, including the use of assistive technology.[32] More detailed information is contained in the ministry's Special Education Update.[33]

For students with special needs, the global competences are critical in ensuring that students develop the necessary skills and abilities to navigate life successfully. The global competences are easily adapted to support individualized learning plans and differentiated instruction to support the unique learning needs of every student and provide an inclusive framework that can be used to assist students in the acquisition of skills on a developmental continuum.

4.7 Measuring and Assessing Twenty-First Century Competences

Ontario's framework for twenty-first-century/global competences provides six specific, evidence-based competences that have the capacity to transform both teaching and learning in schools. The competences, when embedded into the K-12 curriculum, provide a coherent framework and context to develop and prepare students to thrive as global citizens. "The research shows that whatever is measured matters" [2, p. 20].

For the twenty-first-century skills to be embedded and assessed in Ontario schools, Ontario educators require a formal structure for measuring and assessing the impact on student learning. This strategic planning process needs clear, focused, and purposeful direction on the use of the framework by both system and school leaders [29]. To establish a structure for success, a strategic execution process that outlines the implementation and monitoring process must be developed, including metrics that assess evidence of impact.

The tools to secure accountability are provided by the Education Quality and Accountability Office (EQAO) provincial assessments, the School Effectiveness Framework K-12 (2013), District Reviews, School Self-Assessment (SSA), and ongoing system/school leadership.

4.7.1 Education Quality and Accountability Office

In Ontario, the provincial agency tasked with assessment is the EQAO. The EQAO was established to design and deliver large-scale assessments and to measure Ontario's students' performance in reading, writing, and mathematics in Grades

[32] Assistive Technology Tools: http://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/WW_TechnologyTools.pdf.

[33] Ministry of Education Special Education Update: http://www.edu.gov.on.ca/eng/general/elemsec/speced/special_ed_update.html.

3, 6, 9, and 10.[34] The provincial assessments are developed by Ontario educators and aligned to the provincial curriculum.

The EQAO provides schools and school districts with detailed information about students' achievement on the provincial assessments as well as contextual, attitudinal, and behavioral information from questionnaires. The data are used to inform school planning and interventions. The school and district results are publicly available, which encourages education members and systems to be accountable and enhances public confidence as part of the Achieving Excellence mandate.

The EQAO conducts research into educational practices and administers and reports on the pan-Canadian and international assessments[35] including PISA. Participation in the national and international assessments is another form of measuring; a framework is being developed for PISA 2018 to measure students' knowledge and understanding of global skills/competences.

As the EQAO assesses the provincial curriculum, it also assesses twenty-first-century skills as a component of its mandate. In 2014, the EQAO identified four skill categories that align to the provincial assessments: communication, numeracy, critical thinking and problem-solving, and the "learning to learn" as outlined in Ontario's global competences. These are measured through assessment tasks, item analysis, and questionnaires. The results have been referenced in the international assessment results of Canadian students, such as the financial literacy component of PISA. The EQAO has plans to convert the assessments into an electronic format mirroring the PISA initiatives.

Table 4.4 outlines two of the twenty-first-century skills assessed by the EQAO.

A detailed discussion of how Ontario students perform on components of twenty-first-century skills across the EQAO and the pan-Canadian and international assessments can be found in the background papers on 21st Century Skills for Elementary and for Secondary Students referenced at the end of this chapter.

For example, Ontario students show a progression toward acquiring important skills such as applying a variety of thinking skills, demonstrating a systematic approach to solving problems, and analyzing information to make judgments and draw conclusions. While the EQAO confirms that Ontario's students are progressing in their acquisition of twenty-first-century skills, there are areas requiring consolidation and mastery for all students. These include

- Using critical-thinking skills to solve problems;
- Communicating ideas clearly, coherently, and effectively; and
- Making real-world connections to literacy and numeracy skills.

[34] Grade 10 Assessment: Ontario Secondary School Literacy Test (OSSLT).

[35] Pan-Canadian Assessment Program (PCAP), PISA, Trends in International Mathematics and Science Study (TIMSS), Progress in International Reading Literacy Study (PIRLS). The results are on the EQAO's web site www.eqao.com.

Table 4.4 Examples of twenty-first-century skills assessed by the EQAO

twenty-first-century skills	EQAO
Communication	
• Communicate clearly and correctly in written form • Respond to written text in a manner that will ensure effective communication • Read and understand information presented in a variety of forms	• In the writing components for Grades 3 and 6, and OSSLT, students respond to multiple-choice questions and prompts, write responses expressing opinions, finding evidence from the text, communicate ideas and information clearly and coherently, interact with narrative, informational, and graphic selections to construct an understanding, and make connections between the text and their personal knowledge and expertise
Critical thinking and problem solving	
• Apply a systematic approach to solve problems • Use a variety of thinking skills to solve problems • Analyze ideas and information to draw conclusions and make judgments	• Students are expected to solve problems by selecting and applying a variety of problem-solving strategies. They have to make a plan and carry it out. Students identify the most important elements of the problem, understand relationships between elements, and draw appropriate conclusions. Students provide relevant supporting evidence from the text • Students analyze ideas and information presented in reading selections and respond to questions that require justification of interpretations from the text

4.7.2 Implementation of Provincial Directives in Schools and School Systems

In terms of monitoring school systems and schools' implementation of provincial directives such as Ontario's framework for twenty-first-century/global competences, the provincial government mandated that every school board should create and submit the BIPSA to the ministry. These plans contain measurable goals, increasingly including twenty-first-century global skills, and evidence/data of the intended changes as a measure of accountability. Additionally, each school in the district must create and submit their SIP. There is a mandated provincial process for school and school system reviews to measure and assess defined metrics in terms of learning, including twenty-first-century/global competences.

In other Canadian provinces, school reviews are used to assess and monitor change and can be a tool for transformative change [13]. These reviews include the improvement plans and student achievement data described within the "School Effectiveness Framework K-12" (2013).[36]

The "School Effectiveness Framework K-12" (2013) is a self-assessment tool for schools. "It serves to:

- Help educators identify areas of strength, areas requiring improvement, and next steps;
- Act as a catalyst for shared instructional leadership through collaborative conversations focused on high levels of student learning and achievement;
- Promote inquiry focused on student learning, achievement, and well-being that informs goals and effective teaching and learning practices/strategies;
- Support educators in determining explicit, intentional, and precise improvement planning decisions which inform monitoring and feedback for continuous improvement and future planning in relation to enhanced student learning, achievement, and well-being;
- Maintain communication with stakeholders to foster increased public confidence about school effectiveness; and
- Build coherence in and across schools and districts" (SEF 2013, p. 3).

As Ontario's system/school leaders and teachers build their capacity at full and sustainable integration of the global competences, the future of educational innovation becomes more engaging and fluid. Creating dynamic teaching and learning environments that embrace the global competences and are integrated into a culturally responsive, inclusive curriculum provides a formula for innovative twenty-first-century education.

The best outcome of the development of twenty-first-century skills/competences is that it provides clearly defined expectations to ensure equitable and inclusive learning spaces for all students. It transcends all grades and creates a responsive education approach for focusing Canadian students, teachers, and leaders. The EQAO and the "School Effectiveness Framework K-12" (2013) provide mechanisms to assess how effectively Ontario's students will respond to the changing world and workplace.

However, the successful adoption and implementation of a change initiative also requires a formal structure, a strategic planning process, and the implementation of action plans at a system level and in all of Ontario's schools. This requires clear, focused, and purposeful direction on the use of the framework by both system and school leaders [62]. At the heart of leading a successful change is the ability to monitor the implementation process and its effectiveness on a shift in instructional practice and an improvement in the academic success of students. This strategy focuses on intentionally building professional capacity, establishing plans, operationalizing implementation, and monitoring.

[36] School Effectiveness Framework K-12 (2013): http://www.edu.gov.on.ca/eng/literacynumeracy/SEF2013.pdf.

The "School Effectiveness Framework K-12" (2013) provides a focused structure for monitoring school improvement, staff instructional strategies, and student achievement success by implementing the SSA monitoring process three times a year. The SSA process brings school leaders together with their school staff and board staff to formally review the SIP and to assess data and evidence of impact. Three times a year, school teams meet to review data and conduct school learning walks to observe visible learning and engage student voices. Input from parent surveys and the School Community Council is often included to incorporate attitudinal/perceptual data into the assessment and analysis. This process will be discussed further in Sect. 4.8.

In Ontario, supervision of school leaders and schools is the responsibility of superintendents and directors[37] of the 72 Boards of Education. Superintendents of schools play an integral role in developing and supporting principals as instructional leaders and learners within the change process. The emphasis is on improvement and excellence for senior leaders.

The school teams, with superintendent support, complete an analysis report of the SSA and adjust goals and outcomes in the school plan. As school teams are becoming more proficient in using the SSA process, it is proving to be an effective assessment tool for monitoring; it shifts accountability and ownership to school staff in assessing their impact on school improvement and student achievement and success. The superintendent's leadership in monitoring is an essential component of ensuring monitoring at all levels; this process has purpose and structure to support overall system accountability. Superintendents visit their "Family of Schools" at least three times a year to meet with the school administrators and school staff. Together, data are analyzed and learning walks are completed to demonstrate the implementation of key strategies and instructional practices, as outlined in the School Plan. Superintendents provide formal, written, and descriptive feedback and set targets with school teams.

A clearly defined strategic execution process, with formal and informal monitoring, is necessary to achieve sustained change in practice and adoption. The following guidelines build on research adapted from [32]:

- Establishing a sense of urgency with shared leadership and accountability
- Creating a team of key individuals to lead, guide the work, and collaborate
- Developing a vision, which includes success criteria, indicators, and measurable goals
- Creating an implementation plan with incremental steps and defined timelines
- Communicating the vision and change process
- Empowering leaders and teachers to implement change (resource allocation and ongoing, relevant professional development) that reflects twenty-first-century classrooms
- Developing an accountability framework that outlines each individual's responsibility in monitoring, including intentional visibility
- Establishing the metrics based on success criteria and report on the results

[37] Council of Ontario Directors of Education (CODE): http://www.ontariodirectors.ca/.

- Gathering and analyzing data from a variety of sources to inform the next steps
- Monitoring the results regularly for impact and adjustment
- Achieving sustainability

School monitoring is a critical process for ensuring high expectations and ongoing school, staff, and student improvement. The most effective monitoring systems include formal processes for both internal and external accountability. The EQAO provides an external monitoring process that includes a critical lens on data. Internal monitoring by school administrators, school leadership teams, and superintendents creates a process for internal accountability and responsibility, which has the power to yield incredible results as our schools take ownership for improvement [18].

4.8 Teacher Development and the Role of Leaders: Teachers and Leaders Continually Learn from Each Other

As Ontario strives to prepare students for success in a changing, technology-reliant world, collective efforts continue to address the inevitable implications for the ways in which students learn, teachers teach, and leaders lead. The focus on creating system coherence indicates the success of Ontario, as it has, in a relatively short time frame, learned the required conditions to improve outcomes for students [16].

"Achieving Excellence: A Renewed Vision for Education in Ontario" (2014) articulates a commitment to define and measure twenty-first-century competences. The commitment is highlighted in the budget statement that "by 2025… Ontario will be a world leader in higher-order skills, such as critical thinking and problem solving, which will allow Ontario to thrive in the increasingly competitive global marketplace" ([58], p. 9).

"Achieving Excellence" also acknowledges a renewed focus on leadership, indicating that "Ontario will cultivate and continuously develop a high-quality teaching profession and strong leadership at all levels of the system" ([46], p. 1).

4.8.1 Professional Learning for Teachers: The Idea Is for Schools to Recognize that "Learning Is Voluntary but Inevitable"

Teacher professional learning and leadership capacity building have long been a focus in Ontario. The success of Ontario's improvement strategy has hinged on supporting the growth of an innovative culture of learning, encouraging risk taking, and promoting continuous learning, collaboration, and capacity building. The Ministry of Education's Phase 1 document "21st Century Competences" (2016)

notes that these approaches "are key to transformations in pedagogical practice, new learning partnerships, enhanced use of digital tools and resources and strategic design of learning spaces required for the development of 21st-century competencies" ([47], p. 48).

Both pre- and in-service teacher development programming have been continuously evolving to keep up with Ontario's direction and the changing global context. There is renewed focus on revising approaches to teacher training, including a newly mandated two-year preservice teaching program.[38] The expanded program was designed to ensure that teacher candidates are able to develop pedagogical strategies that offer opportunities to promote deep learning and twenty-first-century skills/competences. Pellegrino et al. [55] note that "novice and experienced teachers need time to develop new understandings of the subjects they teach as well as the understanding of how to assess 21st-century competences in these subjects, making ongoing professional learning opportunities a central facet of every teacher's job."

"Engaging in problem solving and critical and creative thinking has been central to learning and innovation" ([55], p. 50). Providing opportunities for teachers to learn from each other through the implementation process has been key to the transformation of school cultures. Our changing times require heightened attention to the process of teaching and learning to ensure that these competences are explicit and intentional, not only within the curriculum, but also in the necessary shift in classroom and leadership practice [28]. As Fullan notes, the idea is for schools to recognize that "learning is voluntary but inevitable" ([14], p. 42). To this end, the Ontario Ministry of Education has collaborated with teacher federations in developing professional learning opportunities and resources.[39]

4.8.2 Evidence-Based Developments in Teaching and Learning Approaches

Ever since 2011, school districts in Ontario have been learning more about the manner in which technology-enabled teaching and learning has affected the demonstration of these competences [46–52]. The ministry offers a variety of grants to assist teachers and leaders in working together on projects, such as the Teacher Learning and Leadership Program (TLLP).[40] These projects are also included in the body of evidence of effective practices and approaches. This selection of research provides important, Ontario-based evidence to inform future work in defining and measuring twenty-first-century competences. Evidence demonstrates that teaching strategies and the

[38] Teacher candidates have an undergraduate degree and then a two-year teaching program at a Faculty of Education: http://edu.gov.on.ca/eng/general/list/faculty.html.

[39] One example is the Elementary Teachers Federation of Ontario (ETFO): http://www.etfo.ca/Pages/Home.aspx.

[40] 2017–2018 TLLP: http://edu.gov.on.ca/eng/teacher/tllp.html.

provision of "rich learning tasks" [21] have continued to broaden as teachers build on their repertoire of pedagogical approaches to support this deep-learning emphasis.

Hattie's comprehensive meta-analysis of the research outlines that teaching approaches are shown to have positive impacts in schools [23]. Fullan and Langworthy ([15], p. 20) note that these may range from "project-based learning through direct instruction to an inquiry-based model where the teacher uses strategies based on student needs." Arising from these deepening approaches to teaching and learning has been a renewed consideration of assessment: "If there is value in promoting new pedagogical models that make it possible for students to apply their learning to real-world problems with authentic audiences, then assessments need to be adapted to widen the range of skills and knowledge being observed" ([2], p. 20). This requires ongoing professional development to ensure that assessment skills align with the broader goals for student learning.

4.8.3 The Role of Leaders: Leadership Has Made an "Undeniable" Difference in Ontario

Effective leadership is a key supporting condition for achieving the province's core education priorities [27]. The Ontario Leadership Framework, which defines effective leadership practice, was last revised in 2013. Fullan [17] has noted that leadership has made an "undeniable" difference in Ontario.

Since 2013, the Ontario Ministry of Education has introduced its "Well-Being Strategy for Education" (2016) and a heightened focus on its "Equity and Inclusive Education Strategy" (2009). The challenge falls upon leaders to ensure that these strategies, together with Ontario's twenty-first-century global competences, are firmly grounded in the work of schools as they focus on improving student achievement and well-being. The proposed global competences together with the well-being and equity strategies point to deepening the knowledge and skills necessary to support the work of teachers, schools, and leaders. Many district school boards have now moved to include these in their strategic plans [15].

Teacher and leader communication and collaboration processes have long been of interest to those engaged in professional learning. Dede [11] acknowledges that collaborative inquiry is "tough to do well" in practice. At the school and district levels, collaborative inquiry involves teams of educators working together as co-learners to study student learning. Dweck [12] explains that as a professional learning strategy, collaborative inquiry encourages all educators to "fulfill their potential" to help students "fulfill their potential."

Leithwood [28] has described leadership as "the exercise of influence." Much of the focus on capacity building in the current context addresses how leaders work with their teams to improve student achievement and well-being. Leaders across Ontario have also appreciated the capacity building and resource supports provided by the Ontario ministry. One example is the professional learning series titled "Capacity

Building Series" (Ontario Ministry of Education),[41] which supports leadership and instructional effectiveness in Ontario's schools.

In recent years, interest has been generated in the power of professional networked approaches to teaching and learning. The process provides opportunities for education leaders and practitioners to develop a shared understanding of high-quality instruction and how schools and districts can collectively support this effort [6]. The process of teaching and learning is observed in practice and a collaborative learning culture is nurtured.

4.8.4 Collaborative Efforts Between Teachers and Leaders

In 2016, aligned with its efforts in reaching the goals outlined in "Achieving Excellence" (2014), the province introduced Policy/Program Memorandum (PPM 159) on Collaborative Professionalism [46–52]. This policy builds on Ontario's solid foundation of achievement promoting "the establishment of trusting relationships that value the voices of all encourage reflection and support professional growth" [46–52]. Specifically, the core priority of the PPM 159 addresses the building of a shared commitment to working together to improve student achievement and the well-being of both staff and students. It also addresses the need to "transform culture and optimize conditions for learning, working and leading at all levels of the education sector" [46–52].

Leaders across Ontario are exploring a variety of successful processes. One that shows promise is The Learning Conversations Protocol (2016).[42] Katz and Dack [26] designed the protocol to enable focused learning discussions among educators. The seven steps of the protocol must be followed carefully enabling collaborative groups to structure their learning conversations as a central part of their professional learning efforts.

4.9 Community and Stakeholder Engagement: Stakeholder Engagement Has Been a Source of Strength and Support

For over two decades, Ontario has been experiencing a transition to an education system based on clearly articulated twenty-first-century competences. Community and stakeholder engagement has been an important factor in shaping this change. The engagement has included public consultations leading to policy development

[41] Capacity Building Series: http://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/capacityBuilding.html.

[42] The Learning Conversations Protocol (2016): http://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/learning_conversations.pdf.

or program change; encouragement for active involvement by parents and citizens in projects, committees, and councils; emphasis on communication and welcoming environments for parents; and initiatives of citizen organizations to supplement and support the directions of public education.

Throughout this transition, parents, teachers, education organizations, teacher unions, the business community, and other education-focused citizen groups have been engaged to contribute ideas and express concerns. As the system has moved toward its goals of excellence, stakeholder engagement has been a source of strength and support.

4.9.1 Public Engagement Efforts

A seminal event involving extensive engagement occurred in the mid-1990s. During this event, a ministry-appointed Royal Commission, a high-level panel of five education experts and academics, conducted broad consultation among citizens and educators.[43] The commissioners began by acknowledging widespread concern over a publicly funded education system that seemed insufficiently responsible to the public and set out to hear from as many people as possible. They listened to presentations from 1,396 groups and individuals in 27 cities and received written, voicemail, or email messages and submissions from 3,350 other individuals.[44]

Because of the interest generated by its comprehensive process, the commission's report was widely read and deeply influential. It provided "a blueprint for changing Ontario's schools to equip all students for the challenges of the twenty-first century" [44]. The cochair of the commission stated its goal that all students would become "literate, knowledgeable, creative and committed young men and women … able to solve problems, and think logically and critically" [44]. She added that "they will be able to communicate articulately, work cooperatively, and most importantly, will have learned how to learn" [44].[45]

The report also emphasized technological literacy and school-community councils to foster connections with parents and community members. The commission's engagement of stakeholders was more far-reaching than any consultation previously undertaken, and the goals that resulted were the precursors of Ontario's twenty-first-century competences and skills.[46]

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[43] Royal Commission on Learning Report: http://www.edu.gov.on.ca/eng/general/abcs/rcom/short/short.html.

[44] For the Love Of Learning: Report of the Royal Commission on Learning (1994): http://www.edu.gov.on.ca/eng/general/abcs/rcom/full/volume1/volume1.html.

[45] Royal Commission on Learning Press Release (1995): http://www.edu.gov.on.ca/eng/general/abcs/rcom/news.html.

[46] 21st Century Competencies: Foundation Document for Ontario (2016): http://www.edugains.ca/resources21CL/About21stCentury/21CL_21stCenturyCompetencies.pdf.

Despite the success of this major exercise in public engagement, no one claimed that all views could be harmonized and included. The report acknowledges a fundamental truth that "it was not easy to find common themes or concerns among all these interested citizens, and certainly there was consensus about precious little."[47] The lesson communicated was that public engagement yields a range of material. There are immediately useful ideas, interesting but currently impractical thoughts, and complaints that are often passionate and highly personal. The Royal Commission's report could not include everything that everyone expressed, but its consultation had a key merit: it was an open-minded search for ideas and opinions. It was definitely not a case of education authorities looking for evidence of public support for what they had already decided to implement.

4.9.2 Establishing the EQAO: Tests Would Be Fair and Data Would Be Used to Support Improvement, not Make Judgments

Between 1997 and 2001, Ontario acted on a number of recommendations by the commission, including the creation of an agency to assess the learning of every student and provide publicly accessible data from these assessments.[48] The implementation of this province-wide testing was controversial. Parents were generally in favor of the initiative, but most teachers saw tests as an unfair attempt to judge their pedagogical performance.

The new agency, the EQAO, embarked on several forms of engagement to convince its constituencies that tests would be fair and data would be used to support improvement, not make judgments:

- An advisory committee was established with members from all levels of education, from the business community to unions. The committee made key recommendations about the need for tests firmly based on the newly developed provincial curriculum.
- EQAO leaders, including members of a citizen board, traveled the province speaking to district officials and teachers about the tests. They spent long hours with teachers and representatives of the various unions, discussing improvement as the goal of the assessment. Initial engagement with these core groups lessened opposition, although it did not create enthusiastic support.
- EQAO engagement also included meetings with leaders of groups with specific interests such as learning disabilities or parent participation and with representatives of educational associations. These organizations provided ideas to improve

[47] Royal Commission on Learning: http://www.edu.gov.on.ca/eng/general/abcs/rcom/short/short.html.

[48] For the Love Of Learning: Report of the Royal Commission (1994), Chapter 11: Evaluating Achievement: http://www.edu.gov.on.ca/eng/general/abcs/rcom/recommen.html.

assessment tools as well as offer support based on a clearer understanding of assessment goals.

In 2016, after 15 years of implementing tests for Grades 3, 6, 9, and 10, many educators agreed that intensive stakeholder engagement to support and improve provincial assessments was an important factor in the program's success. Furthermore, they agreed that improvements in Ontario education (as reflected in PISA results) were linked to effective curriculum-based assessment that incorporated twenty-first-century competences.

4.9.3 Engaging with Parents: Parents Are Essential Partners

In 2010, the Ministry of Education released "Parents in Partnership: A Parent Engagement Policy" (2010).[49] This document formalized expectations that had been developing over the past decade, as the benefits of parent involvement in education became very clear. The four foundations of engagement identified in the policy were

(a) A welcoming environment;
(b) Clear communication of opportunities to participate;
(c) Ongoing dialogue; and
(d) A flow of information relevant to parent support of children.

The policy emphasized new ways to engage parents, such as using twenty-first-century technology to allow them to view, hear, or read materials related to their children's schools. The policy also acknowledged the need for global awareness in twenty-first-century Canada, where an appreciation for diversity is essential. Districts were encouraged to provide key messages and information in several languages to avoid excluding parents whose language or cultural background left them feeling remote from schools. Schools and districts were also reminded that including parents of diverse backgrounds on councils and committees would enrich the learning environment and that providing community outreach workers would help hesitant parents to become involved. By planning for complementary approaches by schools, districts, and the province, the education system can send a powerful message that parents are essential partners.

Parent Reaching Out Grants[50] are another example of ministry engagement. This grant program invites participation by school-based parent councils, district parent involvement committees, and not-for-profit organizations. Groups are asked to define projects that address important issues in their school communities and then apply for funding to implement their plans. Grants are awarded for a wide variety of activities, for example, learning events for families where parents attend and participate alongside their children in activities that emphasize twenty-first-century competences such

[49] Parents in Partnership (2010): www.edu.gov.on.ca/eng/parents/involvement/pe_policy2010.pdf.
[50] Ontario Ministry of Education Parent Reaching Out Grants: www.edu.gov.on.ca/eng/parents/reaching.html.

as problem-solving and critical thinking. Over 19,500 projects have been funded by these grants since 2005, and the program has contributed to lasting engagement in thousands of communities.

4.9.4 Citizen Groups

The examples presented earlier are associated with the ministry's initiatives. However, citizen groups committed to public education initiate some stakeholder engagement independently. One such group is **The Learning Partnership (TLP)**, founded by Ontario business leaders to build bridges between the education and business communities.[51]

Among other activities, TLP develops programs for students. Included in its student programs are "Entrepreneurial Adventure" that emphasizes twenty-first-century skills such as marketing, planning, team building, and social responsibility and "Investigate! Invent! Innovate!" that integrates science, technology, engineering, and math (STEM) skills and twenty-first-century competences such as critical thinking, creativity, collaboration, and communication.

Another citizen organization with different purposes is **People for Education**.[52] This organization is devoted to research, policy recommendations, and public dialogue. It produces an annual report on publicly funded schools designed to engage the community in thoughtful conversation about system improvement. Although its 2017 report[53] is not specifically focused on twenty-first-century competences, one section does comment on Ontario's "strategy to help the province's current and future workforce adapt to the demands of a technology-driven knowledge economy" ([56], p. 30).

TLP and People for Education are examples of the citizen groups that engage productively with Ontario's evolving education programs.

4.9.5 Achieving Excellence Report

In 2014, "Achieving Excellence: A Renewed Vision for Education in Ontario"[54] was released by the ministry after a comprehensive engagement of stakeholders. Its premise was that Ontario had taken great strides in the previous decade but needed to move from great to excellent. The emphasis on "renewed" in the title of this document

[51] The Learning Partnership: http://www.thelearningpartnership.ca/.

[52] People for Education: http://www.peopleforeducation.ca/.

[53] People for Education [56] Annual Report: http://www.peopleforeducation.ca/research/annual-report/.

[54] Achieving Excellence: A Renewed Vision for Education in Ontario (2014): http://www.edu.gov.on.ca/eng/about/renewedVision.pdf.

reminds us that periodic consultation should be an important part of an evolutionary process.

Consultation for "Achieving Excellence" (2014) included input sessions for provincial organizations, regional meetings for local groups, and digital-only opportunities for individuals and groups not otherwise included. Participants in the consultation were asked to respond to seven questions developed by a committee of stakeholders. These questions invited input on graduation outcomes, student well-being, achieving equity, lifelong learning, use of technology, and partnerships. The report reflects input that supported twenty-first-century competences as it envisages students who will "become personally successful, economically productive and actively engaged citizens" and also "motivated innovators, community builders, creative talent, skilled workers, [and] entrepreneurs" [46, p. 1].

To some extent, the outcomes of this and other consultations are dependent on who is likely to have participated most effectively. Often groups that are well-organized and well-funded have the best chance of expressing their views in a forceful manner. They are more likely to have research data and speak in professional terms familiar to policy makers. It is always useful to ask whether the "average person" is adequately represented when the majority of input is from professional groups. A report such as "Achieving Excellence" (2014) must find a fair balance among the voices heard.

4.10 Twenty-First-Century Skills and Industry Needs

In Canada over the last 10 years, 40% of labor growth has been due to migration. The Canadian and Ontario economies have continued to improve since the 2008/2009 global downturn and the economic projections are hopeful due to impacts from NAFTA, European Union, and pan-Asian trade opportunities. To meet the challenges, Ontario and Canada require a highly skilled (including skilled trades) and educated workforce.

4.10.1 Twenty-First Century Skills for the Changing Workplace

The Conference Board of Canada identifies employability skills for 2000 and beyond including fundamental skills, personal management skills, and teamwork skills requiring the ability to

- Communicate;
- Manage information;
- Use numbers;
- Think and solve problems;
- Demonstrate positive attitudes and behaviors;

- Be responsible;
- Be adaptable;
- Learn continuously;
- Work safely;
- Work with others; and
- Participate in projects and tasks.

In Ontario, the Premier's Highly Skilled Workforce Expert Panel's task was to develop an integrated strategy to inform policy and direction regarding the development of a highly skilled workforce to meet Ontario's demands of technology, knowledge economy, and the shifting labor market realities. The panel's aim was to develop approaches, responses, and resources to, "bridge the worlds of skills development, education, and training" ([33–35], p. 2). The panel and government understand the need for a highly skilled workforce and view the training as a shared responsibility to plan, train, and reskill. Ontario's workforce is diverse and "recognized as well credentialed."

Overall, the Canadian labor force is considered well educated. The percentage of Ontario students graduating from high school after five years is above 85%. In 2014, the OECD ([33–35], p. 5) reported that 66% of Ontario adults had a post-secondary degree or diploma—more than any OECD member nation. Supporting a highly educated workforce, Canada at 55% has the highest proportion of working-age adults with degrees/diplomas/accreditation from post-secondary institutions, as compared to the OECD average of 35% [8].

4.10.2 Implications for Education

According to Statistics Canada, 70% of new jobs will require a high school diploma and some degree of post-secondary education. Immigration will be increasingly important as birth rates decline. More than 50% of immigrants have a university degree, twice that of the Canadian-born population. The government wants to develop an integrated learner-focused adult education system focused on reskilling and retraining through incentivizing lifelong learning.

Grose [22] challenges the existing expectations noting that, "as students grow to become digitally literate citizens and leaders in our connected world, multi-faceted thinking skills are needed to navigate digital, multimodal text and media laden environments to interpret large volumes of new information, to use oral, listening and written language to communicate persuasively and to promote and advance ideas; and to think critically and ethically in contexts to collaborate, communicate, create and succeed in learning and life." Jenkins ([25], p. 4) explains that a changing workplace, "participatory culture shifts the focus of literacy from one of individual expression to community involvement." The twenty-first-century skills/competences are transitioning from workplace demands into the written and taught K-12 curriculum in response to this changing reality.

4.11 Twenty-First Century Competences Implementation Best Practices

This section considers best practices in pedagogical implementation, describing the influence of these factors in our shift from teaching organizations to learning organizations and in the adoption of learner-centric pedagogies aided by technology to support deeper learning [9, 19, 15, 22, 55, 61].

Responding to a changing world and workplace, the emerging learning-focused paradigm requires an explicit and intentional transition from what is known as objectivist[55] to that of interdisciplinary, inquiry-based learner-centric approaches. These types of pedagogical practices provide students with opportunities to lead their own learning, collaborate with each other as well as experts to solve authentic and complex problems, explore their own questions, and address real-world challenges [46–52]. Learner-centric practices foster student agency by embedding student choice and voice in the learning process itself. This includes, but is not limited to, the choice regarding the ways in which they demonstrate their learning and the type of technology they use to support their learning.

The process by which students learn rich core content in innovative ways and are able to transfer and apply that learning to new situations requires new pedagogies accelerated by technology [19]. The following supports the development of twenty-first-century skills/competences:

- Implementing pedagogical practices that include inquiry-learning, project-based learning, experiential learning, internships, and physical and virtual connections with the wider community. As the World Economic Forum's "The Future of Jobs Report" [63] indicates, the global economy is expected to gain 2 million jobs in STEM-related fields in less than five years. These pedagogies should include formal and informal STEM-related experiences in computer, environmental, health and data science, engineering, gaming, and digital media production through technology-supported and hands-on experience in coding, hackathon challenges, computer programming, and robotics to spark interest in STEM-related careers. These are of particular importance to female students.
- Creating knowledge-building communities [57] that collaboratively explore and share new knowledge, expose students to a diversity of thought, and broaden perspectives, thereby enhancing critical and ethical thinking and deepening understandings
- Encouraging students to creatively use different types of tools, styles, formats, and digital media to participate in global conversations and to collaborate with multiple audiences to analyze data and solve real-world problems
- Providing broader participatory face-to-face, blended, and online environments where students engage in dialogue, collaboration, and inquiry and where they feel their voice matters, thereby empowering ownership in the learning process

[55] More traditional, teacher-focused methodologies.

- Ensuring there is shared ownership for learning by providing authentic opportunities for students to learn from and with each other, and for educators to learn from and with students
- **Focusing explicit and intentional learning opportunities** regarding digital leadership and the rights and responsibilities of respectful participation

Educators are striving to implement deeper learning and ensure learning is personalized, flexible, and supported by a culturally relevant and globally contextualized curriculum. Students, then, have opportunities to develop the cognitive, interpersonal, and intrapersonal competences needed to lead, learn, and work more collaboratively with all cultures in both physical and online environments.

Opportunities are provided for students to direct and construct their own learning; their own professional learning models must also evolve to support teacher agency. This requires a shift from a traditional top-down professional learning model to more authentic learning ecosystems that support collaborative professionalism, deprivatization of practice, knowledge construction, and ongoing growth. Opportunities for professional learning and growth are collaboratively constructed and reflect the "4Rs" of authentic learning summarized in the Ontario Ministry of Education's 2017 "Mentoring for All eBook" (see Table 4.5).

Table 4.5 4Rs of authentic professional learning

Relational	Recursive
• Relational trust creates an inclusive learning space with all partners in the learning process listening to each other (students, educators, parents, and school community) • All learners collaboratively construct communities of practice that build upon their strengths, attributes, and experiences	• Rich learning tasks reflect embedded beliefs that learning itself is a messy, iterative, recursive process • Protocols for application of learning, follow-up, and evaluation of impact are embedded into the learning process
Responsive	**Real World**
• Learners are listened to and their individual and collective voices directly inform learning designs • The "how" and "what" of the learning designs employed are based on authentic learning goals identified by the participants • Learning "makes sense" to the learners and involves authentic collaboration, choice, voice, and agency	• Learners construct learning together that is relevant and has authentic real-world connections and applications • Learning designs that leverage peer-to-peer networks for deep learning and foster the intentional sharing of knowledge and practice are utilized • A direct connection to student learning and well-being is evident (that is, students are at the center of the learning)

4.11.1 New Roles in Learning

Co-constructing empowers student ownership, collaboration, creativity, and innovation, resulting in teaching and learning that is more inclusive, instructionally precise, attributes based, and culturally responsive. As teachers shift their traditional roles, emerging as facilitators of learning-centered environments, students become authentic sources of learning for both the teacher and their peers. Teachers utilize a combination of modeling, coaching, and scaffolding to direct and guide instruction facilitating deep-learning tasks. The teacher is also a learner alongside their students.

In the context of these types of learner-centric environments in classrooms that are flexible and connected locally and globally 24/7, a more fluid and adaptive participatory learning culture emerges for all learners [22] where:

- Critical thinkers and problem solvers use "evidence and data, analyze, think critically and manage projects, solve problems and make informed decisions using digital tools and resources"
- Collaborators work together both face-to-face and virtually, to support personalized learning and contribute to the learning of others;
- Communicators make and share meaning and their point of view using a variety of digital tools with real and online audiences; and
- Creators and innovators "demonstrate creative thinking, construct knowledge and develop innovative products and processes using technology" [10], p. 7.

4.11.2 The Role of Technology: Digital Spaces for Educators

There are two innovative and collaborative digital spaces to assist all educators in Ontario with knowledge building, accessing research and evidence, and sharing of best practices in action. The first is TVO's award-winning TeachOntario.[56] TeachOntario was created by TVO, in partnership with the Ontario Teachers' Federation (OTF) and its affiliates, the Ministry of Education and in consultation with elementary and secondary teachers from a variety of districts across the province. TeachOntario offers tremendous opportunity to support professional learning, to foster educator leadership, and to facilitate the sharing of exemplary practices with others, both locally and globally. TeachOntario is a unique destination created "for Ontario's educators, by Ontario's educators."

The second digital space is the Ontario Ministry of Education's Learning Exchange, created by the Ministry of Education's Student Achievement Division.[57] The Learning Exchange supports the goal of achieving excellence in education for early learning, K-12, and adult education.

[56] TeachOntario: www.tvo.org/teachontario.

[57] Ministry of Education's Learning Exchange: http://thelearningexchange.ca/.

4.12 Twenty-First Century Competences Implementation Challenges

Inherent challenges for effective implementation involve "will and skill" [16]. Learning to collaborate, communicate effectively, and use creativity, critical thinking, and problem-solving skills is challenging to implement coherently and deeply across Ontario's classrooms and 5,000 schools. Section 4.11 of this chapter examines (a) how twenty-first-century competences are applied in Ontario, (b) what challenges schools and school systems face in this type of large-scale implementation, and how educators and policy makers know if the intended change is occurring and if it is affecting student learning.

We know that it is difficult to effectively implement complex policies in education and to sustain the implementation. Policy makers and educators struggle with the challenges of moving to scale and having a new practice actually taking place, roughly as intended, in all or almost all schools and classrooms. Freedman and Di Cecco ([13], p. 3) examine "how to decrease variability among and between schools and classrooms." Coburn [7] argued that moving to scale involved issues of sustainability, spread of norms and beliefs involved with the change, and a shift in ownership to a shared model, so the reform becomes self-generative. This means to scale up and embed an initiative such as implementing twenty-first-century competences, the design and planning needs to account for depth and breadth across the system, province, and nation.

For education, depth means substantive change in teaching and learning. Fullan and Quinn ([16], p. 3) argue that implementing change coherently involves "a set of right drivers that are effective: capacity building, collaboration, pedagogy, and systemness (coordinated policies)." These drivers also comprise the challenges to implementation. Educators tend to be risk-adverse. The change, therefore, must be clearly articulated and implemented gradually. Intentional and thoughtful action planning, including time lines, resources, professional learning, designated champions, and measures/indicators of success, provides road maps for the desired change. There are implications for policy and practice.

4.12.1 Policies and Funding

The Ministry of Education released its foundational document "21st Century Competences (2016)", referenced in Sect. 4.5 of this chapter. The document had a focus on "developing these competences in explicit and intentional ways through deliberate changes in curriculum design and pedagogical practice" [1, p. 6]. The challenge is "to prepare students to solve messy, complex problems—including problems we don't yet know about—associated in living in a competitive globally connected, technologically intensive world" [47, p. 3]. This is part of the shift from schools of teaching to schools of learning and thinking.

The initiatives are going to be effective in raising academic bars and closing gaps. The initiatives are aligned to avoid fragmentation and educators feeling overwhelmed with the scope of the change. Increasingly, educators want policies and strategies that are evidence informed [23, 24]. Effective change does not happen within a single school term or even year. It requires three to seven years of intentional implementation, targeted and intentional support, and monitoring.

4.12.2 Range of Learners

In addition to embedding twenty-first-century competences/skills in the curriculum, instructional time and pedagogical practices must be adapted to develop these skills in Ontario's students. Another issue in implementation is a recognition of support required to increase student engagement and achievement. These accommodations are required by a range of learners. While Ontario supports both excellence and equity and has made significant gains in closing achievement gaps, complex issues remain. There are still gaps in learning experienced by indigenous students, youth in care and custody, learners with mental health issues, and students identified with special education needs. The curriculum policy documents and resources include these students as learners within the system. There are specialized supports and services provided, and the Ministry of Education works with its partners to deliver inclusive, culturally relevant education for all learners.

4.12.3 Human Resources

Effective implementation of twenty-first-century competences/skills can occur with trained and confident staff members who understand professional pedagogy and the use of digital technology. Fullan and Langworthy [15] caution about the challenges to implementing new pedagogies accelerated by technology. Teachers need to acquire the growth mind-set that twenty-first-century skills can and will affect student outcomes [1]. Dede ([9], p. 9) notes that "teachers will find it hard to provide deep learning opportunities without employing learning opportunities," however, many teachers lack the skill and confidence to make this happen.

On the Grade 9 EQAO mathematics assessment, only 40% of math teachers reported solving open-ended problems, less than 30% conducted math investigations, and 35% asked students to use computer software in mathematics classrooms. In the 2017 mathematics assessments, Ontario students in Grades 3 and 6 experienced challenges in responding to thinking problems and multistep, open-ended mathematical problems.[58]

[58] Retrieved from: https://ca.yahoo.com/news/math-scores-flat-falling-among-143409293.html.

Increasing professional learning and expertise of teachers and leaders remains an ongoing challenge for implementation:

- Designing and delivering preservice training that incorporates knowledge and evidence-informed pedagogies on implementing twenty-first-century competences/skills
- Building the skills and knowledge of school leaders to lead collaborative deep change
- Providing funding and release time for ongoing professional learning
- Sustaining productive and impactful collaborative professional learning inquiries and sharing leadership and accountability for collectively implementing twenty-first-century skills/competences
- Developing incentives for teachers to voluntarily enroll in Additional Qualifications (AQs), where teachers take ministry-approved courses such as "Integration of Information and Computer Technology in Instruction and Assistive Technology"
- Developing outreach partnerships with community agencies and business to offer students authentic learning experiences
- Providing frameworks and tools for knowledge sharing and mobilization
- Working with the teacher federations/unions as partners in the change process. The unions represent Catholic teachers, elementary teachers (public), secondary teachers (public), and French first-language teachers.

An equity issue involving implementation is that teachers and administrators do not reflect the student diversity that exists in Ontario's classrooms. There are challenges in developing responsive methodologies and pedagogies that allow Ontario's diverse student body to see themselves reflected in the curriculum:

- Multilingual resources and/or translated resources including braille and other accessible formats and modalities;
- Using examples and ensuring that names that are reflective of the students as twenty-first-century skills are integrated;
- Changing assessment practices to provide evidence of twenty-first-century skills/competences;
- Learner-centric materials and active student involvement in terms of voice and choice;
- Providing intentional interventions to close existing academic gaps.

4.12.4 Learning Environment

In times of fiscal restraint, change implementation needs to be cost-effective and efficient. There are inequities existing within the system, as wealthier communities

can supplement ministry/board funding and provide extra technology and opportunities to local schools.[59] Schools in urban areas have access to reliable high-speed Internet. This may not be the case in Ontario's rural/remote communities. The cost of updating equipment is very challenging. Additionally, there are challenges in terms of

- Access to current, well-maintained technology;
- Awareness of digital tools and their effective use;
- Teachers' competency with digital tools and integrating them into their practice;
- Integration of technology into the learning environment;
- Providing flexible seating for collaboration and constructivist learning; and
- Transforming school libraries into learning centers or hubs of learning.

4.13 Conclusion. Ontario Education: Where to Next?

The Ontario Ministry of Education [47, p. 45] states that "transformations in pedagogical practice, new learning partnerships, enhanced use of digital tools and resources, physical and virtual spaces designed to support learning are required to ensure students' development of 21st-century competencies."

In that spirit, on September 6, 2017, Premier Wynne and the Minister of Education announced a plan to modernize the curriculum and improve assessment and reporting to parents and the public. To keep Ontario schools competitive and world-class, "Ontario's updated school curriculum will be developed through the public consultations with the goal of improving student achievement in core skills such as math and increasing emphasis on transferable life skills that can help students of all ages meet the changing demands of today and tomorrow. Communication, problem-solving, critical thinking, creativity, and global citizenship are skills that will help Ontario students thrive as they grow up in a changing, interconnected world. Beginning next school year, new report cards will better track a young person's development of these essential and transferable life skills" [39–43, 53, 54].

Where to next is becoming now.

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[59] The top 5% of fundraising schools in affluent areas can raise as much funds as the bottom 83% combined: http://www.peopleforeducation.ca/wp-content/uploads/2017/06/P4E-annual-report-2017.pdf.

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Chapter 5
China: Fostering Students with All-round Attainments in Moral, Intellectual, Physical and Aesthetic Grounding

Huanhuan Xia and You You

Abstract The chapter explores China's experience of fostering twenty-first century skills. Chinese school focuses on the cultivation of "comprehensively developed people," thus shifting to appreciate individuality in mass education. Its key competency model seeks to enhance students' sense of social responsibility, innovation, and practical ability. The task of developing key competences is integrated into all school subjects and is further supported in informal education; schools may flexibly adjust their timetable and curricula to better fit this task. Students are assessed not only in their academic outcomes, but also in their moral character, physical and mental health, social practice, etc. The model is based on the quality-oriented education concept (1980-s) and Core Values, which are consistent with the theoretical base of Marxism, and with the policy of the Chinese Communist Party of China. The model

A note from the editors:

This essay about curriculum and education reform in China was prepared by scholars from Capital Normal University and Peking University. It describes the experience of transforming education in a country with centuries-old cultural (and educational) traditions which are very different from the Western model, so influential nowadays for the global development of education.

With the twenty-first century as the boundary point, the curriculum reform in China before this period has emphasized the need for collective demand, the curriculum of subjects, knowledge transmission and selection competition. The subsequent curriculum reform emphasized individual development, experience course, self-investigation and moral, intellectual, and physical health. The new round of curriculum reform based on key competences, which inherits the "all-round education," highlights the individual characteristics of the new generation, and responds to the internal needs of all-round education in the new era.

The key competences framework in China has three characteristics. Firstly, paying attention to ideological and moral education, for the all-round development of students. Secondly, centering on the main line of students who have all-round attainments in moral, intellectual, physical and aesthetic education, the specific content changes with the development of society. Thirdly, educating students with top priority is given to cultivating their moral integrity and their overall qualities such as social responsibility, innovative spirit, practical ability and so on. The ultimate goal is to turn China into a country rich in human resources.

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also reflects the history and culture of the Chinese nation, integrating their elements into the curriculum in all academic disciplines.

Keywords Core competences · All-round development · Social responsibility · Innovative spirit · Moral education · Self-development · Social participation · Cultural accomplishment · Teacher training

Highlights

- The education system took "Building Moral Character and Cultivating Humanity" as the fundamental task of education, focused on the "comprehensively developed person" in moral, intellectual, physical and aesthetic education.
- The framework of key competences of Chinese students' development is centered on the cultivation of "all-round development of students," it is divided into three aspects: "cultural foundation, self-development and social engagement," which is comprehensively manifested as six qualities: humanistic heritage, scientific spirit, learning to learn, healthy life, responsibility, practice and innovation.
- From *Dual Foundation to Three-Dimensional Objective*, and then to Key Competences, the emergence of the key competences of Chinese students' development reflects the latest achievements of the curriculum reform of basic education in the past 70 years, it provides a clear development direction and education blueprint for China's compulsory education practice.

5.1 China's Education System and Basic Facts

By the end of 2015, there were a total of 512,000 schools at all levels and of all types in China, including 223,700 kindergartens, 242,900 compulsory schools, 24,900 senior high schools, 2,053 special education schools, and 2,852 colleges and universities.

The total number of full-time teachers at all levels and types of schools is 15,429,000. Specifically, there were 2,303,100 kindergarten teachers, and 9,160,800 full-time teachers in compulsory education, with 1,699,000 full-time teachers in senior high school, 50,000 full-time teachers in special education schools, and 1,573,000 full-time teachers in colleges and universities. The total number of students of all levels and types of schools is 260 million, an increase of more than 3 million over the previous year. Specifically, this includes 63.65 million preschool children, 140 million students in compulsory schools, 40.3769 million students in senior high schools, approximately half a million students in special education schools, and 36.47 million students in colleges and universities. The overall enrollment rate in higher education is 40 percent [12].

In summary, since the beginning of the twenty-first century, China's education has developed rapidly and achieved remarkable achievements. Free compulsory education has been fully implemented, preschool education resources have been expanded,

and high school education was universalized. China is now entering a new stage of consolidating these achievements, improving quality, and promoting balanced development. In this context, education needs to constantly return to the original point of reflection and questioning: What kind of person do we need to develop? How do we best develop our children? What are we educating our students for? The idea of key competences is included in this context, to solve the problems of educational practice for a new stage of education in China.

5.2 The Brief History of Key Competences Development in China

With a focus on the concept of sustainable development and the emergence of humanistic education, more and more people are beginning to reflect the concept of educational value and attach more importance to the core values of education. China put forward the fundamental task of education in China since the 18th CPC National Congress—fostering virtue through education. Taking the school curriculum in basic education as the important carrier of implementing fostering virtue through education, for the current and future, the key competences students in basic education needed should be demonstrated and elaborated. In addition, *key competences* are inherited and developed as the achievements of recent reforms and experiences in basic education that have occurred since the Reform and Opening up Policy in China. The idea of *key competences* is consistent with the concept of *all-round education* which was put forward in the 1980s. Although China started curriculum reforms since 1949, the curriculum reforms during 1949–2000 have emphasized the need for collective demands, the curriculum of subjects, knowledge transmission and selection competition. Students' personal development is seldom mentioned. In June 2001, the Ministry of Education issued the Outline of Basic Education Curriculum Reform (Trial), which set off the wave of the eighth curriculum reform with the goal of "for the rejuvenation of the Chinese nation and for the development of every student." The construction of the new curriculum system under quality-oriented education is the core expression of the curriculum reform in this period [1]. Since 2001, China witnessed a national curriculum reform guided and organized by the MOE, all of those reforms have been aimed at educating students to be an overall quality person who have all-round attainments in moral, intellectual, physical and aesthetic education. The new curriculum reform was initiated in 2001, so the following discussion begins in 2001, the brief history of curriculum reform before 2001 could be found in Table 5.1.

5.2.1 2001–2005: The Experimental Period of Developing Key Competences

The new reform in 2001 for the first time put forward the curriculum concept of three-dimensional objectives. In 2001, the Ministry of Education launched a new curriculum reform, taking the aim of "all-round education" as the guiding idea, further analyzing and studying the main problems in educational practice and aiming to establish an educational curriculum system that fostered students with all-round moral, intellectual, physical and aesthetic grounding. *The 2001 Basic Education Curriculum Reform Outline* emphasizes "the formation of a proactive learning attitude, the process of acquiring basic knowledge and basic skills turns to the process of learning to learn and form correct values..." [7], it aimed at implementing the government's educational purpose, and promoting quality education thoroughly at a national level. It put forward an organizing principle of curriculum reform, namely, the Three-Dimensional Objective, which is constituted by the dimensions of (1) knowledge and skills, (2) process and methods, and finally, (3) emotion, attitudes, and values. The Three-Dimensional Objective was a new interpretation of China's education for the all-round development of the young by highlighting the importance of aspects of education beyond knowledge and skills [31].

In December 2002, with the approval of The State Council, the Ministry of Education promulgated the *Notice on Actively Promoting the Reform of the Evaluation and Examination System for Primary and Secondary Schools*. This document for the first time put forward the concept of "fundamental development goals," and specifically expressed as six aspects—"moral traits," "civic literacy," "learning ability," "communication and cooperation ability," "sports and health," "aesthetic and performance." The concept of "Comprehensive literacy evaluation" was used for the first time in 2004 in *the Guiding Opinions on the Reform of the Graduation Examination and the Enrollment System of Ordinary Senior High Schools in the Experimental Area of National Basic Education Curriculum Reform*. The interpretation of the content of comprehensive literacy evaluation is exactly the six aspects of "fundamental development goals." Although the new ideas and policies proposed in the above documents are not the same as key competences, they could be seen clearly in its context and can be regarded as the first step in the exploration and formation of the key competences [18].

5.2.2 2006–2013: The Deepening Period of Developing Key Competences

The Compulsory Education Law of 2006 proposes "to make school-age children and adolescents develop in terms of morality, intelligence, and physical fitness, and to cultivate ideals, ethics, culture, and discipline." The Law on the Protection of Minors in 2007 states "Focus on cultivating undergraduate students' independent

thinking, innovation, and practical ability to promote the comprehensive development of students." In 2010, *the National Medium- and Long-term Education Reform and Development Plan* claimed to focus on educating students with top priority given to cultivating their moral integrity, improving their overall quality, modernize the educational system, and train socialist builders and successors who have all-round attainments in moral, intellectual, physical and aesthetic education.

Up to 2011, after ten years of practice and exploration, the curriculum reform has achieved remarkable results, and a basic education curriculum system with Chinese characteristics has been established, reflecting the spirit of the times and the concept of all-round education. During the process of implementing the curriculum standards, it is found that the content and requirements of some standards need to be adjusted and improved [10]. Therefore, under the background of comprehensively implementing all-round education, deepening the reform of basic education curriculum, and improving the quality of education, the revised compulsory education curriculum standards for various disciplines came into being. The revised edition combines the guidelines about school subjects and the characteristics of students, with an increased emphasis on moral education [16]. Firstly, each discipline takes the implementation of national core values as the guiding ideology for revision and organically penetrates it in combination with the content of the discipline. Secondly, to further highlight the outstanding cultural and traditional education of the Chinese nation. For example, the Chinese course has a special calligraphy course; in mathematics, it is recommended to include "Nine Chapters of Arithmetic" as the content of the textbook; history adds traditional drama and other content that reflects the country's traditional culture. Thirdly, to further enhance the pertinence and epochal nature of ethnic unity education. According to the basic national conditions of the country's multi-ethnic groups, and in accordance with the overall requirements of a harmonious society, the connotations of "ethnic exchanges, exchanges, and integration" and "common development" are more prominent in the original content of ethnic unity education. Fourthly, to strengthen the content of legal education. In addition, the 2011 edition of the new curriculum standard emphasizes the cultivation of students' sense of social responsibility, encourages students to question boldly, and especially proposes to cultivate students' innovative ability, learning ability and practice ability.

In 2012, the Report of the 18th National Congress of the Communist Party of China proposed that *Building Moral Character and Cultivating Humanity* was the fundamental task of education and cultivating socialist builders and successors with all-round development of morality, intelligence, physique, and aesthetic growth, advocating the socialist core values of "prosperity, democracy, civilization, harmony, freedom, equality, justice, rule of law, patriotism, dedication, integrity, and friendliness." In 2013, the third plenary session of the 18th central committee of the Communist Party of China put forward the insistence on *Building Moral Character and Cultivating Humanity*, developing socialist core values education and Chinese traditional culture education, and enhancing students' social responsibility, innovative spirit, and practical ability.

5.2.3 2014–now: The Era of Key Competences

China education for the first time put forward the concept of "key competences" since 2014. To implement the objectives and requirements of educational reform, ways of "strengthening moral values and cultivating people" in theory and practice are required. In 2014, China's MOE embarked on a new round of curriculum reform based on a governmental document published on March 30 of the same year, titled *The MOE's Suggestions on Deepening Curriculum Reform Thoroughly and Realizing the Basic Task of Building Moral Character and Cultivating Humanity* [32], in which the concept of key-competence was first officially mentioned though it was literally formulated as core-competence.

China comprehensively planned to improve education quality and promote the development of key-competences-based education, taking curriculum reform as the entry point, and after full preparation and investigation, issuing new revised general high school curriculum standards in 2016. The most prominent research project funded by the MOE in recent years is an ambitious project carried out by a team at Beijing Normal University. At the end of February 2016, Chinese Students' Key Competences Development (draft for public comments) was released. On September 13, 2016, the release conference of the research results of Chinese Students' Key Competences Development was held at Beijing Normal University, at which Chinese Students' Key Competences Development was proposed [33].

The most important idea proposed in this curriculum reform is the quality orientation, that is, key competences for all subjects [34]. Compared with the curriculum reform in 2001, this reform marked that the curriculum reform of basic education in China has really gone to a deepening stage. The path is to change the original view of knowledge and the original epistemology of students. The most fundamental concept is to truly respect each student's individuality, uniqueness, and freedom of thought for the sake of each student's development. In this context, the key competences are proposed, which increases the understanding dimension of curriculum objectives and changes the understanding of the essence of textbook knowledge, that is, the essence of textbooks for all subjects is to understand the world, and children should be taught to understand the world. As shown above, from *dual foundation* to *three-dimensional objectives* to *key competences*, the current movement toward key-competences-based education in China is actually a result of the merging of China's persistent goal of educating the all-round person and a current response to a global imperative for qualified human capital in the twenty-first century.

Table 5.1 The historic development of curriculum reform

Development period	Characteristics of the curriculum reform	Content of curriculum reform in basic education
1949–1956	Learn from the Soviet Union	It set up a relatively complete range of subjects and courses, put forward the principle that primary and secondary school textbooks must be unified nationwide, and set up People's Education Press to undertake the task of compiling unified national textbooks. The number of teaching hours was drastically reduced, and for the first time, labor and technical education were included in the teaching and learning program. For the first time, MoE proposed the dual foundation of curriculum goals as knowledge and skills.
1957–1965	Independent exploring curriculum	Formed the labor curriculum; Decentralize course management; Improved foreign language teaching in middle schools; Adjusted part of the subject setting and arrangement.
1966–1976	Revolutionary curriculum	Shorten the length of schooling; Decentralize the management of the curriculum to schools, teachers and students; Gradually establish a set of "revolutionary" curricula; re-promulgated the national unified teaching syllabus, organized the "Working Conference on Compiling Textbooks for primary and secondary Schools," and focused on compiling the fifth set of textbooks for primary and secondary schools.
1977–1985	Modern curriculum	Rewrite the national textbooks; The curriculum of primary and secondary schools gradually returned to the pre-Cultural Revolution model; Restoration of the curriculum structure based on subject courses. Dual Foundation of curriculum goal are basically implemented in primary and secondary schools.
1986–1998	In-depth development from 1985	Designed the primary and secondary school curriculum in a unified way, and clarified the two-level curriculum as compulsory education and high school education. Appropriately increased the music, sports and arts course and labor technology course, and more flexible and diverse in the construction of teaching methods and textbooks.
1999–2013	All-round education	Implement the three-level curriculum management system of "national curriculum, local curriculum and school-based curriculum," highlight the comprehensiveness, balance and selectivity of curriculum structure, strengthen the connection among curriculum content, students' life, modern society and technology, and advocate inquiry-based teaching and cooperative learning, emphasizes the scientific, contemporary and vivid nature of textbook construction, and pays attention to students' individual life experience.
2014–now	Key competences era	Key competences are the central hub for coordinating all aspects of curriculum standards, textbook construction, classroom teaching, and curriculum evaluation in the new era.

5.3 The Framework of Key Competences for Chinese Student's Development

Key competency is an essential and most important ability that students gradually adapt to their needs for lifelong development and social development while receiving the corresponding education. Key competency has the following basic characteristics: key competency is a comprehensive expression of knowledge, ability, and attitude; key competences can be formed and developed through education; key competences have its development continuity and stages; key competences have both personal value and social value [18].

China's key competences lie in the following three aspects: first, paying attention to ideological and moral education and cultivating people with well-round development; second, focusing on the main line of "moral, intellectual, and physical" development, although the specific content changes with social development; and reflecting moral education as the primary ability is most important, which emphasizes social responsibility, innovative spirit, practical ability, and so on [24, 25].

Taking "educating all-rounded person" as the core, the key competences are divided into three aspects, namely cultural foundation, self-development, and social engagement. Self-development mainly reflects subjectivity and cultivates and develops physical, psychological, and learning qualities; social engagement mainly reflects sociality and deals with the relationship between individuals and groups, society and countries; and cultural foundation mainly reflects culture, and students master and apply the various achievements of human wisdom and civilization. These three aspects are described as verbs, reflecting their dynamic changes and developmental concepts that keep pace with the times. Cultural foundation is the necessary basis for individual self-development and engagement in society. Self-development and social engagement are important prerequisites and fundamental guarantees for individuals to adapt to society and realize their own personal values. These aspects are subdivided into six qualities; humanistic connotations, scientific spirit, learning to learn, healthy life, responsibility and practice innovation, as in Chart 5.1 [33].

a. Cultural Foundation

Culture is the root and soul of human beings. The cultural basis focuses on acquiring knowledge and skills in various fields such as humanity and science, mastering and applying the best of human wisdom and the inner spirit, pursuing the unity of the true, the good, and the beautiful, and becoming a person with profound cultural cultivation and higher spiritual pursuit.

(1) **Humanistic connotation**. This concept refers to students' basic ability, emotional attitude, and value orientation in learning, and understanding and applying the knowledge and skills in the field of humanity, including humanistic accumulation, humanistic feelings, and aesthetic taste.
(2) **Scientific spirit**. It refers to students' value standard, mode of thinking, and behavior in learning, and understanding and applying the knowledge

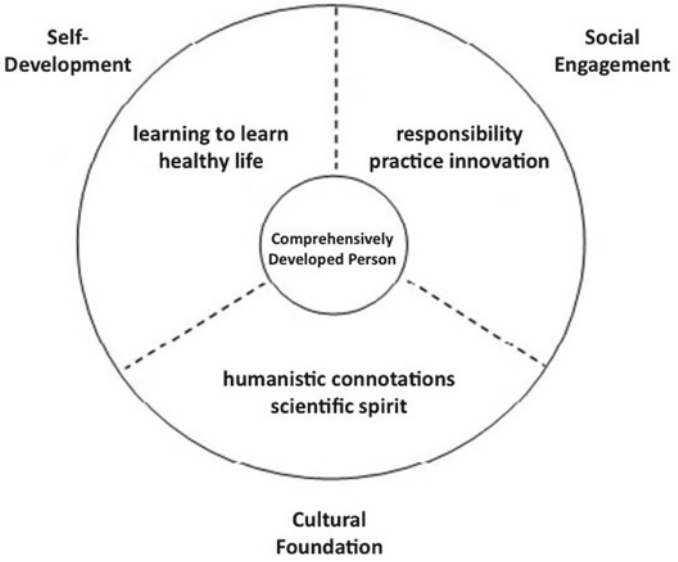

Chart 5.1 The framework of key competences of Chinese students

and skills, including rational thinking, critical questioning, and having the courage to explore.

b. Self-Development

Autonomy is the fundamental nature of a human being. The key points of self-development are effectively managing one's own study and life, recognizing and discovering self-worth, exploring one's own potential, dealing with a complex and changing environment effectively, making life colorful, and ultimately, becoming a person who has a clear direction and enjoys their quality of life.

(1) **Learning to learn**. It means students' overall performance in learning consciousness formation, learning method selection, learning process evaluation and control, and so on. It specifically includes love to learn and being good at learning, frequent reflection, and information consciousness.
(2) **Healthy life**. It means students' comprehensive performance in self-cognition, physical and mental development, and life planning, including cherishing life, developing a healthy personality, and self-management.

c. Social Engagement

Sociality is the nature of man. Social engagement emphasizes the management of the relationship between self and society, complying with a code of morals and conduct which modern citizens must observe and perform, enhancing the sense of social responsibility, promoting an innovative spirit and practical ability,

promoting personal value and social development to be realized, and becoming a person with ideal beliefs and with the confidence to take on responsibility.

(1) **Responsibility**. Responsibility refers to students' emotional attitude, value orientation, and behavior mode in dealing with social relations, national relations, and international relations, including social responsibility, national identity, and international understanding.
(2) **Practice innovation**. Practice innovation refers to the practical ability, innovative consciousness and behavior in daily activities, and problem solving and adaptation challenges, including labor awareness, problem solving, and technical application (Table 5.2).

5.4 What Changes Will Key Competences Bring

Key competences are not only the change of classroom teaching, curriculum reform is definitely not as changing the curriculum, but the reform of the whole education system, which is the overall reform of the curriculum as the core of education mode. The key competences of student development answer the question of what kind of people China is educating. Establishing the key competences of students aims to drive forward the teaching reform of education. There needs to be an active discussion on what impact did the concept of key competences have on the education system in China.

5.4.1 Improve the Compilation of Textbooks and Provide Diversified Courses

To promote key competences used in teaching practice, it is necessary to emphasize the orientation of cultivating students' key competences when compiling textbooks. On the one hand, the traditional idea of "knowledge as the center" should be changed in the compilation of textbooks, which should reflect the cultivation of students' innovative practical ability, and guide their emotions, attitudes, values and other aspects. On the other hand, textbooks should break the thought of "subject-centered," especially when compiling interdisciplinary textbooks such as "science, society and art," it is necessary to break the discipline boundary and cultivate the comprehensive competences above the discipline. When compiling textbooks for a single subject, we should pay attention to the cultivation of discipline literacy, and provide discipline support for students, emphasizing more on the generation of comprehensive ability literacy, instead of focusing only on discipline knowledge and ignoring human integrity [19].

Curriculum is an important support for students' lifelong learning and key competences development. With the proposal of students' key competences and the efforts

Table 5.2 Basic contents and main features of key competences

Key competences		Basic contents	Main features
Cultural foundation	Humanistic connotation	Humanistic accumulation	Have the accumulation of basic knowledge and achievements in the field of humanities in ancient and modern China and abroad; Be able to understand and master the methods of understanding and practice embodied in humanistic thought.
		Humanistic feelings	Have a human-oriented consciousness, respect and safeguard human dignity and value; Be concerned about humanity's survival, development and well-being.
		Aesthetic taste	Accumulation of artistic knowledge, skills and methods; Be able to understand and respect the diversity of culture and art, and have the awareness and basic ability to discover, perceive, appreciate and evaluate beauty; Have a healthy aesthetic value orientation; Have the interest and awareness of artistic expression and creative expression, and be able to expand and sublimate beauty in life.
	Scientific spirit	Rational thinking	Advocate true knowledge, be able to understand and master basic scientific principles and methods; Respect facts and evidence, have an empirical awareness and rigorous intellectual attitude; Clear logic, able to use scientific thinking to understand things, solve problems, guide behavior, etc.
		Criticize and challenge	Be problem-aware; Be able to think and judge independently; be thoughtful, be able to analyze problems from multiple angles and dialectically, make choices and decisions, etc.
		Dare to explore	Be curious and imaginative; Be able to be fearless of difficulties and have a persistent spirit of exploration; Be able to experiment boldly and actively seek effective problem solutions.

(continued)

Table 5.2 (continued)

Key competences		Basic contents	Main features
Self-development	Learning to learn	Happy to learn and good at learning	Be able to correctly recognize and understand the value of learning, have a positive learning attitude and strong interest in learning; Be able to develop good study habits and master learning methods suitable for themselves; Able to learn independently, with the awareness and ability of lifelong learning, etc.
		Frequently reflection	Have the awareness and habit of examining their own learning status, and be good at summarizing experience; Be able to choose or adjust learning strategies and methods according to different situations and their own reality.
		Information awareness	Be able to consciously and effectively acquire, evaluate, identify, and use information; Have digital viability and actively adapt to the development trend of social informatization such as "Internet +"; Have network ethics and information security awareness, etc.
	Healthy life	Respecting life	Understand the meaning and value of life; Have safety awareness and self-protection ability; Master the exercise methods and skills suitable for yourself, and develop healthy and civilized behavior habits and lifestyles.
		Healthy personality	Process positive psychological qualities; be confident and self-appreciative, resilient, and optimistic; demonstrate self-control, be able to adjust and manage their own emotions, have the ability to resist setbacks, etc.
		Self-management	Be able to correctly understand and evaluate themselves; Choose the right development direction according to your own personality and potential; Rational allocation and use of time and energy; Continuous action to achieve goals, etc.

(continued)

Table 5.2 (continued)

Key competences		Basic contents	Main features
Social engagement	Responsibility	Social responsibility	Self-respect and self-discipline; polite, open to criticism, honest and friendly, and generous with others; respect for elders; with a heart of gratitude; enthusiastic about public welfare and volunteer service. dedicated to work; With team spirit and mutual help spirit; Be able to take the initiative, perform their duties, be responsible for themselves and others; be able to distinguish right from wrong, have a sense of rules and rule of laws, actively perform civic obligations, and rationally exercise civil rights; Advocating freedom and equality, and upholding social fairness and justice; Love and respect nature, have green lifestyle and sustainable development concepts and actions, etc.
		National identity	With national consciousness, understanding national history, accept own national identity, being able to consciously defend national sovereignty, dignity, and interests; having cultural confidence and respect for the excellent civilization achievements of the Chinese nation, and being able to spread and carry forward the excellent traditional Chinese culture and advanced socialist culture; Understand the history and glorious traditions of the Communist Party of China, and have the consciousness and actions of loving and supporting the Party; Understand, accept and consciously practice the core values of socialism, have the common ideal of socialism with Chinese characteristics, and have the belief and action to make unremitting efforts to realize the Chinese dream of the great rejuvenation of the Chinese nation.
		International understanding	Have global awareness and open mind, understanding the process of human civilization and world development; being able to respect the diversity and differences of the world's diverse cultures; actively participate in cross-cultural exchanges; Pay attention to global challenges facing mankind and understanding the connotation and value of a community with shared future for mankind.

(continued)

Table 5.2 (continued)

Key competences		Basic contents	Main features
	Practice innovation	Labor consciousness	Respect labor, have a positive working attitude and good working habits; Have hands-on operation ability and master certain labor skills; In the housework, production labor, public welfare activities and social practice in which they actively participate, have the awareness of improving and innovating working methods and improving labor efficiency; Have the awareness and action to create a successful life through honest and legal labor, etc.
		Problem solution	Good at discovering and proposing problems, with interest and enthusiasm for problem-solving; Be able to choose and develop reasonable solutions based on specific situations and specific conditions; Ability to operate in complex environments, etc.
		Technology application	Understand the organic connection between technology and human civilization; have the interest and willingness to learn and master technology; Process engineering thinking; be able to transform ideas and programs into tangible goods, or improving and optimizing existing objects.

of schools to make key competences school-based, many schools have optimized and integrated school resources, social resources, teacher resources and student resources in recent years. On the basis of existing courses, Diversified courses such as scientific courses, art and sports skills courses, humanistic literacy courses, language tools courses, technical courses, discipline expansion courses, experience and perception courses, and cultural exchange courses have been formed. Such as the "model culture" course in Qingdao second middle school, after taking part in activities such as the model United Nations conference, model economic association, moot court, model journalism competition, and so on, students can use their knowledge and intelligence to think and solve pressing international issues like a real diplomat.

5.4.2 Strengthening Teacher Resources and Expanding School Resources

Schools and universities have established close cooperation in developing diversified curricula. In order to provide high-end intellectual support and an excellent incubation platform for the growth of innovative talents, many schools have connected with universities to establish modern laboratory groups such as mechanical engineering, robotics, engineering workshop, human health, new energy vehicles, and modern biological tissue culture [21]. At the same time, the school makes full use of university and social resources, "recruit" university teachers to teach in primary and secondary schools, and set up teacher guidance teams for scientific innovation, robotics and models, engineering technological innovation, environmental protection and new energy, invention creativity, humanistic innovation, etc., to provide students with more professional guidance and help. In cooperation with social enterprises, the schools set up an experimental base for student innovation, students can carry out their investigation to visit and research on the base and get effective guidance from the experts [20]. For example, Hangzhou second middle school has a number of collaborative projects with various agencies, such as Iflytek Co. Ltd, Zhejiang Police College, and Hangzhou Normal University.

5.4.3 Pay Attention to the Accumulation of Key Competences

Key competences have a certain cumulative generation, which indicates that the formation of key competences has stages, and needs to be constantly developed and improved. Students reflect different levels of development. The overall framework of key competences contains a series of specific indicators, which are integrated together, and the performance of each indicator varies in different years and situations. In terms of "morality," primary schools are more about gratitude and integrity, while middle schools are more about responsibility and responsibility. In terms of

"independence," primary school emphasis more about developing children's self-confidence, while middle school emphasis more about resistance and persistence. Therefore, in the process of cultivating the key competences, Key competences should be refined according to the age characteristics and development rules of students and teach them in accordance with their aptitude.

Taking Chinese language teaching as an example, Chinese teaching should carry out the whole life education ideology and put students' ongoing development as a priority. Language is the foundation of a person's survival and development. It is through listening, speaking, reading, and writing that people communicate with the outside world (nature, others, and society), constantly enriching and developing their inner world, opening up the free space of the spirit, and developing the imagination and creativity of oneself. In the information society of the future, owing to the increased pace of knowledge change and social development, people's careers, status, and roles are characterized by variability and diversity [29]. Therefore, Chinese language teaching should move from merely the accumulation of knowledge to promoting the development of students' abilities, to promote students' sustainable development. In the teaching process, teachers should pay more attention to cultivating students' self-studying ability, developing confidence in the subject and good study habits, mastering the basic learning methods, making students enjoy Chinese and learn how to learn Chinese, and laying the foundation for their lifelong learning. This is closely integrated with the "learning" and "information" categories of the "eight qualities."

5.4.4 Enhance the Cultivation of Key Competences in Informal Learning

The establishment of core competences is based on the needs of students for lifelong learning and social development. The concept of key competences breaks the existing pattern of education. It advocates that education is not only the acquisition of teaching and learning methods in classroom teaching, but also the cultivation of core competences such as humanistic culture and social participation. For example, encouraging children to do what they can do in meaningful social practice such as community service and volunteering, thereby improving their social responsibilities. For example, tomb sweeping in Qingming Cemetery is a type of traditional patriotic education. Taking care of the elderly can develop students' love and kindness. Participating in various kinds of agricultural work can help students to acquire a good work ethic and a sense of responsibility. Developing core competences is not limited only to the school classroom. The school should establish an effective network of social activities according to local conditions, to encourage students to go out of the classroom as much as possible, so that students can learn and grow in activities and practice in reality.

5.5 How Do Key Competences Affect Current Educational Practice in China

5.5.1 Schools Play a Pivotal Role in Implementing Key Competences

The role of schools is undergoing a great transformation as a result of recent changes in these competences. The first transformation is from the concept of running a school to the school curriculum plan, from the education concept, intention of cultivation of person to a systematic and organized school curriculum system. After the transformation, the curriculum structure of school planning is to be obtained, which is also the map of the school curriculum. From students' development quality, the school curriculum structure is planned by surrounding with the structure of students' key competences.

When establishing the curriculum system, the school needs to consider the requirements of the university entrance exams (both in China and abroad), and these needs should be integrated into the curriculum structure of the school. Schools should build the curriculum based on the demand for educational value and the fundamental mission of education. It has been more than ten years since the reform of the high school curriculum. Many high schools have made efforts to offer many school-based courses, as well as complete school curriculum plans.

Students' core competences, therefore, are what the school wants each student to develop and achieve. However, these shared qualities do not mean that every student attains an equal level of quality. For the same quality, different students may have different ways of realizing it. The value of the school curriculum is to translate the common qualities into an individual quality system which adapts to the characteristics and needs of students. In this transformational process, it is important to implement the curriculum selectivity and provide hierarchical teaching.

In the new curriculum reform, high school courses based on the liberal arts branch increase elective module, to adapt to the different needs of different students on the course. Following the reform of the college entrance examination system, the division of arts and science no longer exists in high school. For high school students, in principle, they can combine subjects independently, which means an increased focus on students' key competences. For example, many colleges and universities in China now offer school courses and various elective courses, so that students can focus on developing their own interests and develop their own potential beyond merely completing the tasks. For these students, providing each of them with different courses is a way to emphasize their key competences. Even with the same quality, different students may improve it through different courses. At the same time, many schools also carry out hierarchical teaching according to the level of learning, and students are divided into different classes or groups to learn different subjects.

5.5.2 The Way to Evaluate Students Learning and Test has been Changed According to Key Competences

One of the most important measures to promote the evaluation reform based on the key competences criteria is to evaluate students according to their academic quality standards. Academic quality standard is the organic combination of key competences and curriculum content. According to the academic quality standard developed by the key competency system, the main result is that students should achieve certain standards after completing the learning content at different learning stages, grades, and subjects. Evaluation based on the academic quality standard has a great advantage over traditional examinations [26]. On the one hand, the academic quality standard is a part of the curriculum standard and it is closely integrated with the course content. It can reflect students' standard of performance and evaluate them according to the academic quality standard, which can effectively solve this problem. On the other hand, the academic quality standard based on key competences can be used to direct education evaluation, which can then be promoted to break the restrictions of subject learning and make the comprehensive evaluation of interdisciplinary ability possible. As the ability to solve problems is one of the important qualities of students in science, math, and social disciplines, combined with each subject, the academic quality standard can develop the grading ability performance of this quality to evaluate both quality and ability.

Moreover, the reform of exam content needs to reflect the transformation from knowledge-oriented measurement to ability- and quality-oriented measurement. It includes a two-way checklist which can examine knowledge and ability, giving a functional orientation for each test question. When setting questions, we need to ensure the authenticity of the item materials, which should closely resemble the actual situation in society, economics, and science, to help students solve problems in real life. We also need to be realistic about the subject difficulty and length of the exams, as well as reducing the number of questions that rely on complex calculations or memory, giving students more space to think and encouraging open and creative answers. Following the exams, we need to carefully explore the students' cognitive structures and problem-solving strategies hidden under the scores.

The last, innovative evaluation methods need to be explored to ensure the key competences are oriented to test evaluation. At present, there are two main ways of evaluating students' academic competence and quality. First, the method is based on large-scale testing, including students' academic achievement tests and any related questionnaire surveys. The former is mainly based on using academic quality standards to test students' academic achievements. The latter is mainly based on testing students' interest in learning and their physical and mental states, emotional attitude, and values. The second is the evaluation method based on daily data accumulation, which mainly involves observing students, performance evaluation, and other methods. When integrating students' homework, it is not only about the interest, knowledge, effective training, and skills of student work, but also more about the student's understanding of education, understanding life, and understanding of their

emotional and moral life. Therefore, there should be an awareness of this in the task design, content, and form. In terms of the evaluation of homework, which looks at children's attitude to do homework, there should be more humanistic consciousness for children.

5.5.3 *Teacher Training Plan has been Adjusted According to Key Competences*

Teaching is a combination of teaching and learning. It is a learning community consisting of teachers and students. The key competences of students' development are developing alongside new social development. Teachers' professional skills are also changing, so it is imperative to strengthen teacher training. National teacher training Plan has developed comprehensively according to key competences. The "National Teacher Training Plan" is a major national project for implementing educational development with the aim of comprehensively improving the quality of teaching. The "National Teacher Training Plan" includes "the demonstration training program for primary and secondary school teachers" and "the training program for excellent rural teachers in the Midwest." The former so-called "demonstration," refers to the training that is directly organized by the national Ministry of Education and the national Ministry of Finance to the primary and secondary school teachers from all provinces, autonomous regions, and directly controlled municipalities, to make the direction of the financial investment and training demonstration to the national governments at all levels, to train the excellent teachers for the primary and secondary school teachers all over the country, and to provide a batch of teaching resources with high-quality training courses. The latter refers to targeted training for rural compulsory education teachers in the central and western regions of the country [22]. This aims to strengthen rural teacher training, to improve rural teachers' teaching ability and their professional level. The project mainly includes the short-term intensive training of rural primary and secondary school teachers and the remote training of rural primary and secondary school teachers.

Moreover, launch *the Project of Enhancing Quality of Teachers* to meet the needs of key competences teaching. At the new stage of further developing the reform of the training model for primary and secondary school teachers and enhancing the quality of training comprehensively, all regions of the country have actively adapted to the development of basic education curriculum reform and the realistic demand of implementing quality education comprehensively. According to the demand in different developing stages, such as pre-job training for new teachers, improving training for on-the-job teachers, and advanced studies for key teachers, targeted training is being carried out, to satisfy the needs of teachers' professional development and to guide teachers' professional growth.

The last, establish a provincial training institution of "tripartite synergy" to improve the overall level of teachers in the country. Promoting training platforms for

teachers in universities, municipal and county training institutions and provincial-level teachers' workshops aim to achieve the integration of research, training, and application and promote teacher training at all levels [20]. Combined with the local reality, relying on existing universities and teachers' professional academic power in comprehensive universities, participating in the basic education teacher training, enhancing the quality of the trainer team, improving training ability, and building a support system, guarantees the implementation of a long-term plan for teacher development [14]. At the same time, the teachers' training system and institutions can be established and improved, making full use of all the aspects such as institutional organization, academic leaders from institutions in universities, and first-rate teachers in primary and secondary schools.

5.6 Case Study: Practical Exploration based on Key Competences

Zhongguancun No. 3 primary school is a primary school located in Beijing, It is famous for its educational philosophy of true learning. After the announcement of the key competences for student development in China, it has made great efforts to implement key competences in the school. It believes that a student's time in school is relatively fixed, but the contents of the curriculum are increasing. The education goal of the school is to develop a "complete person," while the distinct boundaries of the subject system divide things. How can we get teachers out of these fixed classes and out of these similar teaching spaces? How can the learning mode reform of the national curriculum be a "dinner" for children?

(1) **Define the core competences dimensions of student development**

Zhongguancun No. 3 primary school has proposed three dimensions of students' development: (a) basic knowledge ability: the ability to learn and apply this knowledge; (b) interdisciplinary ability: comprehensive knowledge ability, exploration ability, discrimination ability, and cooperative communication ability; (c) the spirit of transcending the academic subject: outlook on life; world outlook and values; the ability to emerge in new fields; and establishment of positive behavior and good character.

(2) **Reset learning relationships and course systems for students**

To achieve the goal of helping students develop, Zhongguancun No. 3 primary school has reconstructed the learning relationship, making multiple environments with stable relationships for teachers and students. The students are put in mixed age "class + group" and "head teacher + tutor" teams, so that a teacher can monitor more students and a student is directed by more teachers (Fig. 5.2).

Moreover, in terms of courses, Zhongguancun No. 3 primary school established, a "class-unit–semester-year" learning chain, advocating that learning means life and

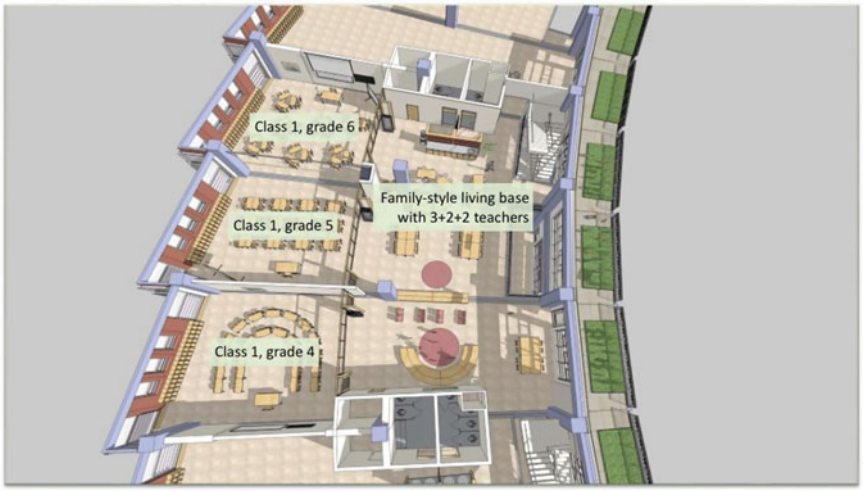

Fig. 5.2 Resetting the learning relationship

life means learning. Therefore, Zhongguancun No. 3 primary school integrated the original subject courses and formed six groups of courses, including (1) mathematics, engineering, science and technology, (2) performing arts, (3) visual arts, (4) language, (5) history and social sciences, and (6) physical education classes. In order to effectively manage the learning of six courses, it was necessary to integrate the basic course, expand certain courses and open other courses, and realize the subject integration, interdisciplinary connection, and multidisciplinary learning in a real learning situation. To achieve this goal, Zhongguancun No. 3 primary school adjusted the course template and changed the timetable (Fig. 5.3).

In addition to the above changes, Zhongguancun No. 3 primary school also allocated Tuesday afternoon to project learning, including research on school furniture, garbage collection and disposal, car design, and so on. This idea of project learning broke down the walls of the classroom. Different project researches have created more possibilities for more students to develop new learning partnerships. During

		Monday		Tuesday		Wednesday		Thursdays		Friday	
Part 1	8：00-9：30	Language	Chinese / English	mathematics engineering science and technology	Math / Science	mathematics engineering science and technology	Math / Science	Language	Chinese	interdisciplinary	Chinese / Music
	9：30-10：10	fitness exercises									
Part 2	10：10-11：40	interdisciplinary	Math / P. E.	interdisciplinary	Chinese	Language	Chinese / English	interdisciplinary	Math / P. E.	interdisciplinary	English / P. E.
	11：40-13：00	group activities + lunch									
	13：00-13：15	eye exercise+ broadcasting+ rest									
Part 3	13：20-14：50	interdisciplinary	Arts	Project learning		Language	Calligraphy	interdisciplinary	Moral Education	Optional course	

Fig. 5.3 The template of course arrangement

the process of researching, students learn to solve practical problems, acquire fundamental knowledge and skills, and develop their ability to communicate with others, along with other positive learning behaviors.

(3) **Graduation project: Change the way to evaluate students learning**

The proposal of key competences aims to promote the comprehensive and personalized development of students. It not only promotes the reform of curriculum concepts, but also provides an opportunity to adjust the curriculum evaluation standard scientifically. The new curriculum evaluation supported by key competences should actively establish the evaluation concept of "evaluating and serving the improvement of teaching and the personalized development of students," and refine the key competences into specific index systems and value dimensions that can be evaluated on the premise of referring to curriculum standards. Zhongguancun No. 3 primary school aims to measure the cultural and functional structure of students at the levels of participation, performance and outcome, so as to ensure the effective improvement of educational quality. The graduation project is an attempt to achieve the above goals.

The graduation project of Zhongguancun No. 3 primary school is known as a "1+1+1" project. Students are required to choose one subject each from categories A, B, and C to complete the graduation project, as shown in Table 5.3. It is important to note that every student has to participate in the community project in category C. The graduation project can be completed individually or as part of a team. The tutor team is composed of university professors, graduate students, and teachers.

Key competences proposed by China at the current stage is the trend of future basic education. Key competences have only been proposed for quite a short time in China, and the implementation of key competences is still under continuous exploration. However, it can be clearly seen that schools in China are actively exploring the key competences curriculum, teaching, evaluation, teacher training and other aspects to make key competences education suitable for local and school characteristics,

Table 5.3 Graduation project

Category	Curriculum domain
A	Language arts (Chinese, English, and other languages)
	Mathematics, science, technology, engineering, and information
	History and social sciences (including finance and law)
B	The visual arts
	The performing arts
	Active physical activity and healthy lifestyle
	Other growth experiences
C	Community welfare activities

Zhongguancun No. 3 primary school is just one of them, different schools will present different characteristics in the practical exploration.

5.7 Conclusion

In this chapter, we have discussed the brief history of key competences development in China, and presented the framework of key competences of Chinese student development, we also conducted an analysis of the impact of key competences on the Chinese education system and current education practices in China. We also presented a case study of practical exploration based on key competences, to show how schools implement key competence. Reviewing the history of curriculum reform in China, Chinese traditional education attaches importance to *Dual Foundation*, namely basic knowledge and basic skills, and later put forward *Three-Dimensional Objective*—knowledge and skills, process and methods, emotional attitudes and values. From *Dual Foundation* to *Three-Dimensional Objective*, and then to *Key Competences*, it is a different stage in the process from teaching to educating students. The emergence of the key competences of Chinese students' development reflects the latest achievements of the curriculum reform of basic education in the new era. It responds to the important concerns of the times on the basis of inheriting and surpassing the historical experience of curriculum reform in the past 70 years.

Key competences train students' correct values, necessary characters and key abilities for future development, guide students to clear the direction of their life, and cultivate socialist builders and successors with all-round development of morality, intelligence, physique, and aesthetic growth, advocating the socialist core values of prosperity, democracy, civilization, harmony, freedom, equality, justice, rule of law, patriotism, dedication, integrity, and friendliness. The new trend of key-competences-based education in China introduces the personal, cultural, and social dimensions into the list of the competences, paying considerable attention to the well-being of the students, hence it is a great step toward educating for wholeness of the person [31], and it provides a clear development direction and education blueprint for China's compulsory education practice in combination with China's local characteristics and the requirements of modern development. Key competences could guide Chinese education to achieve the transfer of teaching purposes, from teaching knowledge to the cultivation of student literacy, from the pursuit of scores, the one-sided pursuit of promotion rate to the cultivation of student's character and ability, establish the core concept of curriculum education, teaching and education, and make it an educational belief, so student development can be truly implemented. However, the new trend of competences-based education is not without issues and challenges in China. Curriculum reform, teaching reform, evaluation reform and teacher development based on key competences are major challenges that Chinese educational practitioners, researchers, and policymakers will face in the near future. Due to the complexity of education around the world, in the process of promoting and implementing key competences, it is necessary to coordinate and cooperate with

international organizations and economies, to build a support system for key competences education in the twenty-first century at different levels of the education system through a variety of ways.

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Chapter 6
England: Knowledge, Competences and Curriculum Reform—Why the English Case Stands Out

Gemma Moss, Ann Hodgson, and Susan Cousin

Abstract This chapter offers a very special case: in England, there is no education policy discourse focused on key competences and new literacies. School subjects belong to either a higher-status academic track or a lower-status vocational track. Pupils are pushed toward an academic track. Such an emphasis on academic—"powerful"—knowledge hinders development of key competences at school and leads to "teaching to the test." Key competences (e.g., critical thinking) can be integrated into subject content at the discretion of the teacher and the school. There are

A note from the editors:

This chapter was written by scholars from the Institute of Education at the University College London, one of the leading global centers in educational research. It describes a very special case: it is shown how the government can be not so much the engine of the new agenda in the curriculum, as its brake. This outstanding phenomenon illustrates a conflict between two influential vectors: the "back to basics" movement with its idea of a uniform set of basic knowledge mastered by every child, and the competence-based approach to education. The English case provides rich food for thought about the interplay of basic knowledge, the ability to apply it, and key competences.

Another theme of the chapter is England's attention to the school and the question of the relationship between academic and vocational tracks. The authors convincingly show that in early vocational education there are both needs and opportunities for the development of key competences.

The English experience of developing foundational skills of literacy and numeracy (tool-based instrumental literacy, as we call it in our framework) deserves a special attention.

Two more features should be highlighted, though they are not mentioned explicitly in the chapter. First, England's educational trajectory today is radically different from the trajectories of Scotland, Wales, and Northern Ireland, which are confidently heading for a competence-based approach. Second, our informal observations suggest that culture and traditions play a significant role in England, but they are taken for granted and therefore are not made explicit in curriculum documents (this may be especially true of practices aimed at the development of critical thinking and interaction with people skills). They fall outside the scope of policy analysis but may significantly affect the actual daily life of the school.

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many bottom-up innovations, often successful but difficult to scale up. The most sustained and successful attempts to change pedagogy and curriculum in England have combined in-depth analysis of data on student achievement and curriculum change with opportunities for continuous professional discussion of educational practices.

Keywords Key competences · New literacies · New labour's education policy · Curriculum reform in England · National literacy and numeracy strategies · Literacy hour · Post-16 curriculum · Vocational education · Core skills · London curriculum · Quasi-market school reforms

Highlights

- In England, there is no education policy discourse focused on key competences and new literacies.
- School subjects belong to either a higher-status academic track or a lower-status vocational track. Pupils are pushed toward an academic track. Such an emphasis on academic—"powerful"—knowledge hinders development of key competences at school and leads to "teaching to the test."
- Key competences (e.g., critical thinking) can be integrated into subject content at the discretion of the teacher and the school.
- There are many bottom-up innovations, often successful but difficult to scale up.
- The most sustained and successful attempts to change pedagogy and curriculum in England have combined in-depth analysis of data on student achievement and curriculum change with opportunities for continuous professional discussion of educational practices.

6.1 Background: Setting Curriculum Reform in England in the U.K. National Context

6.1.1 School Structures and Governance: England in the U.K. Context

Since the late 1990s, governance of the education system in the United Kingdom has been devolved to the four nations of the United Kingdom: England (population just over 55 million and site of the U.K. Parliament); Scotland (population 5.4 million); Wales (population 3.1 million); and Northern Ireland (population 1.9 million). England is unique among this group in pursuing what has been described as "an extreme example of high-autonomy–high-accountability quasi-market school reforms" [18]. Each nation takes its own decisions on school structures, curriculum organization, and assessment. Current arrangements reflect different histories and political settlements.

The main differences are:

- **Qualifications**

In England, Wales, and Northern Ireland, children take the General Certificate of Secondary Education (GCSE) examinations at age 16, though the grading is somewhat different in England. Those not leaving for employment or for vocational study then specialize and study three A-level subjects which are examined at age 18.

In Scotland, students study more subjects to the end-of-stage examinations, called Highers and Advanced Highers. If successful at age 17, they can transfer from school to a four-year university degree.

- **School structures**

In England, Wales, and Scotland, comprehensive secondary schools predominate.

In Northern Ireland, selection at age 11 is common, with pupils required to take a 11 plus exam to gain entry into selective academic track grammar schools (in England a few local authorities still select pupils for grammar schools at age 11). The Northern Irish system is also largely segregated on religious lines.

In England, government policy has increasingly encouraged the entry of new not-for-profit school suppliers (for example, academy chains; sponsored academies; converter academies; free schools; and university technical colleges [UTCs]). In parallel, the role of local authorities in running and supporting schools in their locality has reduced: current legislation prohibits them from opening new schools.

- **Early years provision**

In England, formal education and direct teaching are encouraged from entry to school at age 4–5. The other three nations encourage play-based learning in the early years.

6.1.2 The Organization of Education in England

Education in England is divided into five main stages as set out in Table 6.1.

Using this framework, the government regulates provision by:

- **Specifying the Early Years Foundation Stage** which all registered providers are expected to follow. The framework is non-statutory (that is, not a legal requirement) but is used by the Office for Standards in Education (Ofsted) in its inspections of registered providers.
- **Setting out National Curriculum programmes of study for Key Stages 1–4**. These are statutory requirements that state-funded schools under local authority control are required to follow between ages 5 and 16. In practice most academies and free schools also follow the same programmes of study.
- **Mandating tests in key stages 1 and 2** at age 6 (phonics screening check, with resits at age 7 for those who fail it); age 7, end of key stage 1 tests in English, math, and science; and age 11, end of key stage 2 tests in English, math, and science.

Table 6.1 Structure of education in England

Stage	Year/grade	Typical age	Type of institution	Assessment	Accountability measure
Early years foundation stage	Preschool and nursery education	0–5	Preschool settings	Early years foundation stage profile	
Reception	R	4–5	Infant/primary school		Baseline profile (TBC)
Key stage 1	Year 1	5–6		Phonics check	% pass/fail
	Year 2	6–7		KS1 Sats	% pupils at floor standard
Key stage 2	Year 3	7–8	Junior/primary school		
	Year 4	8–9		Multiplication tables check	No expected standard
	Year 5	9–10			
	Year 6	10–11		KS2 Sats	% pupils at floor standard
Key stage 3	Year 7	11–12	Secondary school		
	Year 8	12–13			
	Year 9	13–14			
Key stage 4	Year 10	14–15			
	Year 11	15–16		GCSE[a]/Ebacc[b]	% pupils at floor standard
Key stage 5	Years 12–13	16–18	6th form, secondary school	A levels[c]; vocational qualifications:	
Post—16			6th form college; further education college	BTEC/CGLI; International Baccalaureate	

Note a. Level 2: GCSE grades 5–9; Level 1: GCSE grades 1–4. b. A school accountability measure recording how many students achieved five grade 5–9 passes in English, math, science, a language, history, or geography. c. Level 3: Advanced Level examinations (A levels)

School results in English and math are placed in the public domain and used to compare schools against the national average. A Reception Baseline Assessment has been introduced to measure progress pupils make between the start and end of primary education.

- **Holding schools to account for the numbers of pupils passing GCSE at key stage 4** with good grades (5–9) in particular subjects (the EBacc) and for the progress they have made between key stage 2 and key stage 4.
- **Creating high penalties for failure to meet target**. Schools judged not to meet floor standards after inspection can be placed in special measures, leading to a new governing body and head teacher and change of staff and ultimately enforced academization.

In the English system, this combination of curriculum specification, performance data, floor standards, targets, and the inspection regime means schools are held accountable for pupil performance across the key stages 1–4. Despite widespread concern that this has led to too much "teaching to the test" [23], the high-accountability measures remain in place.

Students in England may leave school for work with a substantial training element at age 16, but otherwise they are now required to stay in education or work-based training until age 18. All pupils take end of stage examinations at 16 (GCSEs or their equivalents) which act as qualifications for further study or eventual employment. Pupils staying on in education post 16 can follow an academic track to age 18 at 11–18 schools or 16–18 sixth-form colleges, taking A-level exams as their end-of-stage qualification; they can pursue vocational qualifications at further education colleges; or opt for apprenticeships with work-based training providers or employers.

There are a small number of recently introduced UTCs and studio schools catering for 14–19-year-olds wanting to take a more vocational and technical study programme earlier than post 16. However, changing institutions at age 14 is unusual in England and the curriculum and assessment frameworks in place are not fully tailored to these alternative patterns of provision [21, 35].

6.1.3 Curriculum and Assessment in the English School System: Where the Emphasis Rests

The National Curriculum, introduced in 1988, was designed to ensure that all students studied both arts and sciences until age 16 (Previously students had chosen between arts or science tracks at age 14). It also replaced a two-tier system of examination at age 16, (consisting of O Levels, intended as preparation for A levels, and CSEs, intended to accredit students who might well leave school for work or vocational study at age 16) with a single examination called the GCSE. See Table 6.2 for an outline of the subjects studied up to 16.

Although only three foundation subjects are compulsory in key stage 4, the EBacc—a measure of entry and attainment at key stage 4 used in performance tables—requires schools to teach students to exam level in a language and history or geography, alongside the core subjects of English, math, and science. Students are also entitled to study at least one subject from each of the following areas, leading to an approved qualification:

- The arts (comprising art and design, music, dance, drama, and media arts),
- Design and technology,
- The humanities (comprising geography and history),
- Modern foreign language.

Those passing the requisite examinations at age 16 can continue to in-depth study of a small number of subjects at A level. Most students on an academic track study

Table 6.2 Structure of the National Curriculum and exam entry in english schools, ages 5–16

		Key stage 1	Key stage 2	Key stage 3	Key stage 4
	Age	5–7	7–11	11–14	14–16
	Year groups	1–2	3–6	7–9	10–11
Core subjects	English	✓ *x*	✓ *x*	✓	✓ *x*
	Mathematics	✓ *x*	✓ *x*	✓	✓ *x*
	Science	✓	✓	✓	✓ *x*
Foundation subjects	Art and design	✓	✓	✓	
	Citizenship			✓	✓
	Computing	✓	✓	✓	✓
	Design and technology	✓	✓	✓	
	Languages		✓	✓	*X*
	Geography	✓	✓	✓	Either *x*
	History	✓	✓	✓	or *x*
	Music	✓	✓	✓	
Additional areas of study	Religious education	✓	✓	✓	✓
	Sex and relationship education			✓	✓

Note ✓ = Compulsory subjects at each key stage; *x* = High stakes assessment

just three advanced level subjects post 16, generally either arts or sciences, largely as preparation for single subject disciplinary study at university. This remains as the unchanging "gold standard" for education in England, driving much of the rest of the system.

Even though around 60% of English students do not pursue A levels post 16, high-quality vocational education has never been successfully planned into the English system to provide an equally high-status alternative route through education post 16.[1] The most recent policy has focused on preparing more students to continue their education into university. New Labour (1997–2010) set a goal of 50% of students doing so. Currently, just under 40% progress to higher education, double the number attending university in the 1970s.

The historically low status of vocational subjects in England, coupled with the difficulties of reconciling a vocational route through education pre-16 with a comprehensive and inclusive system of education, partly explains why key competences have low traction in English policy discourse. New Labour (1997–2010) placed great stress in their education policy on adopting a socially inclusive approach. They did so by

[1] The current Secretary of State is beginning to re-consider this with plans to introduce T levels as alternative vocational qualifications to A levels, in the near future. See Bolton [3, Sect. 1.5].

setting out to directly tackle the historic underperformance of children from socially disadvantaged backgrounds. At the start of New Labour's administration, this led to an emphasis on ensuring high-quality teaching in literacy and numeracy in every primary school.

In the secondary school, New Labour placed more value on introducing vocational equivalents to GCSEs believing they would help more children leave education with qualifications they could take to the labor market. Similarly, A levels were made more accessible by modularizing the curriculum and introducing a midcourse qualification known as an AS level that could be taken as a stand-alone qualification or could count toward the eventual grade at A level. Students were assessed through both coursework and external examinations.

However, because of the association with leaving school early, vocational education has continued to be regarded by many as no more than a route to lower paid jobs. In contrast, A levels are characterized as a period of knowledge-focused study that prepares the student for university, the life of the mind, and highly paid employment. On either side of this divide, little recognition has been given to specifying the many diverse competences that could be relevant to a modern working life or preparing children along these lines.

If New Labour's approach to the curriculum was driven by a desire for social inclusion—ensuring that more children from socially disadvantaged backgrounds would realize the benefits of qualifications they could take with them to the world of work or use to enter higher study—then the Coalition and Conservative administrations that have followed have adopted a "social mobility" approach. A high-status academic curriculum has been reinstated as the cornerstone to educational success on the expectation that, to achieve their full potential, all children must be judged against its exacting standards with those who reach them reaping its rewards, but with very little on offer for those who do not. Accordingly, the number of vocational equivalents to GCSEs recognized in the secondary sector has been significantly reduced, with much more emphasis placed in the accountability system on all students following an academic track to age 16. An additional ninth grade has been introduced at GCSE to further distinguish between high-achieving candidates. At the same time the modular approach to A levels has been rescinded with the reintroduction of a single final-stage exam.

Such an emphasis on academic achievement is designed to enlarge the pool of talent at the top while guarding against grade inflation. However, what has become increasingly urgent, yet much less well resourced, is what to do for those students who do not successfully follow an exacting academic track.

6.2 Key Competences and New Literacies? Curriculum Reform in England, 1997 to the Present day

In this section, we explore the relationship between knowledge content, key competences, and new literacies in New Labour's National Literacy and Numeracy Strategies. The strategies were introduced to primary schools in 1998 and ran in various forms until 2010. By that stage, they had changed into a Primary National Strategy and begun to support many more areas of the primary school curriculum and school management.

6.2.1 A Curriculum for the 21st Century? New Labour and the National Literacy and Numeracy Strategies 1997–2010

The National Literacy and Numeracy Strategies were at the heart of New Labour's education policy. They were part of a considerable investment in education which included:

- Rebuilding many schools, (the Building Schools for the Future initiative saw many older buildings replaced with priority given to rebuilding schools in areas of greatest disadvantage).
- Equipping schools for the digital age by providing a computer in every classroom, adequate wi-fi connectivity, a computer suite in every school, and funds to enhance the use of technology for teaching in every classroom (through, for example, interactive whiteboards; laptops; data projectors; school-based intranet; and peripherals such as tablets and visualizers).
- Experimenting with new ways of channeling more resources to those schools seen as operating in the most challenging circumstances (for example, Education Action Zones; the first academy schools, run by sponsors with the freedom to define their own ways of working and curriculum).

The intention was to use the National Literacy and Numeracy Strategies to raise standards across the board in English primary schools. The value orientation was for a uniform entitlement curriculum that would equip all children for the more specialist secondary school programmes of study that lay ahead.

The National Literacy and Numeracy Strategies had a major impact on primary schools and primary school pedagogy during their lifetime. They combined:

- New frameworks for teaching, specifying what should be taught and how, year by year[2];

[2] The Framework specification (3rd edition, 2001), set out by year, can be downloaded from (available October 16, 2017): http://dera.ioe.ac.uk/4699/2/nls_fwk050001objectives.pdf

- Assessment, targets, and monitoring regimes that ensured the strategies were fully implemented;
- Resources and training to put the programmes into place and maintain them;
- Data for decision-making that would travel up to the dedicated central strategy team who could then initiate further developments or make other adjustments from their base in the Department for Education and Skills; and
- Ongoing support to schools provided by an infrastructure of locally based consultants who were in turn managed by the central team (See [14] for a comparison to other large-scale education reform programmes).

Using a combination of "challenge and support," both strategies emphasized reintroducing high-quality whole-class and small-group pedagogy to English primary schools, setting explicit instructional goals that were driven by high expectations of what every child could achieve [34]. For accountability purposes, schools' results were compared to other schools working in similar circumstances. Significant underperformance would incur both challenge and support for improvement from the local strategy teams, with inspection by Ofsted able to instigate further change if a school was considered to be failing.

The Literacy Framework introduced the concept of the **Literacy Hour** to English schools. This created a dedicated period for literacy teaching every day, focused on teaching the skills of reading, writing, and verbal communication (speaking and listening). The hour specified that teacher planning should cover word-, sentence-, and text-level objectives and be delivered in a sequence moving through whole-class, independent or group work, and plenary phases. This structure created the means for the teacher to provide dedicated support for each group of pupils in meeting the same objectives over the course of a week and represented a radical change from previous teaching practice in English primary schools through the way in which it balanced whole-class with small-group work.

The framework defined literacy in terms of the breadth and depth of pupil knowledge, skills, and understanding of "language in both oral and written forms."[3] Text-level objectives drew on genre theory to specify the range of texts pupils should learn to read and write, with levels specifying how children should progress as they moved toward the target of 80% of pupils reaching level 4 by the end of primary school. Detailed teaching objectives for each term of each year were set out in the framework document.

Teaching materials that could support such objectives were supplied by the National Literacy Strategy (NLS) central team, with teachers encouraged to share good resources locally using cluster meetings led by regional consultants or via their schools' intranet. The strategy website increasingly acted as a national hub to

[3] Based on the premise that behaviours change beliefs [34], the combination of curriculum specification and the tight pattern of daily delivery that the strategies introduced effectively reorganized the expected pattern of teaching in primary schools, placing far more emphasis on whole-class teaching planned to match the curriculum aims and objectives. NLS Framework. introduction (3rd edition) downloaded from (available October 16, 2017): http://dera.ioe.ac.uk/4699/1/nls_fwk050001rationale.pdf.

distribute curriculum materials and provide resources designed to support teacher planning, curriculum innovation, pedagogy, leadership, and continuing professional development (CPD).

Integrating information and communication technology (ICT) into curriculum pedagogy and planning became an increasingly important theme to enable both teachers and pupils to be digitally literate and design and use digital resources effectively.[4]

6.2.2 Data and Reform: The Trajectory to Change

At first, the strategies experienced considerable success, and pupil performance rose sharply, but in concert with other large-scale reform programmes (see [22]) results then plateaued just short of the targets set. Although the shortfall was not large (79% of students reached level 4 in English against a target of 80%, then raised to 85%[5]) media coverage reported this as policy failure. As time went on, the Numeracy and Literacy Strategy teams made great efforts to identify new areas for intervention and support, they weakened top-down regulation of working practices, and encouraged teachers to exercise more agency in their planning. However, the longer pupil performance remained short of the expected targets, the more political support for the strategies began to drain away.

As difficulties in managing public expectations multiplied for New Labour [24], the government increasingly sought to place some distance between themselves and the school system. They turned instead to "**quasi-market**" **solutions** and new players such as academy chains, who could be contracted to manage the problems for them. This approach has become more pronounced under successor administrations. Coalition and Conservative governments dismantled the centralized support structures that New Labour had put in place, and intensified attempts to create a marketplace for innovation and reform.

The drivers remain the high-accountability measures against which school performance is judged. Successful schools are expected to act as innovation incubators, although with so many now outside of local authority control, their structural relationship with their peers is unclear; unsuccessful schools can be placed directly into academy chains who take on the responsibility for sorting things out. Such changes in direction at the center have affected how schools and colleges address the challenges of equipping students to meet the new demands society places upon them in terms of knowledge competences and new literacies. In practice, high-stakes accountability

[4] See for instance, *ICT across the curriculum: ICT in English: Key Stage 3.* (2004) downloaded from (available October 16, 2017): http://dera.ioe.ac.uk/5257/97/sec_ict_en_train_pck_Redacted.pdf.

[5] More than 80 percent of students reached level 4 in reading but not in writing. In hindsight expecting writing skills to develop in tandem with, rather than behind, reading skills is not well supported by research evidence.

pressures have militated against much innovation that can successfully spread from school to school.

6.2.3 *Why Key Competences and New Literacies Occupy Such Little Space in Educational Discourse in England*

Throughout the lifetime of the New Labour administration most weight in the assessment and accountability system in the primary phase rested with improving children's performance in literacy and numeracy tests at key stage 1 (age 7) and key stage 2 (age 11). This was seen as crucial in enhancing attainment higher up the system.

The kinds of transversal competences that are the subject of this project were not explicitly emphasized, though communication skills were embedded into the speaking and listening strand of the literacy curriculum, and critical thinking skills were promoted, for example, in problem-solving tasks in numeracy. Key competences and literacies regarded as essential for full participation in wider society (health literacy, financial literacy, collaboration, communication, and creativity) were addressed through lessons in Personal Social and Health Education and Citizenship. However, these subjects were not statutory (that is, schools are not legally bound to follow them).[6] Moreover, they remained at the periphery of school planning, as they formed no part of the accountability measures by which schools' performance was judged.

In the closing years of the New Labour administration, the Qualifications and Curriculum Authority (QCDA), a regulatory body with independent oversight of the National Curriculum and its assessment (since abolished), devised a more integrated curriculum that made explicit reference to transferable competences (see Annex for a summary of how definitions of curriculum values, aims, and purposes have changed over time since 1988). Holding more in common with curriculum reforms elsewhere, the revised National Curriculum had among its aims, to "widen horizons and raise aspirations about the world of work" and "make children more aware of, and engaged with, their local, national, and international communities" [30, p. 5].[7]

The curriculum was divided into "Essentials for learning and life" (competences considered as a necessary set of tools) and Learning Areas (disciplinary content that children should master). The essentials were defined as "the skills, attitudes, and dispositions that children need to become well-rounded individuals and lifelong learners" [30, p. 14] and were listed as:

- Literacy,
- Numeracy,

[6] For the current government's curriculum guidance for citizenship education in primary schools see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/402173/Programme_of_Study_KS1_and_2.pdf (Downloaded 16/10/17).

[7] Available from http://www.ibe.unesco.org/curricula/unitedkingdom/enk_prfw_2010_eng.pdf (Downloaded 16/10/17).

- ICT capability,
- Learning and thinking skills,
- Personal and emotional skills, and
- Social skills.

The Learning Areas grouped subjects together under these headings (each Learning Area included a range of transferable competences):

- Understanding the arts,
- Understanding English,
- Communication and languages,
- Historical, geographical, and social understanding,
- Mathematical understanding,
- Understanding physical development, health, and well-being,
- Scientific and technological understanding,
- Religious education.

However, before the new curriculum could be introduced the government changed. The revised curriculum was never implemented, the strategy team was disbanded and its materials were withdrawn. The QCDA was abolished shortly thereafter.

The incoming Coalition and Conservative administrations have in many respects sought to create ideological clear water between themselves and New Labour in their approach to education. They have distanced themselves from what went before by championing different methods of teaching reading (for example, the use of synthetic phonics which has now come to dominate the early years literacy curriculum and testing) and by placing more emphasis in the secondary sector on an academic track curriculum based on "powerful knowledge." In government rhetoric, the role of the curriculum in fostering communication, collaboration, critical thinking, and creativity has been replaced by a preference for an openly didactic style of teaching which valorizes rote learning and conceptualizes the curriculum in terms of information to be transmitted rather than competences to be acquired. This is presented as a more rigorous and therefore a more valuable approach. This has been supplemented by a discourse of character, grit, and resilience that draws from the nineteenth-century independent school system and is based on an understanding that education is competitive and there will be winners and losers.

In terms of pre-service teacher training, government guidance now very much emphasizes the teacher's subject knowledge, rather than knowledge of child development, as the prerequisite for high-quality teaching. At the same time, craft routes into teaching that bypass university-based education departments have also been encouraged. Although transferable competences, such as critical literacy, can still be integrated into knowledge content at the discretion of the teacher and the school, work-related competences find little mention in National Curriculum programmes of study. The high-status academic versus low-status vocational divide makes them liable to be defined as low skills, with limited transferability and serving little purpose in a race to push more students through an academic track with the pressures of selection and competition that this brings.

In a high-accountability, high-autonomy, quasi-market system, room for interested parties to suggest new ways of incorporating "essential life skills" into the school curriculum now rests with an array of knowledge brokers who operate in a market for curriculum ideas, speaking to schools who are highly geared to meeting the performance targets the government sets them [6]. Under these conditions only some schools are in a position to take risks and look beyond teaching to the test to ensure their own survival [1].

6.2.4 Locally Driven Initiatives and Education for Employment in a Rapidly Changing World

In all this change there has been very little concerted discussion between government and other stakeholders over how the content of the curriculum should best prepare all children for the future. Instead, the academy programme, first introduced by New Labour, has provided the opportunity for businesses to sponsor academies and given them the freedom to design their own curricula. In some areas this has led to more creative engagement with large local employers.[8] Elsewhere, other interested parties have tried to devise more opportunities to ensure children are equipped with high-quality engineering and technical skills. UTCs are a good example, a new type of 14–19 school, which was driven by the interests of a former Secretary of State for Education, and has emerged as a new way of offering the kind of higher-status vocational track one might find in other countries.[9]

However, such initiatives are driven locally and individually rather than nationally. They take place against the backdrop of a system of assessment and accountability which in practice keeps many institutions, including academies, sticking to the National Curriculum, and, in an effort to meet the floor targets and standards they have been set at age 16, delivering an academic curriculum to all students.

6.3 Key Competences and Skills in Upper Secondary Education

In this section, we examine why it has been so difficult in England to modernize and enrich the upper secondary (14–19) curriculum under a range of different governments. In many ways this is linked to the historically high-status accorded the

[8] See the Royal Society of Arts area-based curriculum initiative, Peterborough. https://www.thersa.org/globalassets/pdfs/reports/rsa_abc_peterborough_independent_evaluation.pdf.

[9] See the UTCs initiative, started by a Conservative ex-Minister for Education http://www.utcolleges.org/ and http://www.edge.co.uk/projects/institutions/university-technical-colleges.

academic track in secondary education in England, with only those preparing for university expected to stay on in school beyond the age of 16, up until the relatively recent past.

6.3.1 Enriching and Modernizing the Post 16 Curriculum: How the Past Shapes the Future

From the late 1980s numerous proposals from a range of civil society organizations, thinktanks, independent government committees, and governments in opposition in England have repeatedly raised the question of how to prepare all young people for the demands of working and adult life in the challenging global economic context of the twenty-first century (see [20], p. 19–38). These have stemmed from a concern to modernize the secondary curriculum even as the age at which pupils are expected to leave school has risen. This has led to powerful debates over how to meet the needs of a changing economy (that is, globalization, the rise of new technologies and digitalization, artificial intelligence and robotics, and a move from a manufacturing to a service sector base in England), to cope with the increasingly diverse nature of the population in England; and to cater for the growth in the number of young people staying on in education and training up to the age of 18.

Most of these debates have centered around.

- The need for a broader curriculum to tackle the narrowness of the dominant three A level programme and the early specialization it encourages;
- Tackling the divide between the academic and vocational tracks to ensure that the curriculum provides greater flexibility for 16–19-year-olds and that young people are able to change direction if they wished;
- Putting in place vocational qualifications that are intended to have the same status as GCSEs and A levels; and
- Developing a key set of "core," "key," "essential" skills, or a core curriculum that all 14–19-year-olds should take as part of their study programmes, whether as separate courses or integrated into the main curriculum for 14–19-year-olds.

Some of these proposals have been influential with the national government of the day, but none has ultimately stood the test of time.

6.3.2 Education 16–19: The Status Quo

From 2015 participation in some form of education or training to the age of 18 became compulsory for young people in England under legislation that was known as the Raising of the Participation Age (RPA). Yet, despite the RPA legislation, provision for 16–19-year-olds has not changed fundamentally. There is no National

Curriculum or even broad curriculum aims beyond the age of 16 and the reform of education for 16–19-year-olds has normally been treated as something separate from a secondary curriculum designed for pupils up to the age of 16 (see discussion of core skills below).[10]

In practice, each 16–19-year-old's programme is determined by their capacity to access an academic or vocational pathway, consisting of a small number of individual subject qualifications—normally three single subject A levels or a broad vocational equivalent.[11] Until 2013, there was no compulsion on either the education institution to offer or the young person to take anything other than these qualifications. Since 2013, there has been a small move toward a curriculum (as opposed to a free choice subject based) approach for 16–19-year-olds through the introduction of 16–19 Study Programmes. Alongside their chosen subjects, all 16–19-year-olds are now required to continue to study mathematics and English, if they have failed to gain an adequate GCSE grade in these subjects; have to be offered work experience "to give young people the opportunity to develop their career choices and to apply their skills in real working conditions"; and are expected to experience "other non-qualification activity to develop their character, skills, attitudes, and confidence, and to support progression" [10, p. 6].

The content of Study Programme has to be carefully monitored and recorded by schools and colleges offering provision to 16–19-year-olds. This is not only inspected rigorously by Ofsted but is also a requirement of funding. The introduction of 16–19 Study Programme may be considered a recognition by government that young people require more than the narrow diet of a small number of A Level subjects or their vocational equivalents to be able to function effectively in the twenty-first century, but it by no means signifies a real change in the direction of policy. This continues to preserve traditional qualifications and to hold schools and colleges to account primarily through these mechanisms.

[10] During 2002–2010, the New Labour administration began to try to align the last two years of secondary education (Years 10 and 11) more closely with upper secondary education (Years 12 and 13) through policies for 14–19 year olds. This 14–19 approach stopped immediately with the election of the Conservative/Liberal Democrat government in 2010 and policies once again reverted to those for secondary education (Years 7–11) and separate ones for upper secondary education (Years 12 and 13).

[11] For those who have not achieved adequate passes in their GCSEs at age 16 to progress to advanced level study, there are a number of broad vocational qualifications at intermediate level or below that can be taken, together with GCSE English and mathematics, as one- or two-year programmes to support post-16 learners eventually to progress to advanced level study, an apprenticeship, or employment. It is not possible to repeat a full GCSE programme beyond the age of 16.

6.3.3 *Conceptualizing Core Skills in a System Geared to the Academic Track*

Perhaps the best way of illustrating the difficulties in reaching a long-term conclusion to these debates and developments is through an examination of how the issue of "core skills" has been treated by successive governments. In 1989, the Confederation of British Industry (CBI) produced an influential report, "Toward a Skills Revolution" [4], which recommended that a broad range of "core skills" should be built into both academic and vocational qualifications for 16–19-year-olds and should influence the National Curriculum more generally. They were:

- Values and integrity,
- Effective communication,
- Applications of numeracy,
- Applications of technology,
- Understanding of work and the world,
- Personal and interpersonal skills,
- Problem solving, and
- Positive attitudes to change.

Although some schools and colleges in England participating in the government-funded Technical and Vocational Education Initiative (1988–1997) were already expected to develop some of these in a cross-curricular manner in their 14–18 curriculum, the CBI call was for something more universal. In response, the Conservative Secretary of State at that time asked the National Curriculum Council (NCC) and the body responsible for secondary-level examinations to provide him with advice on how core skills could be developed and examined across all programmes for 16–19-year-olds. The NCC reported in 1990, suggesting there should be six core skills:

- Communication,
- Problem solving,
- Personal skills,
- Numeracy,
- Information technology (IT),
- Modern language competence.

In the event, only three of these (Communication, Numeracy, and IT) went on to be developed and only in the new vocational qualifications—General National Vocational Qualifications—that were brought in 1992 as an alternative to A levels. Here, as several inspectors, researchers, and government committees reported, they proved problematic to teach, unpopular with students, and difficult to assess.

Despite this, the argument for core or key skills being introduced as a way of broadening and modernizing the curriculum, perhaps as part of a baccalaureate approach to replace the narrow three A level diet, did not die during the 1990s. It lived on in a number of reports by civil society organizations (for example, [17], National

Commission on Education, 1993, 1995; [31], Secondary Heads' Association 1993) and most notably in a report commissioned by government, "Review of Qualifications for 16–19" [7].[12] The Dearing Report recommended the development of three main key skills (Communication, Application of Number, and IT) to remedy weaknesses perceived in the pre-16 curriculum, and four wider key skills (Team Working, Interpersonal Skills, Problem Solving, and Managing One's Own Learning).

The three main key skills were subsequently developed into a free-standing qualification that was designed to be offered to all 16–19-year-olds as part of the new "Curriculum 2000" programme introduced by the New Labour Government in 2000.[13] However, the qualification was only mandatory for young people taking a vocational programme, with schools and colleges receiving funding if students took it. These imbalanced incentives caused huge tensions between young people and education providers with many students viewing the qualification as "pointless," "insulting," and "a waste of time" [19, p. 129].

Following a review of Curriculum 2000 by the QCDA in 2001, the government phased out the combined Key Skills Qualification and the wider key skills on the grounds that they could not be reliably assessed.

This experience of a short-lived attempted reform has subsequently been repeated many times. The three main key skills were given a central role.

(a) Within the unified diploma system recommended in the final report of the government-appointed independent Working Group for 14–19 Reform, chaired by Mike Tomlinson [36][14];
(b) In the subsequent 14–19 specialized diplomas[15] that were developed from 2005 for phased introduction to begin in 2008. As with the Key Skills Qualification before it, the New Labour government funded a hugely ambitious development programme, only for the 14–19 diplomas to be withdrawn in 2010 by the incoming Conservative/Liberal Democrat Coalition Government.

[12] Lord Dearing had already been tasked with reviewing the national curriculum, which ended at the age of 16, and was seen as a 'safe pair of hands' to take on a review of both the 16–19 curriculum and then, subsequently, higher education.

[13] While this reform was called 'Curriculum 2000' (because it was introduced in 2000) it was primarily a reform of qualifications for 16–19 years olds only.

[14] The unified diploma system outlined in the Tomlinson Report was designed to bring all qualifications for 14–19 year olds within one certification framework, gradually subsuming GCSEs, A levels, and broad vocational qualifications over time and creating a more common and mixed curriculum for all young people at the end of secondary education (Years 10–11) and into upper secondary education (Years 12–13). This proposal was rejected by the Prime Minister, Tony Blair, although it had been supported by the Secretary of State for Education. The reason for rejection was a concern about losing A-level qualifications, which were seen as the 'gold standard' within the English system.

[15] 14–19 specialized diplomas were sector based, vocational (that is, Engineering, Construction, and the Built Environment) "composite awards" comprising three "components"—principal learning; generic learning; additional specialist learning. They were designed for 14–19 year olds (Years 10–13) at three levels—Foundation (EQF L1); Intermediate (EQF Ls2/3); and Advanced (EQF L4). (See [20] Chap. 4 for more detail.

More recently, discussion of key or core skills has died down again, although, as we have seen earlier, English and mathematics are now a central part of the 16–19 study programmes in England. The idea of broadening the 14–19 curriculum has not gone away, not least because there is still a strong belief among education professionals, many civil society organizations, and some politicians that the post-16 curriculum with its emphasis on the academic track is too narrow, does not allow for a mix of theoretical and practical learning, and does not equip young people adequately for adult and working life in the uncertain world of the twenty-first century (for example, [2], Edge [15, 16], NUT/UCU [27, 32]).

6.3.4 Rethinking a Vocational Education Pathway for the Future

Proposals from these organizations all contain the seeds of a curriculum for the future, but in the current political context they are not likely to make much headway. While the present government recognizes the demands of the modern world and the need to become ever more competitive to survive and prosper as a nation, it is not the school curriculum as a whole that it has in its sights nor academic education, which it believes it has successfully reformed. Rather there is a strong belief that the problem lies within the vocational education and training track post-16:

> We face a major challenge: the pressing need for more highly skilled people trained effectively, to grow the economy and raise productivity… Forecasts suggest greater demand for higher-level technical and specialist skills in the future. Greater international competition and faster technological change will put many roles that exist today at risk. We need young people and adults to have the skills and knowledge that better equip them for employment in the 21st Century, in order to meet the demands of the future. (DFE/DBIS [12], p. 10)

The Post 16 Skills Plan [12] sets out the government's plans for reformed technical education that will sit alongside and separate from the academic route—see Figs. 6.1 and 6.2. This is where government attention and funding are now directed.

Figure 6.1 shows the shape of the new system and the two pathways. The transition year programmes, bridging courses, and higher-level awards noted in this figure will be developed later [11].

Figure 6.2 shows the employer-led qualifications that are now under development. It is proposed that these new "T Levels," as they are now being called, will be available at the advanced level only (EQF L4) in the first instance because their primary function is as an alternative to A levels for 16–19-year-olds.

6.4 Finding Local Solutions to National Problems

In the absence of national government policies to incorporate key competences and new literacies into the school curriculum, there continue to be numerous bottom-up

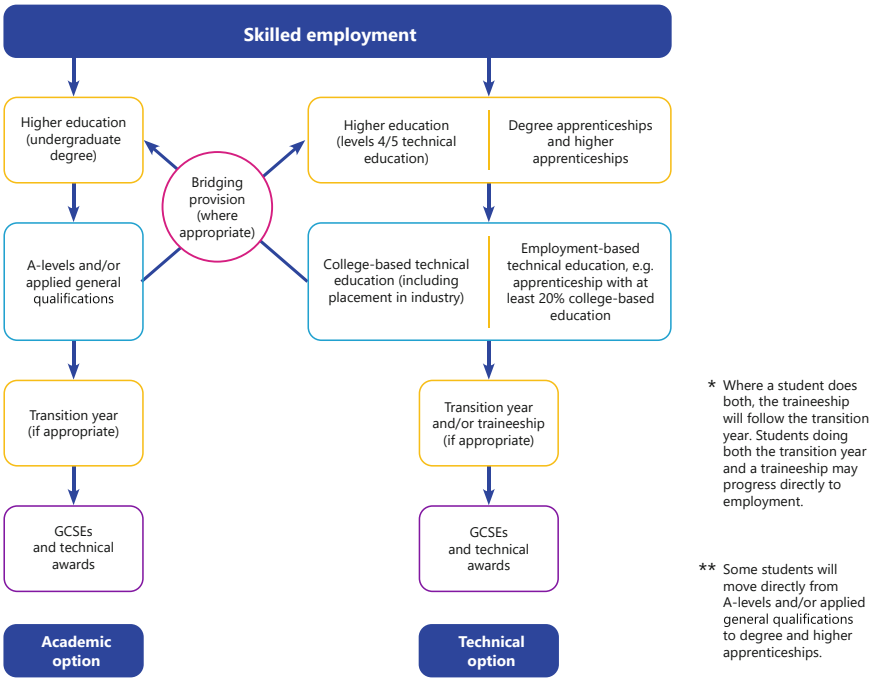

Fig. 6.1 The new post-16 options in England (reform from 2020)

initiatives by a range of organizations in England that in their different ways address the challenges of the future.

6.4.1 Innovating in the 14–19 Curriculum: Finding Local Solutions?

Several organizations are attempting to develop a broader approach to the 14–19 or 16–19 curriculum. Some do this through a focus on new qualifications[16]; others by re-engineering the relationship between vocational and academic skills in the curriculum. The Edge Foundation,[17] for instance, advocates for "high-quality technical and professional education that equips young people with the skills they need for today's global, digital economy." They believe that from the age of 14, "every

[16] See the National Bacc Trust (http://www.natbacctrust.org); Baker Dearing Trust (http://www.utcolleges.org/about/baker-dearing-educational-trust/); the Sixth Form Bac (https://www.sixthformcolleges.org/sites/default/files/a5_mailer_student_single.pdf); AQA Bac (http://www.aqa.org.uk/programmes/aqa-baccalaureate) International Baccalaureate (http://www.ibo.org), Barclays Lifeskills Programme (https://www.barclayslifeskills.com).

[17] Edge Foundation: http://www.edge.co.uk.

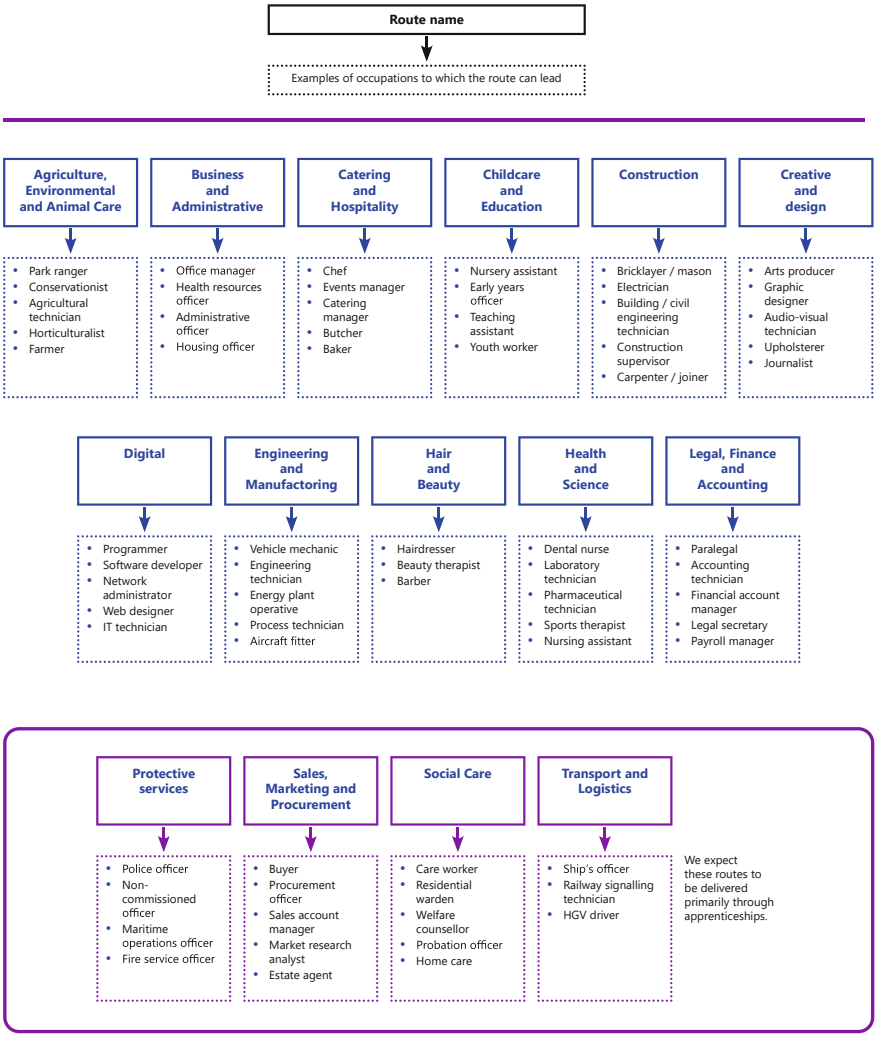

Fig. 6.2 The 15 proposed new T levels

young person should have the opportunity to study technical and creative subjects, alongside an academic core." To this end they support a variety of institutions and organizations committed to innovation in this area and operating at different scales. These include:

- Three academies that integrate into their curriculum the academic and the practical with business and enterprise;

- The Studio Schools Trust, an organization which involves local employers in devising an alternative school curriculum for the 14–19 age group combining academic study with work-based learning; and
- UTCs, a new form of institution which teaches 14–18-year-olds technical and scientific subjects to a high standard. They offer two main technical specializations and enjoy both employer and university sponsorship. UTCs work closely with their employer partners who offer work placements and equipment as well as expertise in the design of a technical curriculum to meet the needs of their industrial sector. Modeled on the German system, all UTCs are designed to meet the skills gap by combining technical, practical, and academic learning in new ways.

6.4.2 *Innovating Through the School Curriculum and School Ethos*

Other third-sector organizations[18] and some schools have taken the freedom that a high-autonomy, high-accountability, quasi-market system gives them to redesign their curriculum and incorporate the key competences and new literacies they consider important.

School 21

School 21,[19] for instance, has built a curriculum based on rebalancing "head, heart, and hand." This means designing a curriculum that provides students with the breadth of cognitive skills required to ensure academic success (head), the values and attitudes necessary to develop student well-being (heart), and the craft, creativity, and problem-solving skills (hand) that are integral to entrepreneurship. The school articulates how these different elements fit together using a jigsaw diagram (see Fig. 6.3).

Under the leadership of the head teacher, Peter Hyman, School 21 has established a clear set of principles for pedagogy and community engagement. This has created a community of teachers who work from a shared set of understandings and for common goals which are well-articulated and jointly owned. A core element of the curriculum involves well-structured project-based learning and design-based thinking. Against the policy trend they provide a well-rounded curriculum that does not sacrifice knowledge for skills. They comment on their website: "School 21 has developed a series of pedagogies and approaches that give students the chance to find

[18] For instance, the Royal Society of the Arts, has supported curriculum innovation: through sponsoring academies that have adopted the Open Minds programme, a competence-based and integrated curriculum in place in 200 schools http://www.rsaopeningminds.org.uk/; through developing area-based curricula https://www.thersa.org/action-and-research/rsa-projects/creative-learning-and-development-folder/area-based-curriculum; and through supporting projects based on innovative, experimental, and creative curricula https://www.thersa.org/action-and-research/rsa-projects/creative-learning-and-development-folder/innovative-education.

[19] http://www.school21.org.uk/.

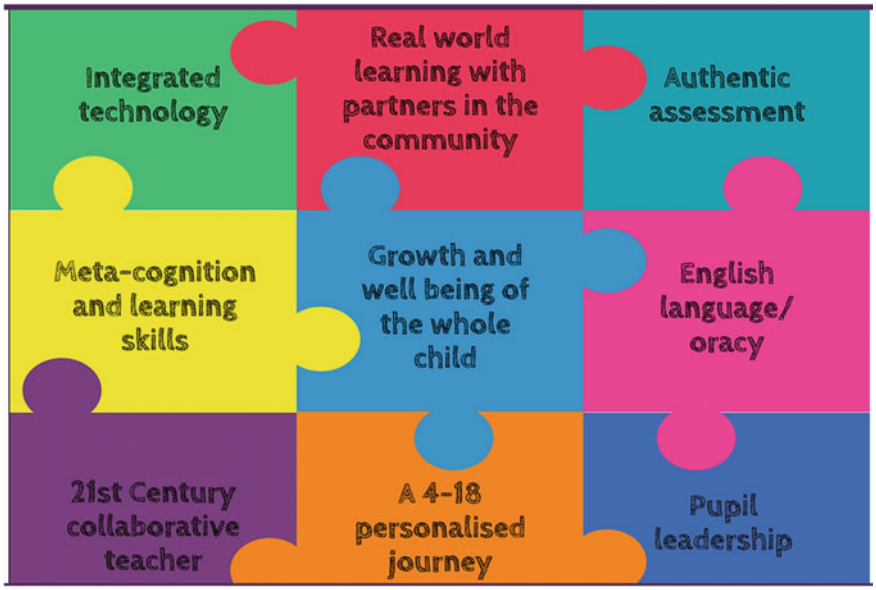

Fig. 6.3 School 21 jigsaw diagram

their voice, develop deep knowledge and understanding, and create beautiful work that has real value beyond the classroom."

Their status as a "free school" (government–funded but established with parental support outside of local authority structures) encourages them to innovate. They operate as a non-selective, state-funded 4–18 free school in an area of London that includes pockets of social deprivation. As a free school, they have control over their budget, and more freedom to experiment than other state-funded schools.

London Curriculum

In London, the Greater London Authority has developed a range of free teaching resources and lesson plans linked to the subject content of the National Curriculum at key stages 2 and 3. These encourage all London schools to use the city itself and its many cultural, scientific, and heritage institutions as an educational resource. These materials were developed in partnership with academics and other education experts from different fields and are designed to help schools bring children who otherwise might not do so to explore the city landscape and learn from it in a dynamic way. Three common principles underpin each resource, as the London Curriculum website[20] explains:

- **Discover**. Get your hands on exciting lesson plans and resources inspired by London.

[20] https://www.london.gov.uk/what-we-do/education-and-youth/london-curriculum/about-london-curriculum.

- **Explore**. Gives you the chance to extend your learning out of the classroom and into the city.
- **Connect**. Sets out a final project so your students can consolidate their learning in a fun and rewarding way.

These materials have provided new ways of connecting pupils to their immediate environment and bringing the outside world into the classroom.

6.4.3 Supporting Innovation in a Quasi Market

The range of organizations seeking to support school-led innovation is diverse and their motivations for getting involved vary. For instance, The Royal Society of Arts is a charity which was originally established in the nineteenth century to strengthen links between the arts, design, and manufacture (its full title is "The Royal Society for the Encouragement of Arts, Manufactures and Commerce"). In line with its broader mission it has launched a sequence of initiatives designed to support schools in actively managing change**.** It places particular emphasis on creativity and innovation as essential elements in the curriculum:

> We seek to close the creativity gap by leading an approach to learning and development that enables everyone, regardless of background, to generate original, valuable ideas and make them happen.
>
> Through our programme of research and innovation, we aim to transform public, professional and political understanding and attitudes, so that families, schools, workplaces and other learning institutions prioritise and generate creative capacities.

In this spirit they have supported a range of school partnerships, locally based initiatives, and research projects which in turn have ensured a range of publications designed to influence policymakers about the importance of the issues they champion and the need to find space for them within the school system. However, they do not have the same reach as the government. Such partnerships also depend upon a willingness to invest in education that can be short lived.

Certainly, the most fundamental changes to the performance of London schools, which saw their transformation from the worst educational performance in the country to one of the best, rests more with sustained investment channeled into professional partnerships within the education sector with government backing. The London Challenge, a citywide attempt to steer meaningful conversations about school improvement between heads of high- and low-performing schools, targeted investment in some of the most challenging boroughs in London (Tower Hamlets, Newham, Lewisham, Hackney, and Westminster), with a focus on leadership, capacity building, and teacher retention [5]. Introduced by New Labour, it ran between 2003 and 2011. School-level challenges, identified through intelligent review of the attainment data, were addressed positively through a system of head teacher peer support using coaching and mentoring systems that all local partners benefitted from. This

created high levels of professional engagement, collaborative problem-solving, and innovation and experimentation in a context in which it was possible to learn from others without jeopardy. The improvement in school performance has endured long after the policy itself ceased.

6.4.4 Conclusion

In the absence of strong steerage from the government, and to some extent against the current direction of travel in education policy, many educational organizations and institutions continue to be committed to finding new ways of ensuring that they prepare students adequately for the future and do so through a robust combination of competences, new literacies, knowledge, and skills. Under the current system, many of the schools championing such new approaches already meet the attainment targets that the government has set, and in these cases individual innovation is often feted. It is more difficult to find a route for disseminating such successful practice system-wide. Not least because, at the present time, the government seems to prefer diversity in provision over system-wide uniformity.

Yet, one unintended consequence of this approach is that it becomes much harder for schools that are more adrift from the national performance targets to innovate, especially if their students are struggling to successfully pass the necessary tests and examinations. An unintended consequence of such a system is that those schools with the least resources in terms of teacher expertise and strong leadership, serving the most disadvantaged communities, are left with the least capacity to change. There are indeed risks associated with operating a "high-autonomy–high-accountability quasi-market school system" [18] which limits the possibility of direct government or local authority support.

It remains the case that the most sustained and successful attempts to change pedagogy and reform the curriculum in England have combined the intelligent use of attainment data and changes to curriculum specifications with structures that resource and sustain professional conversations about practice. When well handled, this combination has made it possible to discuss problems as well as successes with an openness that leads to professional development and increases the capacity of the system to learn from itself. Whatever their strengths and weaknesses, the National Literacy and Numeracy Strategies did this at scale. The London Challenge applied some of these same principles at a regional level and transformed the educational performance of the city in ways that have endured. Whether and how we might return to these conditions in the future remains an open question.

In outlining some of the history that has shaped the present system, we are aware of the constraints set by what political science describes as "path dependency" [28]. This limits what can be done at any point of time because of decisions taken in the past. These then influence the trajectory in present actions. The specific history to English education, and the strong divide between academic and vocational tracks that its examination system entrenches, have all constrained politicians' room for maneuver.

So too does a public discourse around education performance data that treats "average" performance as not good enough [25] and thus proof of the government's failure to intervene successfully.

Yet the bigger questions remain:

- How can we prepare all children and young people for life in the twenty-first century, regardless of their diverse starting points and the resources they bring to school?
- Is it possible to reconcile building an inclusive curriculum open to all with the aims of constructing a specialized curriculum that promotes access to specialist knowledge?
- In what ways can education promote social cohesion at times of political and economic stress?
- How can national education systems balance entitlement for equity with room for local innovation?
- Which key competences and new literacies matter most in these debates?

Annex: Changing definitions of the values, aims and purposes of the National Curriculum, as set out in key official documents between 1988 and 2014

1. Education Reform Act, 1988[21]

The curriculum for a maintained school satisfies the requirements of this section if it is a balanced and broad-based curriculum which.

- Promotes the spiritual, moral, cultural, mental, and physical development of pupils at the school and of society, and
- Prepares such pupils for the opportunities, responsibilities, and experiences of adult life.

The curriculum for every maintained school shall comprise a basic curriculum including.

- Provision for religious education for all registered pupils at the school;
- A curriculum for all registered pupils at the school of compulsory school age (to be known as the National Curriculum) that meets the requirements of the subsection below.

The curriculum referred to in the subsection above shall comprise the core and other foundation subjects and specify in relation to each of them.

[21] Available and downloaded 8/ 09/ 201 from http://www.educationengland.org.uk/documents/acts/1988-education-reform-act.pdf.

- The knowledge, skills, and understanding that pupils of different abilities and maturities are expected to have by the end of each key stage (in this Annex referred to as "attainment targets");
- The matters, skills, and processes which are required to be taught to pupils of different abilities and maturities during each key stage (in this Chapter referred to as "programmes of study"); and
- The arrangements for assessing pupils at or near the end of each key stage for the purpose of ascertaining what they have achieved in relation to the attainment targets for that stage (in this Chapter referred to as "assessment arrangements").

2. **1999 The National Curriculum**[22]

Values and Purposes

> Education influences and reflects the values of society, and the kind of society we want to be. It is important, therefore, to recognise a broad set of common values and purposes that underpin the school curriculum and the work of schools.
>
> Foremost is a belief in education, at home and at school, as a route to the spiritual, moral, social cultural, physical and mental development and thus well-being, of the individual. Education is also a route to equality of opportunity for all, a healthy and just democracy, a productive economy, and sustainable development. ….Education should…reaffirm our commitment to the virtues of truth, justice, honesty, trust and a sense of duty. At the same time education must enable us to respond positively to the opportunities and challenges of the rapidly changing world in which we live and work.

Aims (these aims mean is unpacked at length).

Aim 1. The school curriculum should aim to provide opportunities for all pupils to learn and to achieve.

Aim 2. The school curriculum should aim to promote pupils' spiritual, moral, social, and cultural development and prepare all pupils for the opportunities, responsibilities, and experiences of life.

The four main purposes of the National Curriculum are:

(a) **To establish an entitlement**…to a number of areas of learning and to develop knowledge, understanding, skills, and attitudes necessary for (all pupils') self-fulfillment and development as active and responsible citizens.

(b) **To establish standards**….(which) can be used to set targets for improvement, measure progress toward those targets, and monitor and compare performance between individuals, groups, and schools.

(c) **To promote continuity and coherence** (that) facilitates the transition of pupils between schools and phases of education and provides a foundation of lifelong learning.

(d) **To promote public understanding**…of and confidence in the work of schools and in the learning and achievements resulting from compulsory education.

[22] The second revision, four years after the first Dearing Review (not covered here). *Source*. DfEE [29]. *The National Curriculum: Handbook for Primary Teachers in England*. London: HMSO.

3. The Education Act, 2002[23]

The curriculum for a maintained school or maintained nursery school satisfies the requirements of this section if it is a balanced and broad-based curriculum which.

(a) Promotes the spiritual, moral, cultural, mental, and physical development of pupils at the school and of society, and
(b) Prepares pupils at the school for the opportunities, responsibilities, and experiences of later life.

4. National Curriculum 2010[24]

Aims

The National Curriculum has 3 broad aims. It should enable all young people to become.

- Successful learners who enjoy learning, make progress, and achieve;
- Confident individuals who are able to live safe, healthy, and fulfilling lives; and
- Responsible citizens who make a positive contribution to society.

These aims should inform all aspects of teaching and learning and be the starting point for curriculum design.

Values

The curriculum should reflect the values in our society that promote personal development, equality of opportunity, economic well-being, a healthy and just democracy, and a sustainable future.

These values should relate to.

- Ourselves, as individuals capable of spiritual, moral, social, intellectual, and physical growth and development;
- Our relationships, as fundamental to the development and fulfillment of happy and healthy lives, and to the good of the community;
- Our society, which is shaped by the contributions of a diverse range of people, cultures, and heritages; and
- Our environment, as the basis of life and a source of wonder and inspiration that needs to be protected.

Purposes

The purposes of having a statutory curriculum are.

- **To establish an entitlement** for all children, regardless of…, to develop and apply the knowledge, skills, and understanding that will help them become successful learners, confident individuals, and responsible citizens;

---

[23] Curriculum definition in statute law, available and downloaded 8/09/2017 from http://www.legislation.gov.uk/ukpga/2002/32/section/78

[24] Fourth revision, never implemented. *Source:* QCDA [30]

- **To establish national standards** for children's performance;
- **To promote continuity and coherence**, allowing children to move smoothly between schools and phases of education; and
- **To promote public understanding**, building confidence in the work of schools and in the quality of compulsory education.

5. **National Curriculum 2014**[25]

Every state-funded school must offer a curriculum that is balanced and broad based[26] and which.

- Promotes the spiritual, moral, cultural, mental, and physical development of pupils at the school and of society, and
- Prepares pupils at the school for the opportunities, responsibilities, and experiences of later life

Aims

(a) The curriculum provides pupils with an introduction to the essential knowledge that they need to be educated citizens. It introduces pupils to the best that has been thought and said; and helps engender an appreciation of human creativity and achievement.
(b) The National Curriculum is just one element in the education of every child. There is time and space in the school day and in each week, term, and year to range beyond the National Curriculum specifications. The National Curriculum provides an outline of core knowledge around which teachers can develop exciting and stimulating lessons to promote the development of pupils' knowledge, understanding, and skills as part of the wider curriculum.

Structure

Pupils must follow the National Curriculum. It is organized on the basis of four key stages and twelve subjects, classified in legal terms as "core" and "other foundation subjects."

The Secretary of State for Education is required to publish programmes of study for each National Curriculum subject, setting out the "matters, skills, and processes" to be taught at each key stage.

Key Stage 4 Entitlement Areas

The arts (comprising art and design, music, dance, drama, and media arts), design, and technology; the humanities (comprising geography and history) and modern foreign language are not compulsory National Curriculum subjects after the age of 14 but all pupils in maintained schools have a statutory entitlement to be able to study a subject in each of those four areas.

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[25] Fifth revision, introduced after New Labour had been defeated in the 2010 election. *Source:* The Department for Education. 2013. *The 2014 Secondary National Curriculum in England. Key Stages 3&4 Framework.* Romsey: Shurville Publishing.

[26] See Sect. 28 of the 2002 Education Act: http://www.legislation.gov.uk/ukpga/2002/32/section/78.

The statutory requirements in relation to the entitlement areas are.

- Schools must provide access to a minimum of 1 course in each of the 4 entitlement areas;
- Schools must provide the opportunity for pupils to take a course in all four areas, should they wish to do so; and
- A course that meets the entitlement requirements must give pupils the opportunity to obtain an approved qualification.

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Chapter 7
Republic of Korea: Cultivating Key Competences

Junehee Yoo, Euichang Choi, Dongil Kim, Kyunghee So, Chan-Jong Kim, Il Lee, Hyukjun Son, Yeji Joy An, Euijun Ko, and Youngsun Kwak

Abstract Education in Korea is based on the ideal of *Hongik Ingan*—'contributing to the overall benefit of humankind'. The chapter discussed the recent 2015

A note from the editors:

The case of Korea, described by leading professors at Seoul National University, cannot but inspire admiration for the consistency of government and society actions to implement the new curriculum.

It is important to note that, as in a number of other countries, the framework of key competences in Korea includes civic education. This requires a complex balance of attitudes, values, and skills.

A specific feature of the Korean case is the selection of new literacies integrated into cross-curricular themes.

Korean specialists have systematically and scrupulously approached the task of emphasizing elements of key competencies within academic subjects. Their experience can be very useful for the practical design of educational programs.

Finally, the attention to physical culture is absolutely unique in this case. Not only physical literacy is fostered in Korea, but it is also used as a channel to develop key competences—communication and collaboration with people, self-management, and self-regulation.

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curriculum that was developed in collaboration with families and local communities. It includes six key competences: self-management competence, knowledge-information processing skills, creative thinking skills, aesthetic-emotional competence, communication skills, civic competence. Key competences are integrated into all the disciplines and are linked to disciplinary skills, thus being naturally reinforcing. For each discipline, relevant aspects of key competences and new literacies are identified. Ten cross-curricular themes (new literacies) are further supported (safety-health education, human rights education, economy-finance education, environmental sustainability education et al.). These themes are integrated both in disciplinary learning, and in creative experience activities. Physical culture (literacy) is emphasised as a channel to develop key competences, such as communication and collaboration with people, self-management, self-regulation.

Keywords National school curriculum · Textbooks and learning materials · Curriculum reform · Self-management competence · Knowledge-information processing skills · Creative thinking skills · Aesthetic-emotional competence · Communication skills · Civic competence · Cross-curricular themes · Physical literacy · Creativity experience activities · Teaching techniques · Exam-free semester · Key competences in subjects · Key competences in informal education · Key competences in special education · Assessment of key competences

Highlights

- Education in Korea is based on the ideal of *Hongik Ingan*—"contributing to the overall benefit of human kind."
- The recent 2015 curriculum was developed in collaboration with families and local communities.
- The revised curriculum includes six key competences: self-management competence, knowledge-information processing skills, creative thinking skills, aesthetic-emotional competence, communication skills, and civic competence.
- Key competences are emphasized in general and integrated into all disciplines. They are linked to disciplinary skills, these two strands, thus being naturally

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re-enforcing. For each discipline, relevant aspects of key competences and new literacies are identified.

- Ten cross-curricular themes (new literacies) are supported (safety-health education, human rights education, economy-finance education, environmental sustainability education, etc.). These themes are integrated both in disciplinary learning and in creative experience activities.
- Assessment is under revision to support the 2015 curriculum and is designed to include assessment of key competences.

7.1 General Description of Korea's Educational System

7.1.1 Structure of the System

The Korean Educational System consists of preschool education (3 years), primary schools (6 years), and middle and high schools (3 years each). Compulsory education (sponsored by the government) starts at the age of 6, the 1st grade, and finishes at the age of 15, the 9th grade (Fig. 7.1).

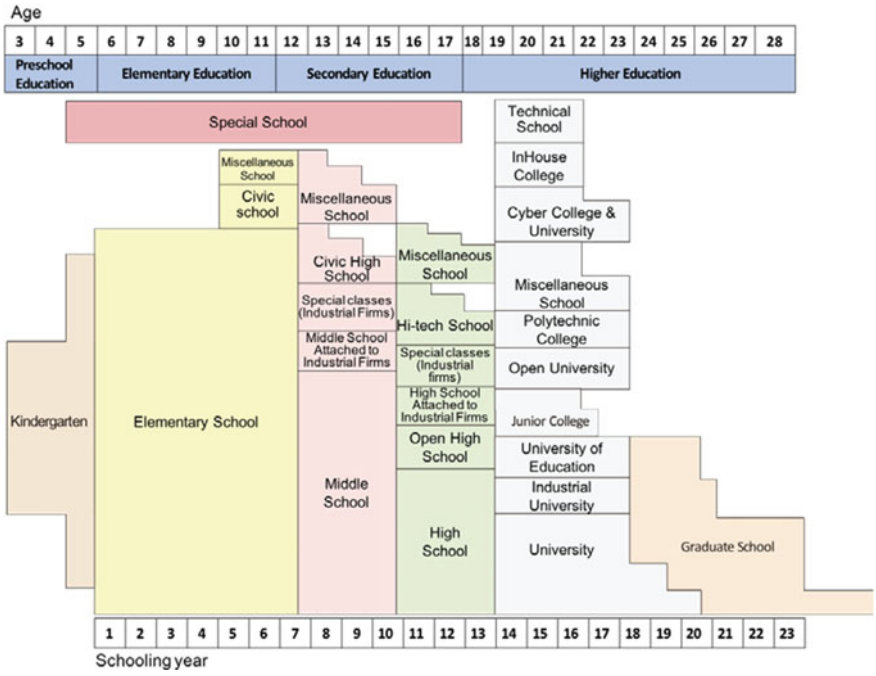


Fig. 7.1 Korean educational system

Table 7.1 Brief statistics of education in Korea (2016)

Schools		Number of schools	Number of students		Number of teachers	
			Total	Female	Total	Female
Total		20,835	6,635,784	3,193,935	491,152	344,068
Preprimary		8,987	704,138	345,177	52,923	52,047
Primary		6,001	2,672,843	1,292,430	183,452	141,248
Lower secondary/middle schools		3,232	1,460,792	698,994	109,536	75,379
Upper secondary/high schools	Subtotal	2,402	1,764,350	843,742	135,523	68,819
	General	1,545	1,256,108	625,300	91,474	48,085
	Special purpose	152	67,607	34,823	7,416	3,252
	Specialized	497	290,632	125,966	26,306	12,233
	Autonomous	159	138,110	50,419	10,231	5,218
Special schools		170	25,502	8,726	8,720	5,944

In Korea, there are 20,835 schools, accommodating 6.6 million students and almost half a million teachers. The enrolment ratio is 98.1% for primary school, 94.9% for lower secondary, and 94.1% for upper secondary (see Table 7.1).

7.1.2 Upper Secondary/High Schools

Individuals who graduate from middle schools or pass a qualification exam and/or an equivalent assessment can be admitted into high schools. Students are required to pay admission fees and tuition since high school is not considered compulsory education in Korea. Annual expenditure per student is US$9,570 for all programs in upper secondary school and 87% of it comes from the public sector and 13% comes from the private sector [29]. The amounts of annual tuition fee change by regions and school types. When students go on to upper secondary schools, they can choose or apply to schools according to their own track. Student selection procedures differ by school types. There are four types of high schools:

(1) **General High Schools** provide general education across diverse areas, which account for the major part of all types of high schools (71% of all upper secondary students). The college entrance rate for general high schools' students is 78%.

(2) **Special-purpose High Schools** accommodate only 3.8% of all upper secondary students and aim to provide professional education and/or training in specialized areas. They can be divided into multiple specialty tracks such as science, foreign languages, sports, and so on. Students are selected through a competition, based on transcripts, teacher recommendations, interviews, performance examination results, evaluations that assess students' self-directed academic skills, and so on.

The college entrance ratio for special-purpose high schools is 55.9%. Generally high achievers prefer to go to the special-purpose high schools, but the trends change by selection methods of university entrance.

(3) **Specialized High Schools** (16.5% of all upper secondary students) provide education in specialty areas through field-based experiments and experience-centered vocational education in agriculture, industry, commercial information, fishery/marine, housework/business, and so on. Students are selected based on their academic records, interviews, performances, and so on. The college entrance ratio is 35.0%.

(4) **Autonomous High Schools** (7.8% of all upper secondary students) have more autonomy in curriculum implementation compared to other schools as well as more accountability in school management. They employ diverse and specialized educational programs. These schools can be both public and private. Students are selected based on academic records and examination scores. Private schools also involve transcripts, teacher recommendations, interviews, evaluations, and so on. The college entrance ratio for autonomous high schools is 74.9%.

7.1.3 Assessments and Tests

At primary school, based on the school curriculum, teachers perform constant assessment/process-based performance evaluations using writing assessments, essays, portfolios, self-assessments, and peer assessments. Students' achievements are recorded based on their performance, and there are no standard tests. The guides of filling in student records are distributed by the local office of education according to the directory of the Ministry of Education (MOE) and "Elementary and Secondary Education Act." The guideline emphasizes cumulated record of students' development and learning processes, and summative grades are not provided. So, it acts as a helpful mirror for students' learning. Mainly students' abilities by the subjects and general development are recorded. Recently, teachers can get help by using software to describe every student's development and learning processes by all aspects.

Box 7.1. Example of Student Record

Creative experience activities

As a class executive during the spring semester (March 1, 2017–August 24, 2017), he tries to solve class problems through class meetings (Club Activity: Chorus) (48 h). His ability to make sounds by abdominal breathing has improved. He could enjoy singing with appreciation of the beauty of the harmony and learn baritone part note correctly (volunteer activity). He visited and served for a service organization (OO center) once a month. Through

volunteer activities for sharing with and caring for other people, he could cultivate democratic citizenship and learn how to cooperate with neighbors. He could recognize various types of jobs and tried to find dreams that match his personality type and multiple intelligence.

Subject

Korean: At first, he wrote an ill-formed travel essay, but after tutoring he could write a travel essay as a series of articles with introductions, main points, and conclusions referring examples of textbooks. He also tried to use words correctly by making and reading his own Korean language guides based on investigation of homophony, especially some words that he and his friends' misunderstood a lot.

Mathematics: He had a low understanding of the planar figure of the cuboid, but he figured out the meaning of the planar figure by cutting and attaching the cuboid. He developed little by little in the process of changing the sketch of the cuboid into a planar figure. By the end of the unit, he was able to draw up the missing parts of the sketch and the planar figure of the incomplete cuboid. It was hard to see that the area of the rectangle could be used to measure the area of the triangle, but it became possible to learn and use the principle through continuous manipulation. He had trouble representing the decimal fraction in the form of fractions, and he did not write them well for the position of each digit in the calculation system. So, he often made mistakes during the final calculation process. However, because of his own efforts, he was more accurate and more confident in calculating.

Science: He empirically knows that when it dissolves powdered material, it will melt better when hot water is used than cold water. In addition, he could share this experience with his friends. He was able to control various non-temperature variations to manipulate the variation of temperature during the experiment. He knows the meaning of humidity and can explain the effect of humidity on our life through more than two examples. He learned how our daily lives are affected by high humidity and low humidity by searching the Internet and sharing experiences with friends. He knew that adding an alkaline solution to the acid solution would weaken the properties of the acid solution and was able to explain precisely why we spray slaked lime at the site of the leakage of hydrochloric acid.

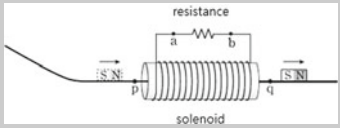
At lower secondary school, there are midterm and end-term exams each semester. Student performances are assessed by process-based performance evaluation, essay, portfolio, self-checklist, and so on. Since 2017, an exam-free semester for 7th graders has been adapted to all middle schools nationwide. During the exam-free semester, students are encouraged to figure out their talents and vision for a career without anxiety about exams.

At upper secondary school, in general, students are also assessed by midterm and end-term exams. The knowledge, skills, and aptitudes of all subjects such as Korean language, mathematics, English, social studies, sciences, classical Chinese or second foreign language, and Korean history are tested. Performance assessments are emphasized even in the high schools. Students get the results of summative assessment at the end of the school year.

College admission entrance in Korea is highly competitive even though the total entrance ratio is high (69.8% in 2016). One of the important selection factors is the College Scholastic Ability Test (CSAT), which assesses applicants' understanding and application of basic concepts and ability to solve, reason, analyze, and inquire problems through given situations. It is a paper exam consisting of multiple-choice and short-answer questions, standardized and based on the national curriculum.

Box 7.2. An Example Test Item of CSAT

10. The figure shows a magnet descending along the oblique plane moving along a frictionless horizontal rail on the center axis of the solenoid. Points p and q are on the rail.



Which of the following(s) is(are) true?

a. When the magnet passes p, the induced current flows in the direction of a → resistance → b.
b. The speed of the magnet is smaller at p than at q.
c. When the magnet passes q, the direction of the magnetic field due to the induction current inside the solenoid is in the direction of q → p:

① a ② b ③ a, c ④ b, c ⑤ a, b, c

National Achievement Tests are performed annually to support the student achievement at the basic level. The populations are the 9th graders and 11th graders. Korean language, English, and mathematics had been tested for all students up to 2016, while science and social studies are tested by random sampling. Since 2017, all National Achievement Tests are performed for randomly selected students (3% of the population). Korean language, English, and mathematics are emphasized in Korea because those subjects are regarded as important and crucial for entering colleges. National Achievement Tests on those subjects focused on basic academic achievement rather than practical literacy.

7.1.4 Learning Materials

The Korean MOE oversees the national school curriculum, as designated by the Primary and Secondary School Education Law, to ensure equal educational opportunities and maintain the quality of education. The national curriculum and regional guidelines provide flexibility to individual schools in accordance with certain characteristics and objectives of each school.

Curriculum standards form the basis for educational contents at each school and also for textbook and teachers' manual development. Textbooks are classified into three types:

Type 1: Copyrights are held by the MOE.
Type 2: Authorized by the MOE and published by private publishers.
Type 3: Recognized by the MOE as relevant and useful.

For kindergartens, a collection of instructional materials for teachers has been developed as Type 1 textbooks. For primary school, the one textbook per subject rule is adopted; so, Type 1 textbooks are developed and distributed by the MOE.

Most textbooks for the lower secondary schools and most regular course textbooks, except for Korean history, are Type 2. The textbook type of Korean history has swung back and forth between Type 1 and Type 2.

School subjects at the high school are largely divided into regular subjects designed for general high schools and specialized subjects for vocational and other specialized high schools. The textbooks are largely divided into basic and advanced ones. Most regular course textbooks, except for Korean history, must be authorized by the MOE (Type 2). Most textbooks for the advanced level are developed by research organizations and universities commissioned by the MOE.

7.1.5 ICT Infrastructure

The National Education Information System (NEIS) is a nationwide intranet for schools to manage students' and teachers' records. Through the NEIS, students can get reports and certificates on their own education. Recently, process-oriented assessment is emphasized as summative assessment results. So, teachers are asked to record student performance after classes. Teachers can make notes on a particular student's development and summarize them into the summative records. Parents can check their children's achievement and school records from the intranet and communicate with teachers.

All schools of Korea run their own websites (6,240,000 users) and mobile apps like School Mom or SNS (user number: 860,000) to communicate with students and parents.

There are also numerous websites to support instructions or new educational policies dissemination, such as the National Curriculum Information Center (NCIC),

National Educational Information Portal Service (EDUNET), process-based performance evaluation portal service, and CareerNet. All these websites are required to meet parents' and students' needs as well as teachers' needs.

7.2 Curriculum Reform in Korea

Education in Korea, based on the ideal of *Hongik Ingan*, aims to enable every citizen to lead a life worthy of human dignity, contribute to the development of a democratic state, and support the realization of an ideal of shared human prosperity, by ensuring cultivation of character and development of abilities for independent life and necessary qualities as a democratic citizen under the humanitarian ideal [15].

Box 7.3. The Ideal of Hongik Ingan (홍익인간, 弘益人間) in Korea
Hongik Ingan was the founding spirit of the first kingdom in Korean history, 6,000 years ago. Currently, it is an important element of Korean history course.

Hongik Ingan means "contributing to the overall benefit of human kind."

This ideal has been regarded in Korea as the vision of an educated person since 1945.

The national curriculum had been revised periodically up to the current 7th national curriculum. Since 2007, the national curriculum has been revised more frequently to reflect the newly rising demands for education, emerging needs of a changing society, and new frontiers of academic disciplines. Most of the current curriculum was revised in 2009.

After the 2009 revised curriculum was implemented, business sector and parents'/families' demands have been raised, changing the social agenda:

- Business community and society demanded new manpower for the future society: creative and integration abilities are needed to solve problems by selecting, regulating, and integrating knowledge in the new circumstances and contexts and creating new values.
- Parents/families demanded for reducing private educational expenses and high competition ratios for top-ranking universities.

By the presidential elections of 2012, politicians made suggestions and pledges to meet parents' demands and win their votes. Candidates' advisory panels included education policymakers, opinion leaders, professors, and so on. One of the pledges was to develop students' dreams and potential, which would be the direction of educational policy after 2012 and new curriculum revision.

In February 2012, the new government formed, initiating the committee for education reform and the committee for general guidelines of the revised curriculum.

In September 2014, the Tentative General Guideline was announced, providing such general directions of curriculum as integration in tracks, liberal arts, and natural science. After that, the committees for all disciplines were launched.

In December 2015, the new revised curriculum had been submitted by the MOE. Its implementation started in March 2017 (1st and 2nd grades and the exam-free semester for 7th grade) and continued in March 2018 (7th grade). The full implementation of the 2015 revised curriculum is planned for 2019.

The implementation campaign included the announcement in the official newspaper and at websites (MOE, NCIC, and Korean Institute of Curriculum and Evaluation [KICE]), press releases, and specialized brochures. Public hearings and town-halls have also been conducted, and a dedicated in-service teachers' training program is planned.

7.3 The 2015 Curriculum: Key Competences

7.3.1 Key Competences in General

Based on the abovementioned ideal and aims of education in Korea, the 2015 curriculum specifies the vision of an educated person:

(a) A self-directed person who builds a self-identity and explores a career and life on the basis of holistic growth.
(b) A creative person who discovers something novel by means of diverse challenges and ideas based on basic abilities.
(c) A cultivated person who appreciates and promotes the culture of humankind on the basis of cultural literacies and understanding of diverse values.
(d) A person who lives in harmony with others, fulfilling the ethics of caring and sharing, as a democratic citizen with a sense of community and connection to the world.

On the other hand, six key competences (see Table 7.2) are emphasized in general and integrated into all disciplines to embody the vision of an educated person in the 2015 curriculum.

To implement the 2015 curriculum, a guideline was developed in collaboration with families and local communities, imposing cross-curricular themes to be incorporated into the educational program, including subject-area teachings and Creative Experiential Activities. The ten cross-curricular themes are shown in Table 7.3.

In this new curriculum, the literacies as skills to use tools (capacities) are not emphasized explicitly, but they are included in subject curricula like Korean language, mathematics, and so on. Domain-based literacies are imposed as 7 of 10 cross-curricular themes, except for Unification Education and *Dokdo* Education (emphasized in the political and social context) and Career Education (specific direction to

Table 7.2 Six key competences in the 2015 revised curriculum

1. Self-management competence	To lead one's life with self-identity and confidence based on basic abilities and qualifications necessary for life and career
2. Knowledge-information processing skills	To process and utilize knowledge and information from diverse fields to solve problems in reasonable ways
3. Creative thinking skills	To discover something novel by integrating knowledge, skills, and experiences from diverse professional fields on the basis of broad foundational knowledge
4. Aesthetic-emotional competence	To find and appreciate the meanings and values of life, based on an empathetic understanding of others and cultural sensitivities
5. Communication skills	To respectfully listen to opinions of others and effectively express one's thoughts and feelings in diverse situations
6. Civic competence	To actively participate in improving the community with values and attitudes required to be a member of local, national, and global communities

encourage the 7th grade students having their exam-free semester to find their own career interests and aptitudes).

7.3.2 Key Competences in Subjects

The six key competences were linked to important skills in each subject area to enhance students' key competences through natural learning process at schools. Each subject curriculum designer developed key competence in the subject in line with the six key competences in general (see Table 7.4).

Table 7.5 shows how the key competence in science can be linked with key competences in general. As it shows, self-management and aesthetic-emotional competences were not reflected in the key competences in science.

Table 7.6 shows how knowledge-information skills, one of the six key competences in general, is reflected in each subject area.

7.3.3 Physical Literacy

A new type of literacy associated with physical culture, sport, and health is of great importance.

Table 7.3 Ten cross-curricular themes in the 2015 revised curriculum

Safety-health education	Safety disaster preparation
Character education	Traditional ethics (filial duty and respect to the elderly) Life respect
Career education	Career exploration Leisure use
Democratic citizenship education	Anticorruption The spirit of the constitution Law and order
Human rights education	The dignity of man and respect of human rights Violence prevention
Multicultural education	Value of diversity Global citizenship, international understanding
Unification education	Recognize the necessity for unification[a] National identity Patriotic sprit
Dokdo education	Understanding of territory Recognition of *Dokdo* as Korean territory[b]
Economy-finance education	Responsibility and right of consumer Entrepreneurial spirit Welfare and tax Understanding of finance in everyday life Intellectual property right
Environmental sustainability education	Low fertility and aging society preparation Water and energy saving Maritime education Understanding of agriculture and rural area

[a] Refers to the potential future reunification of the Democratic People's Republic of Korea, the Republic of Korea, and the Korean Demilitarized Zone under a single government
[b] *Dokdo* (also known as the Liancourt Rocks) are a group of small islets in the Sea of Japan, under control of the Republic of Korea, but also claimed by Japan (Takeshima in Japanese)

> Physical literacy is the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life [32, 33].

The importance of physical literacy is being recognized as an integral concept for balanced development in physical, intellectual, and moral aspects of students with the physical dimension being the axis of the development as follows:

- *Motivation and confidence (affective).* Motivation and confidence refers to an individual's enthusiasm for enjoyment of and self-assurance in adopting physical activity as an integral part of life.
- *Physical competence (physical).* Physical competence refers to an individual's ability to develop movement skills and patterns and the capacity to experience a variety of movement intensities and durations. Enhanced physical competence

Table 7.4 Key competences in each subject area

Subject			Key competences in subject
Korean language			Critical thinking, information application, interpersonal relationship, culture enjoyment, and introspection/self-improvement
Social studies	Social studies		Creative thinking, critical thinking, problem-solving and decision-making, communication/corroboration skills, and information application
	History		Understanding historical facts, analyzing and interpreting historical documents, application of historical information and communication, historical decision-making, problem-solving skills, and identity and mutual respect of different viewpoints
Ethics			Self-respect and managing skills, ethical thinking skills, ethical interpersonal relationship, sense of ethical community, ethical introspection, and practice tendency
Mathematics			Problem-solving, inference making, creative convergence, communication, information processing, positive attitude, and practice
Science			Scientific thinking, scientific research skills, scientific problem-solving skills, scientific communication skills, scientific participation, and lifelong studying skills
Practical course (technology home economics/information)	Technology-home economics	Home life	Practical problem-solving abilities, independent living skills, and relationship formation skills
		Technology	Technological problem-solving abilities, technical system designing skills, and ability to use technology

(continued)

Table 7.4 (continued)

Subject		Key competences in subject
	Information	Information culture literacy, computing thinking skills, and cooperative problem-solving abilities
Physical education		Health management skills, physical training abilities, game performing skills, and physical expression skills
Music		Musical sensibility competence, musical creative-convergence thinking competence, musical communication competence, cultural community competence, musical information processing competence, and self-managing competence
Art		Aesthetic sensitivity, visual communication skills, ability to understand art and culture, and self-directed art learning ability

enables an individual to participate in a wide range of physical activities and settings.

- *Knowledge and understanding (cognitive).* Knowledge and understanding includes the ability to identify and express the essential qualities that influence movement, understand the health benefits of an active lifestyle, and appreciate appropriate safety features associated with physical activity in a variety of settings and physical environments.
- *Engagement in physical activities for life (behavioral).* Engagement in physical activities for life refers to an individual taking personal responsibility for physical literacy by freely choosing to be active on a regular basis. This involves prioritizing and sustaining involvement in a range of meaningful and personally challenging activities, as an integral part of one's lifestyle.

By participating in physical activity and internalizing its value, students will develop the following four physical education specific competences:

- *Health management.* Promote individual's physical, mental, social, and environmental health.
- *Self-regulation and problem-solving.* Achieve new goals through sustained and active efforts while understanding and accepting their physical level.
- *Game performance and teamwork.* Interact to achieve personal or collective goals by exercising appropriate strategies and functions in a competitive environment.
- *Physical expression.* Express and accept thoughts and feelings through the body and movement.

Table 7.5 Key competences in general and science

	Competence in general					
	Self-management	Knowledge-information process skills	Creative thinking skills	Aesthetic-emotional	Communication	Civic competence
Science						
Scientific reasoning		✓	✓			
Scientific inquiry		✓	✓			
Scientific problem-solving		✓	✓			
Science communication					✓	
Scientific involvement and lifelong learning		✓			✓	✓

Table 7.6 Key competences in subjects related to knowledge-information skills

Subject	Competence	Subject	Competence
Korean	• Use of data and information	Physical	• Physical training ability
Math	• Problem-solving • Inference-making • Information process	Ethics	• Ethical reasoning
Science	• Scientific reasoning • Scientific inquiry ability • Scientific problem-solving	Music	• Musical information process
Social studies	• Critical reasoning • Problem-solving and decision-making • Use of information	Art	• Visual communication • Creative-convergence ability
English	• Knowledge and information processing skills	Technology home economics	• Practical problem-solving • Technological problem-solving • Technological design ability
History	• Understandings in historical fact • Analysis and interpretation of historical data • Use of historical information and communication • Historical judgment and problem-solving	Information	• Information culture literacy • Computational thinking

7.4 Key Competences in Creativity Experience Activities

7.4.1 Conceptual Framework for the Curriculum Implementation

Traditionally, Korea had strongly centralized its education system. This means that laws, regulations, and official documents regulated the content as well as the whole educational system. Even though the system is currently moving to a more decentralized one, the documents of the national curriculum are still legally enforced. The national guidelines for the curriculum designate teaching and learning methods, assessment, and supports as well as ways to organize and implement school curriculum. The structure of this guideline is shown in Table 7.7.

To supplement the curriculum documents, the MOE also develops and disseminates "the guideline for organization and management of municipal level curriculum"

Table 7.7 Structure of the national guideline for elementary and secondary curriculum

I. Vision of the national curriculum	1. Vision of an educated person 2. Principles of curriculum design 3. Educational goals for elementary and secondary schools
II. Standards for curriculum organization and implementation by school levels	1. Basic guidelines 2. Elementary school 3. Middle school 4. High school 5. Curriculum organization and implementation for non-regular schools
III. Organization and implementation of school curriculum	1. Basic guidelines 2. Teaching and learning 3. Assessments 4. Equal opportunities for all students
IV. Support for school curriculum	1. Support from the central government 2. Support from the metropolitan and provincial offices of education (MPOE)

and "National Standard for Evaluation." These documents do not have a legal power as does the national curriculum, but they provide details for practice.

Municipal offices of education and schools develop lower level documents in turn as shown in Fig. 7.2. As of 2016, the municipal offices of education comprise 17 MPOEs and 176 District Offices of Education. Textbook publishers and authors are supposed to follow the above documents to pass through the deliberation.

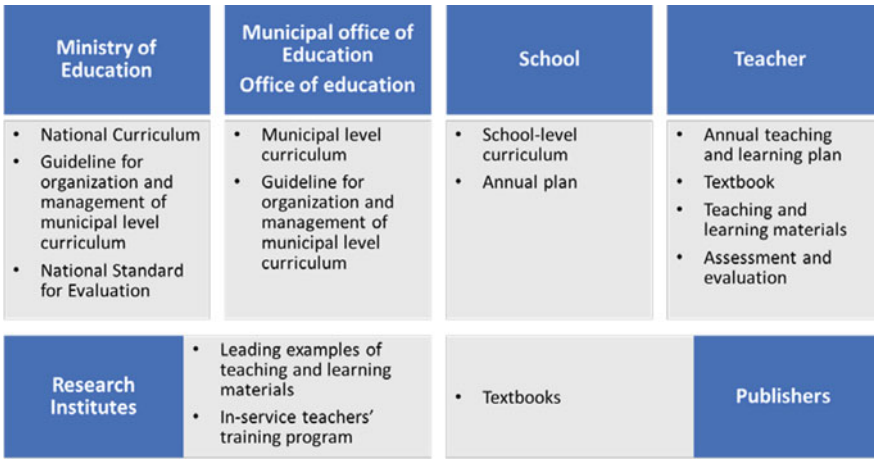


Fig. 7.2 Roles and responsibilities for the curriculum implementation

Table 7.8 An example of achievement standards for science (7th grade)

Achievement standard (2015 revised curriculum)	• Force – [9Sci02-01]* Know that weight is magnitude of gravitational force, and compare mass and weight – [9Sci02-02] Investigate examples of using elasticity in everyday context and explain the characteristic of elastic – [9Sci02-03] Know friction force as a force which interferes with the movement of an object and compare the magnitude of frictional forces through ramp experiments – [9Sci02-04] Know buoyancy acts on an object in gases or liquids and measure the magnitude of buoyancy using a spring balance

*A combination of numbers and alphabets that represent individual achievement standard

7.5 Curriculum Translation into Practical Matters

7.5.1 Educational Standards

Each subject curriculum provides achievement standards. In the past, such standards were related more to the subject knowledge than to key competences. Achievement standards related to the six key competences are developed by research institutes like KICE with evaluation standards and examples of assessment items. The MOE formed a committee to examine the standards and decided to adopt them.

New standards distribution is provided through an in-service teachers' training program and uploading materials to websites and other channels of communication (see Table 7.8 for an example).

7.5.2 Teaching Techniques and Guidelines

In the curriculum of each subject, teaching techniques and guidelines were mentioned as "Directions of Teaching, Learning and Evaluation." An example of such directions for science is in Box 7.4.

Box 7.4. The Directions of Teaching, Learning, and Evaluation in the Science Curriculum
Direction of teaching and learning

"Science" should be taught to cultivate the core scientific concepts as well as the scientific key competences: scientific reasoning, scientific inquiry ability,

scientific problem-solving, scientific communication, involvement in socio-scientific issues, and lifelong learning ability through inquiry learning. The following should be emphasized:

…

(3) **Student-centered instructions** are provided by using various teaching-learning methods such as lecture, experiments, discussion, investigation, projects, and out-of-school activities like visiting a science center.
(4) **Basic investigation skills** (observation, classification, measurement, expectation, inference, communication, and so on) and the investigation (problem recognition, hypothesis establishment, variable control, data interpretation, concluding, generalization, and so on), mathematical reasoning and using computer, modeling, evidence-based discussion, and argumentation should be taught with relevance to contents.

…

(6) **By encouraging cooperative learning of small group investigations**, the importance of cooperation for scientific investigation should be recognized.

…

(14) Student-centered inquiries **should be encouraged rather than teacher-centered experiments.**

Direction of Assessment

In science, core concepts, key competences through scientific inquiry learning, and scientific aptitudes are evaluated in a balanced way. The following should be emphasized:

(a) Ability to understand and apply core concepts of science.
(b) **Scientific key competences.** Scientific reasoning, scientific inquiry ability, scientific problem-solving, scientific communication, involvement, and lifelong learning.
(c) Interest and values in science, active involvement in science learning, **cooperation**, attitude of solving problems scientifically, and creativity.
(d) Variety of assessment methods. Multiple choice, free responses and essays, observation, reports, performance, interview, and portfolio.
(e) To develop and use actively materials and contexts to help cultivate creative-infusion, problem-solving ability, personality, and aesthetic emotion.
(f) **Group assessment** as well as individual assessment can be used to evaluate students' cooperative mind.
(g) Teachers develop assessment tools as far as possible to get high validity and reliability.

(h) Evaluation should be performed on the basis of achievement standards and the results should be fed back on lesson plans, instructional methods revision, and career education.
(i) The process of evaluation should follow the process of plan, development of test items and tools, performance, results, and use of results.

7.5.3 Textbooks

For *primary* schools, the textbook is Type 1, government-published. The MOE selects author groups and forms an Inquiry Committee to decide whether the textbooks reflect the national curriculum and asks to revise the textbook to meet standards, if needed.

Secondary schools' textbooks are government-authorized. The Inquiry Committee decides whether the textbooks reflect the national curriculum. If a textbook does not meet the standard, it is not authorized and not to be published.

New textbooks will be applied to 7th grade from 2018. Each discipline's key competences are integrated with core concepts and activities. For example, the new 7th grade science textbook that will be available from 2018 fosters scientific key competences through various inquiry activities and materials (see Figs. 7.3 and 7.4).

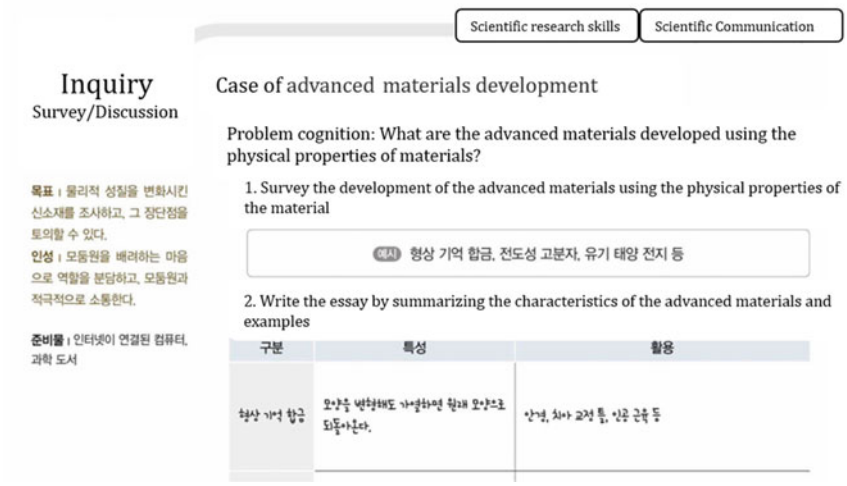


Fig. 7.3 An inquiry activity in the new 7th grade science textbook of the 2015 revised curriculum

Fig. 7.4 An inquiry material in the new 7th grade science textbook of the 2015 revised curriculum

7.6 Key Competences Integration into School Activities

In addition to subject matter education, new activities dealing with key competences (creative experiential activities [CEAs], school sports club activities [SSCAs], and exam-free semester) are implemented at schools. Figure 7.5 shows how to cultivate the competences in schools.

CEAs are designed to develop students' talent and potential and to nurture a sense of community. The 10 cross-curricular themes should be incorporated into the

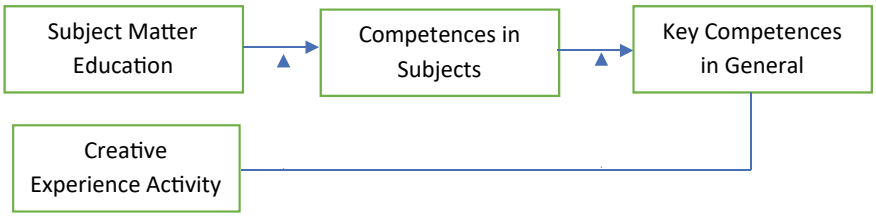


Fig. 7.5 Cultivating competences in schools [1]

entire educational program and delivered in collaboration with families and local communities. CEAs include

- Discretionary activities,
- Club activities,
- Community services, and
- Career-related activities.

Schools can selectively organize and implement CEAs by focusing on different areas, considering the degree of students' development, school circumstances, and other factors. Schools develop and use school-based assessment standards, considering CEA contents and characteristics. Features of CEAs vary by grades, as shown in Table 7.9.

SSCAs were organized and implemented in middle schools (grades 7–9) to cultivate a balanced development of mind and body and to promote socio-emotional skills. The term "balance of mind and body" as used here refers to the whole personal education approach which emphasizes not only knowledge-intensive education but also character building and physical education. This educational approach is rooted in the concept of *Hongik Ingan*, which is the basic element in Korean education. SSCA is a part of CEAs. Schools need to allocate 34–68 h per year (total 136 h in 3 years) for SSCAs. Schools allocating 68 h per year may substitute up to 34 h of physical education. The hours for SSCAs should be acquired by reducing the disciplinary instructional hours by up to 20% or by increasing the instructional hours of CEAs. However, if this is not possible, schools may use for SSCA up to 68 h allocated for CEAs. Schools should consider students' interests in determining SSCA types and

Table 7.9 CEAs, by grade

Grade	Time allocation, hours	Features
1–2	336	Safe life (safety) as part of CEAs (64 h)
3–9	714 (average 102 per year)	In grades 7–9, CEAs may be connected to SSCAs and/or diverse activities offered during the exam-free semester
10–12	408 (average 136 per year)	High schools also organize and implement CEAs to provide diverse experiences related to students' career plans

contents; yet, they must open two or more courses to ensure students' right of choice [2].

An **exam-free semester** is implemented for middle schools to help students develop self-directed learning skills and attitudes by exploring their aptitudes and career plans. During this semester, subjects and CEAs are to be organized in accordance with its aims. Schools should find resources inside and outside the school, including collaboration with local communities, to offer experience-based activities such as

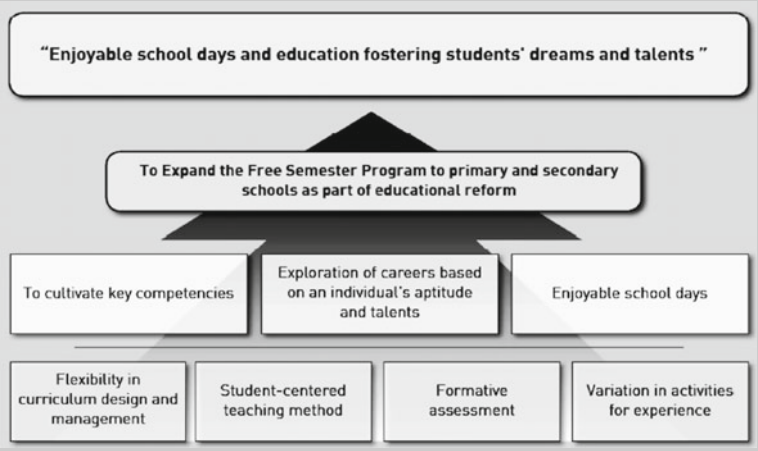
- Career-exploration activities,
- Selective theme activities,
- Club activities, and
- Arts/physical activities.

Assessments during the exam-free semester are also focused on the process of learning to foster students' growth, and to avoid the use of standardized, paper-based midterm, and final tests. The exam-free semester is expected to promote students' participatory learning such as collaborative learning, discussions and debate learning, project-based learning, and so on.

The MOE administers the website (www.ggoomggi.go.kr/) to support the exam-free semester.

Box 7.5. Exam-Free Semester
What is the free-semester program?

1. **The vision of the free Semester program**



2. **Objectives and practices**

(a) Objectives

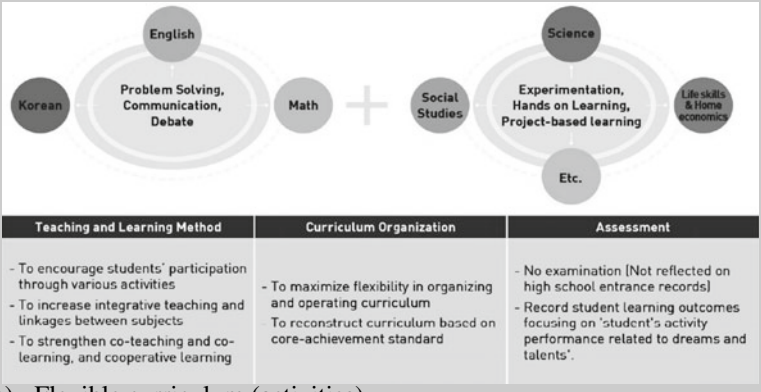
- To reduce academic pressure on students
- To enable students to enjoy school activities
- To allow students to pursue their dreams and talents
- To foster future capabilities (for example, creativity, character, and self-directed learning capacity)

(b) Practices

- 1 single semester during 1st–2nd academic year in middle school
- No midterm or final examinations (excluded from grade point average calculation period)
- Student participation-based courses (for example, discussions and field activities)
- Variety of electives (for example, subject-based, arts and physical education, club activities, and career exploration)

3. **Curriculum of the free semester program**

(a) Common curriculum (subject)



(b) Flexible curriculum (activities)

(i) Career exploration activities

- Systemic career education to allow students to explore career options based on their aptitude and talents.
- The "career and occupation" class is delivered along with the "remote video mentoring" program to set career goals.

(ii) Art and sports education activities

- Art and sports education is operated to bring out students' talents and potential.
- Provide the "Dreams and Talents" program in which students participate in three art programs.
- Provide 15 different art and physical education activities such as musical production, cheerleading, and table tennis during one semester. Students participate in a "5-week art program" and a "5-week sports program" in school, with a "5-week after-school program."

(iii) Club activities

- Survey students' preferences and open clubs based on the results.
- Students join clubs based on their personal interests.
- Sample: Reflect on the characteristics of a student's career by using a career development test. With the results of the test, set up 11 clubs (for example, writing a career-search book and integrating English and history) and coordinate an 8-day "Free Semester Club festival" where students present their findings.

(iv) Elective activities

- Sample: Provide 2 h of 3-D printer modeling practice every Wednesday and Thursday during one semester. This encouraged those who want to become scientists by using the 3-D printer to make a lamp with recyclable materials.
- Survey students' preferences and develop 5–17-week programs based on results.

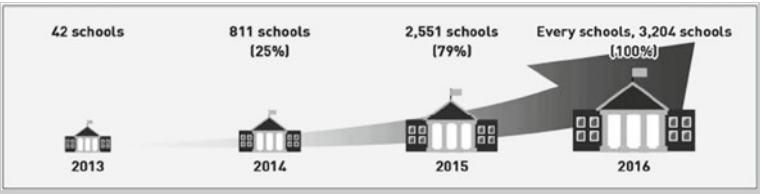
(v) An example of school time table of exam-free semester.

<table>
<tr><th>Day / Hour</th><th>Mon</th><th>Tues</th><th>Wed</th><th>Thur</th><th>Fri</th></tr>
<tr><td>1</td><td colspan="5" rowspan="4">subject(22 hours)
Curriculum: Core achievement standard</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td rowspan="3">Career</td><td rowspan="3">Elective activities</td><td rowspan="2">Club activities</td><td rowspan="3">Art and sports</td><td rowspan="3">Career</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td></td></tr>
</table>

* Career exploration 5 + Elective activities 2 + Club activities 2 + Art and Sports 3 = 12 hours

4. **The expansion of the free semester program**

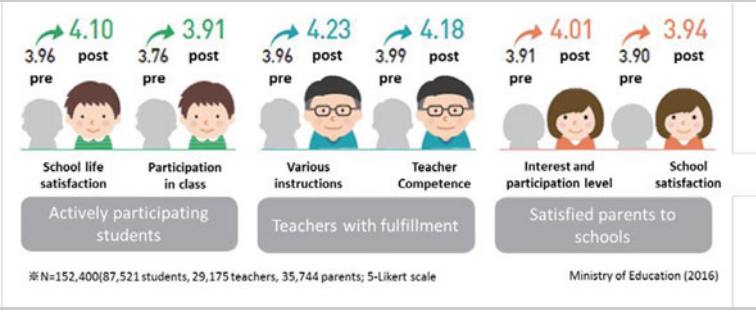
- Progressive expansion plans.
- Rapid rate of expansion due to high demands from the actual classrooms.



5. **Assessment in exam-free semester: Basic direction of exam-free semester assessment (MOE 2015)**

   (a) Conduct a process-oriented evaluation to support student learning and growth instead of midterm and final examinations.
   (b) Implement and formulate self-reflection evaluations to evaluate students' achievement level according to core achievement standards by subject.
   (c) Described in the school record by focusing on student's activities, achievement, participation, and attitude.
   (d) Assessments during the exam-free semester are also focused on the process of learning to foster students' growth and to avoid the use of standardized, paper-based midterm, and final tests.
   (e) Assessment principle and guidance for evaluating key competences included in the 2015 curriculum have been provided, but no standardized testing tools are available yet.
   (f) Currently, the government is supporting key competence evaluation in schools through various ways such as distributing key competence-based activities and assessment case books.

6. **Major achievement of exam-free semester**



Based on the effectiveness of the exam-free semester and the high level of satisfaction of students, teachers, and parents, it was fully implemented in 2017 since it was piloted at 42 research schools in May 2013.

7.7 Cultivating Key Competences in Informal Education

Key competences are also emphasized and implemented in Korea's informal education. Specifically, key competences evolve in such youth activities as after-school program, Boy Scouts, and Girl Scouts. An example of key competences in Korean informal education can be understood in terms of the Youth Policy Basic Plan. Such a plan is to be established for every 5 years to support youth's healthy growth, in accordance with the Youth Act. The 5th Youth Policy Basic Plan (2013–2017) highlights strengthening youth's competences. Its subareas include

(a) Activating youth competence promotion activities.
(b) Strengthening global/multicultural competences.
(c) Strengthening personality and civic education.

According to this plan, Korea's administrative agencies and municipalities provide activities and create environment to enhance youth's competences (see examples in Table 7.10).

7.8 Key Competences in Special Education

The revision of the 2015 curriculum has made a significant change in the educational paradigm not only for general, but also for special education. Korean special education is aiming at inclusive education for students with disabilities as it is prescribed by Article 21 of the Special Education Law for people with disabilities.

The 2015 revised special education curriculum focuses on fostering creative-convergence students with the emphasis on righteous personality by cultivating key competences based on the educational ideology and good citizenship. It adopted and emphasized six key competences and one literacy area for students with disabilities:

1. Humanity, society, and science/technology related to literacy should be harmoniously cultivated, and selective learning should be strengthened according to student's aptitude and career goals.
2. The quality of learning should be improved by structuring and restructuring learning contents and optimizing the atmosphere of learning centered on the key concepts of the subject.
3. Self-directed learning should be encouraged and experienced by implementing various student class participation according to each subject.
4. Assessments of learning processes should be strengthened for students to reflect their own learning, and evaluation results are to be seriously considered to improve the quality of teaching and learning.
5. The consistency of the curriculum objectives, contents, teaching/learning, and evaluation should be strengthened.

Table 7.10 Examples of youth competence enhancement activities by city

City	Title	Contents
Seoul	Strengthening creativity competence through experience programs and municipal participation	Activating of visiting "Surprising Saturday" program
		Organization and operation of youth council
		Finding youth policy through holding a meeting for hope for children and adolescents
Sejong	Strengthening various competences of youth	A-reum youth training center erection
		Youth career experience card support program
		Youth overseas volunteer exchange support program
		Development and dissemination of youth personality education program
		Activating of peer counseling
Gwangju	Strengthening various competences of youth	Extension and maintenance support for youth space
		Activating of various activities for youth
Daegu	Strengthening various competences of youth	"Education sharing in our village" program
		Youth career experience activity support program
		"Youth adventure" management
		Youth creative-personality activity program
		Youth international exchange program, "Friendship project"

6. Specialized high schools and special education high schools should use National Competency Standards (NCS) to cultivate basic competences and job skills required by the demands of the social industry.
7. Individual students' competence should be strengthened by emphasizing individualized education for students with disabilities for their unique educational needs.

Over 70% of students with disabilities in Korea are placed in special or inclusive classes in general schools, while others study in special schools. The general curriculum is prioritized; yet, special education curriculum and modifications are to be applied whenever necessary to meet individual students' needs.

7.9 Key Competences Assessment in Korea

7.9.1 Assessment Principles in the 2015 Curriculum

The main high-stake examination in Korea—CSAT—is performed for those who have already graduated from schools. There is no nationwide assessment of school children; only sample tests are performed.

The 2015 revised curriculum is being applied now, and its assessment approach is still in progress. To assess the quality of the curriculum at the national level, a set of achievement standards has been developed and distributed to meet three objectives for evaluation:

1. **To reflect curricular competences**. The concept of function has been proposed for the achievement evaluation. By combining the key competences with content elements of each subject (curricular competences), the achievement standards reflecting key competences have been emphasized (see Fig. 7.6).
2. **To promote students' participation**. 20% of standard time should be secured for teachers to improve instructional methods/lectures and to deliver improved lesson plans to reinforce creative convergence/key competences in classrooms. A variety of assessments facilitating student participation and learning activities is also required.

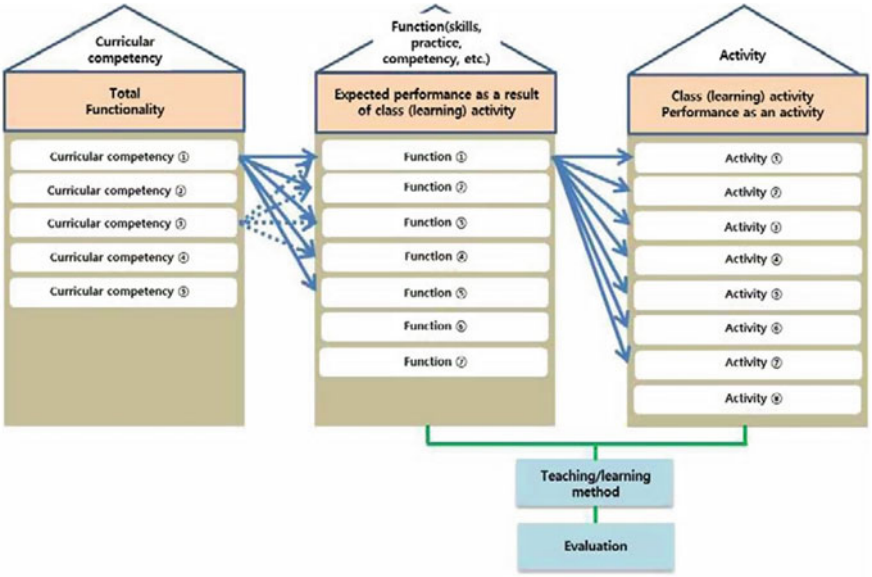


Fig. 7.6 Teaching/learning methods and evaluation framework of the 2015 revised curriculum. *Source* MOE [27]

3. **To utilize a variety of evaluation methods.** Key competences should be measured with formal and informal evaluation within the learning context instead of implementing standardized measurements. To do this, various evaluation methods are to be enforced rather than traditional paper-based evaluation.

The evaluation principle mentioned can be further elaborated as follows. It is important to state the actions or performances of students who reveal key competence-related factors and to evaluate them with the various tasks and methods that can lead students to learn. The more specific classroom assessment steps will be explained with specific examples here [11].

As shown in Fig. 7.7, in Step 1, the teacher is asked to clearly grasp the meaning and evaluation factors of key competences to be evaluated and analyze the relevant curriculum achievement standards. Table 7.11 shows the examples of achievement standard and key competences evaluating factors that are derived from the Korean language curriculum analysis.

In Step 2, the teacher describes the expected results when the student is equipped with the key competences identified in Step 1 during the lessons. It is also necessary to incorporate the key competences evaluation criteria with curriculum achievement standards at this time. In Step 3, the details of how to organize the tasks in the performance assessment and the classroom activities are summarized. This procedure can take the form as shown in Table 7.12.

The teacher who is ready to move on to the next step can implement activities and evaluation in line with the plan and collect data from students.

In the final step, the teacher will evaluate students to determine if they show expected characteristics of key competences and provide feedback on the results. If needed, the teacher can provide new assignments or conduct assessments to improve students' key competences.

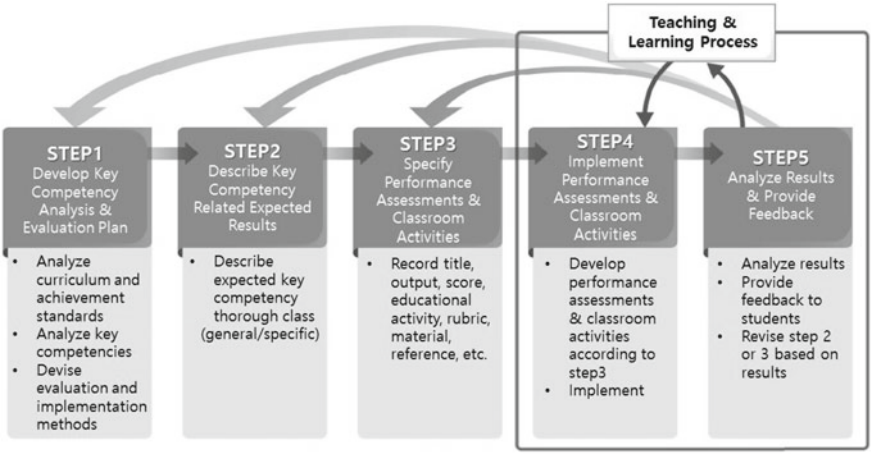


Fig. 7.7 Recommended classroom evaluation steps

Table 7.11 An example of communicative and community competence evaluation criteria for Korean language achievement standards

Achievement standard (2015 revised curriculum)	• Listening/speaking – [9K01-04][a] Communicate at a discussion and resolve the problem reasonably – [9K01-06] Speak with the consideration of the audience's interests and needs – [9K01-08] Give an organized presentation which can deliver key information – [9K01-10] Determine the validity of the information as the student listens – [9K01-11] Determine the effectiveness of media as the student listens • Reading – [9K02-03] Summarize the content of the texts considering the purpose and the nature of it – [9K02-07] Evaluate various expressions and intentions expressed in the medium during the reading – [9K02-08] Read texts while referring to related materials in the library or the Internet • Writing – [9K03-07] Write with variety of expressions to reveal the thoughts • Grammar – [9K04-08] Understand the origins of *Hangul* (Korean alphabet) • Literature – [9K05-09] Shape the valuable experience with unique ideas and expressions		
Key competences	Communication skill	K-I-2[b]	Understand genre and language customs
		K-I-3	Understand various media and media data
		K-II-2	Understand the purpose of communication
		S-I-1	Understand the key contents
		S-I-2	Infer intention, purpose, and contents
		S-I-3	Show critical, reflective acceptance
		S-II-2	Communicate and share information
		S-III-3	Check and adjust communication contents
		S-III-2	Check and adjust communication process
		V/A-I-1	Listen, with sympathy

(continued)

Table 7.11 (continued)

		V/A-II-1	Show confidence in communication
		V/A-III-1	Accept communication results and willingness to practice
	Civic competence	I-S-1	Show community value seeking and willingness to practice
		I-V/A-1	Show identity and belonging
		II-K-1	Understand the problems of the community
		II-S-1	Explore the causes of community problems and solutions
		II-S-2	Participate in the community problem-solving process

Note [a] A combination of numbers and alphabets that represent individual achievement standard; [b] A combination of numbers and alphabets that represent each key competence evaluating factor

Finally, a table summarizing the necessary considerations in each of the evaluation steps is presented in Box 7.6.

Box 7.6. Specific considerations for each step of key competence classroom evaluation

1. **Develop key competence analysis and evaluation plan**
   - What are the key competences that can be cultivated through this achievement standard?
2. **Describe key competence-related expected results**
   - What are the characteristics of the key competences associated with these achievement standards?
   - What can a student who achieves this achievement standard do?
3. **Specify performance assessments and classroom activities**
   - What tasks will you use to assess students' "performance"?
   - How will the class activities be structured?
   - What are the outputs of each activity step?
   - How will each output be evaluated?
   - How will the results be reported and recorded?

Table 7.12 An example of Korean language tasks and evaluation methods

Session	Achievement standard	Evaluating factor	Tasks	Outputs	Evaluating methods
1	[9K01-06] [9K02-03] [9K02-08] [9K04-08]	K-I-2 I-V/A-1 S-I-2 S-I-3	1. Understand the origins and excellence of *Hangul* – Group discussion after watching a video – Record in worksheet 2. Research and organize data – Materials supporting the excellence of *Hangul* – Materials that show the actual conditions and problems of using *Hangul* – Organize the used materials	• Worksheet 1 – The origins of *Hangul* – The excellence of *Hangul* – Personal thoughts on the value of *Hangul* – Find a case of feeling identity and belonging as a Korean • Data collection – Attach the researched data – Worksheet 2 – Organize the data contents	• Self-evaluation • Teacher evaluation • Evaluation of outputs

4. **Implement performance assessments and classroom activities**
   - Is the activity in line with the plan?
5. **Analyze result and provide feedback**
   - What are the characteristics of the student who achieves the expected results?
   - What is lacking for students who have not achieved the expected results?
   - Where and how to record?
   - How will you modify your future goals and expectations?

7.9.2 Existing Key Competence Assessment Practices in Korea

The assessment principle and guidance for evaluating key competences included in the 2015 curriculum have been provided, but no standardized testing tools are available yet. Currently, the government is supporting key competence evaluation in schools through various ways such as distributing key competence-based activities and assessment case books shown in Fig. 7.8.

There are no standardized tests officially developed and distributed in the country, but key competence-related measurements have been developed in the private sector. Kim [6] developed a standardized measurement, Key Competence Test for Children and Adolescents, with the support of Korea Guidance Testing Company. This test was designed for providing comprehensive information by understanding the level of cognitive and personality competence development of middle school students. The test has been used to evaluate the effectiveness of the exam-free semester. It consists of two parts: key personality competence test and key cognitive competence test (see Table 7.13).

Such competence assessment framework has been established at the national level and district level. However, schools vary in implementing their own assessment tools and methods. Further discussion and studies are required.

7.10 Major and Typical Issues and Challenges in Implementing the New Curriculum

– From General to Subjects? or from Subject to General?

The relationship between Korea general competences and subject competences has not been clearly identified. In Korea, key competences in general have been developed at first and then reflected to competences in subjects. Through that way, some specific

Fig. 7.8 Examples of key competence-based activities and evaluation casebook for exam-free semester

Table 7.13 Overview of key competence test for children and adolescents

Configuration of the test		Time	Number of items	Items by area	
1	How to use	5 min	–	–	
	Key cognitive competence test	28 min	75	Language	35 items (8 min)
				Logical mathematics	20 items (10 min)
				Space	20 items (10 min)
2	Key personality competence test	12 min	81	Individual personality competence (vision, self-initiative, and emotional stability)	24 items
				Individual personality competence (communication, conflict resolution, social sensitivity, civic communication, decision making, and social leadership)	24 items
				Learning competence (learning motivation, self-esteem, cognitive-metacognitive strategy, and resource management strategy)	32 items
				Sincerity of response	1 item
Total		**45 min**	**156 items**		

aspects of subjects cannot be included in general competences. For example, practical aspects, such as doing experiments, regarded as crucial in science subjects are missing in the general competences. In the worst case, general competences and subject competences seemed to be going their ways separately. Recently, subject education researchers are looking into competences in subjects from the view of subjects and are exploring the possibility of extracting common competences among subjects.

– How can development of different aspects of key competences and literacies be supported within an individual learning trajectory of each student?

This question arose from the discussions about the place of physical literacy—new to the educational system—in the curriculum [9]. This type of literacy embraces several distinct dimensions (physical, intellectual, moral), but for a comprehensive development of a person it is important that all those are intertwined seamlessly. This will affect the organization of contents in the subjects and the pedagogies necessary for teaching them. Discussions on how to integrate and combine them to work together in an individual student's everyday life and work are needed.

– What methods of teaching are better suited for supporting key competences?

The MOE has run 18 research schools for pilot adaptation of key competence-based curriculum from 2014. The research schools conducted their own designed curriculum for cultivating key competences and reported the results. KICE analyzed the reports and interviewed the teachers to get suggestions from the research schools. One of the main conclusions is that the key competences would be cultivated through innovations of teaching and evaluation methods.

> …the key competency building curriculum design method needs to actively consider characteristics of teaching and learning (student participation class, real-life problem-oriented class, cooperative and discussion focused class etc.), and evaluation methods (process-oriented performance assessment, peer- and self-assessment, assessment of affective features etc.) [1].

This conclusion would mean that the improvement of teaching and learning methods and evaluation methods is one of the keys for implementing a competence-based curriculum.

7.11 Best Practices in New Curriculum Agenda Implementation

Case 1. Seonyoo Middle School

School physical education programs have been promoted in Korea for its potential for character development in the last several years. Seonyoo Middle School located in Seoul has led this movement from the beginning.

Various new sports, such as Netball, Kin-Ball, and Futsal, are introduced for school children. Other ball games such as soccer, basketball, and volleyball are also provided. More than one-third of students are members of 13 sport clubs. Such sport clubs are integrated with regular physical education classes and Saturday Sports Day program.

As a result, from students' participation in sport clubs, several key competences are being developed, such as healthcare ability and interpersonal skills. In addition, the fitness test level increased from 41.6% in 2010 to 62.3% in 2014, while students' violent behaviors decreased from 6 in 2011 to 1 in 2014.

Case 2. Bundang Middle School

The free-semester initiative offered at all Korean schools allows students to participate in various activities such as watching documentaries, discussing issues, visiting sport industrial factories and companies, and listening to athletes' lectures, as well as playing sports. Students can be free from the academic works and tests during one semester of the first year in middle school.

The free semester program in Bundang Middle School has been developed around the theme of careers in physical education, with a variety of diverse in-class and outdoor activities. It consists of physical activities, career-related activities, and humanities-based experiences, such as sport paintings, sport poems, and sport music.

The program is based on the model of Humanitas-Oriented Physical Education (HOPE).

The main purpose of this program is to give students basic understanding of careers in physical education and to cultivate sport literacy. Students get an initial understanding on 10 sport careers, including sport agent, exercise specialist, sport journalist, sport manufacturer, sport retailer, sport team supervisor, and physical education teacher. These experiences are contributing to the development of each student's sport literacy, with which they can enjoy sport in various ways.

Students participating in this program improve their knowledge of sport-related jobs, sport cultural understanding, and love of physical activity. It consists of various indirect activities such as watching, drawing, writing, visiting, listening, and talking, not exclusively of physical activities.

Annex

Information Sharing System for Supporting the Curriculum Reform, Development, and Implementation

The MOE, provincial office of education, and institutions run various websites to share information about new curriculum agenda. Documents, research reports, examples, and various teaching and learning materials are shared through the websites. Communities are activated through the websites [12].

Examples of information sharing system and institutions

Website	Purpose	Address
NEIS	Educational administrative support system	https://www.neis.go.kr/pas_mms_nv99_001.do
NCIC	To share information of national curriculum with teachers, researchers, publishers, and the public	http://ncic.go.kr/english.index.do
Ggoomggi	Support and share information about exam-free semester	http://www.ggoomggi.go.kr/page/new/page_new_main
Crezone	Support and share information about creativity experience activity	https://www.crezone.net/
Career net	Career education	https://www.career.go.kr/cnet/front/main/main.do
Donation for education	Link industry, research institutes, university, and so on that want to donate their resources to schools	https://www.teachforkorea.go.kr/

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Chapter 8
Finland: Improving Pupils' Opportunities for Experiencing the Joy of Learning, for Deep Learning, and for Good Learning Achievement

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Wittgenstein on learning to look for things and learning how to ask questions. Sentence 315:
It would be as if someone were looking for some object in a room; he opens a drawer and doesn't see it there; then he closes it again, waits, and opens it once more to see if perhaps it isn't there now, and keeps on like that. He has not learned to look for things. And in the same way this pupil has not learned how to ask questions. He has not learned the game that we are trying to teach him.
Ludwig Wittgenstein: On Certainty (Uber Gewissheit) (Eds. G.E.M. Anscombe and G.H. von Wright, translated by Denis Paul and G.E.M. Anscombe. Basil Blackwell, Oxford 1969–1975.)

Abstract A fundamental dynamic feature of Finnish education is the role of the national curriculum, renewed after 1985 approximately every 10 years. Over this course, it has been becoming less detailed. The latest revision (2014) was associated with an explicit reform to integrate key (transversal) competences in the

A note from the editors:

The case of Finland is presented by a team from the University of Helsinki, one of the strongest international centers in educational assessment. Finland is a recognized leader of competence-based education, an impressive example that others refer to trying to find a key to success. The country tried to make learning meaningful for every student, to achieve a real disciplinary integration of school subjects. The reforms were based on trust—to the school, teachers, and learners. Key (transversal) competences are embedded in each subject, but there are no direct guidelines as to how exactly it should be done. The authors of this chapter reflect critically on their experience and ask: what are the systemic drawbacks of their approach and what should be improved to keep the country's learning outcomes consistently high?

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core curriculum. The central idea of the revised National Core Curriculum is that transversal competences are embedded into curricular objectives of each subject. Transversal competences are promoted in teaching and learning in every school subject and in multidisciplinary learning modules. Such modules allow students to overcome disciplinary boundaries in their understanding of real-life phenomena, and foster development of transversal competences. Municipalities and schools contribute significantly to the practical implementation of the curriculum: they adjust it to their local priorities and conditions. Some important issues associated with the implementation of the curriculum–such as assessment of transversal competences and learning outcomes of multidisciplinary learning modules–remain yet open. The lack of clear guidelines makes it difficult to compare transversal competencies between schools. Additional research is needed that would perhaps help replace the existing selection of transversal competences in the curriculum with theoretically more robust constructs.

Keywords National Core Curriculum · Curriculum reform · Transversal competences · Multiliteracy · Multidisciplinary Learning Modules (MLMs) · Measuring transversal competences · Assessment of transversal competences

Highlights

- A fundamental dynamic feature of Finnish education is the role of the national curriculum, renewed after 1985 approximately every 10 years. Over this course, it has been becoming less detailed. The latest revision (2014) was associated with a serious reform to integrate key (transversal) competences in the core curriculum.

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- The central idea of the revised National Core Curriculum is that transversal competences are not introduced as additional school subjects—instead, they are embedded into curricular objectives of each subject.
- Transversal competences are promoted in teaching and learning in every school subject and in multidisciplinary learning modules. Such modules allow students to overcome disciplinary boundaries in their understanding of real-life phenomena, and foster development of transversal competences.
- There is no high-stakes assessment in secondary school. Formative assessment with verbal comments plays a key role.
- Municipalities and schools contribute significantly to the practical implementation of the curriculum: they adjust it to their local priorities and conditions.
- Some important issues associated with the implementation of the curriculum—such as assessment of transversal competences and learning outcomes of multidisciplinary learning modules—remain yet open. The lack of clear guidelines makes it difficult to compare outcomes between municipalities and schools.
- Additional research is needed that would perhaps help replace the existing selection of transversal competences in the curriculum with theoretically more robust constructs.

8.1 A General Description of the Education System

Finnish education (Fig. 8.1) for children under 16 is made up of a 9-year comprehensive basic education preceded by 1 year of pre-primary education. These form the compulsory part of education even if school attendance is not obligatory. After completing basic education, approximately 96% of students continue their studies in non-compulsory upper secondary education. Person's liability to participate in compulsory education was extended on August, 2021. Currently, under this new legislation, compulsory education ends when a student turns 18 or when they complete an upper secondary degree or equivalent foreign education before that age.

All these stages of education are governed by their respective national core curricula. The present system of comprehensive education was adopted in 1968–1970 and implemented across the country between 1972 and 1978, beginning in Lapland in 1972 and reaching Helsinki and the other municipalities of the metropolitan region in 1978 [4, 29, 35, 56]. Even if basic education is comprehensive by decree and curriculum, it still carries the heritage of primary (Grades 1–6) and lower secondary (Grades 7–9) education in the form of classroom teachers (Grades 1–6) and subject teachers (Grades 7–9) and often in the form of separate smaller schools for the primary grades. After basic education, there is an option for an extra year (Grade 10) for students to improve their marks, if needed to enter the upper secondary education of their choice. The vast majority (approximately 96%) of students continue their studies in upper secondary education, either in the general (academic) track or in vocational education (about 54% versus 46% of students, respectively). Both tracks

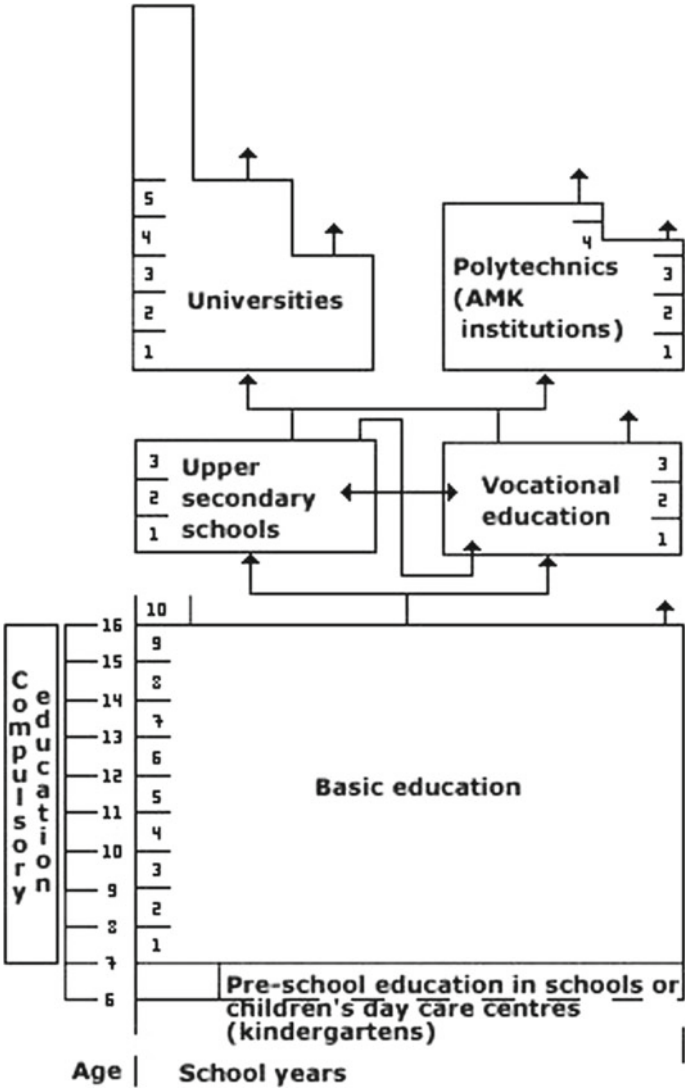

Fig. 8.1 The system of education in Finland

provide access to tertiary education in academic universities or in universities of applied sciences (polytechnics).

In Finland, the main providers of basic education are the 311 municipalities. There are also some private-, state-, or university-run schools. Most of these act as part of the regular municipal school supply, but some have a special status and are able to select their students. All educational providers and all schools are obliged to follow the key national educational standards: the Basic Education Act, the basic

education decrees that include, among others, the distribution of lesson hours, and the National Core Curriculum for Basic Education (NCCBE). Municipalities and other providers of education as well as individual schools are obliged to write their own local curricula aligned with the National Core Curriculum (NCC) and other national standards. These local interpretations do not need formal approval by any state authority, however. Likewise, textbooks, whether printed or e-books or other digital learning environments and materials, do not need approval by national authorities but are provided by commercial enterprises in the field. The authors are mostly experienced teachers or educational scientists and the contents of the books and digital learning materials closely follow the core curriculum of the respective subjects and grade levels. Schools are free to select the textbooks and digital learning materials they use within the guidelines of the municipalities. The steering system is described in the Box 8.1 in relation to basic education, but the same rules are also true for preschool and upper secondary education.

Box 8.1. The steering system of basic education: from national level to classrooms

The purpose of the steering of basic education is to ensure the equality and high quality of education and to create favorable conditions for the pupils' growth, development and learning. The normative part of the steering system comprises the Basic Education Act and Decree, Government Decrees, the National Core Curriculum, and the local curriculum and annual plans of individual schools based on it. Various parts of this system are being updated to ensure that changes in the world around the school can be responded to and that the school's role in building a sustainable future can be strengthened in the organization of education.

The National Core Curriculum is formulated pursuant to the Basic Education Act, Decree, and Government Decrees that specify the goals of education and the distribution of lesson hours. The core curriculum is a national regulation issued by the Finnish National Board of Education, in compliance with which the local curricula are prepared. The purpose of the core curriculum is to support and steer the provision of education and schoolwork and to promote the equal implementation of comprehensive and single-structure basic education.

The education provider carries the responsibility for the preparation and development of the local curriculum. Decisions on the implementation and organization of the educational task of basic education, instruction, assessing and supporting learning, guidance counseling and pupil welfare, cooperation between home and school and other activities are contained in the curriculum. The local curriculum complements and emphasises the goals, policies that direct the activities, key contents and other aspects related to the organization of education specified in the core curriculum from a local perspective. When preparing the curriculum, the education provider takes into account the pupils'

needs, local special features and the results of self-evaluation and development efforts.

When preparing the curriculum, the fact that the instruction may be either mainly subject-based or integrative must be taken into account. When opting for integrative instruction, an integrative curriculum may also be formulated for grade units.

All personal plans for pupils are based on the local curriculum. A school's annual plan specifies how the curriculum will be implemented in each school during the school year. The Basic Education Decree lays down the obligation of informing the pupils and their guardians of key decisions contained in the annual plan."

Sources: Finnish National Board of Education (FNBE) 2016. National Core Curriculum for Basic Education 2014. Printed with the permission of the EDUFI (previously the FNBE). Sections 1.1 and 1.2 (2–15).

A fundamental dynamic feature of Finnish education is the role of the national curriculum, renewed approximately every 10 years. The core curricula for the different education levels are prepared by the Finnish National Agency for Education (EDUFI) (former Finnish National Board of Education, FNBE) in collaboration with relevant stakeholders (for example, parents, educational administrators, universities, and teacher unions).

The first curriculum after the approval of the reform was very detailed, but since 1985, the curricula have become less so. This change was accompanied by another salient feature of the Finnish education system, that is, the abandonment of national inspection in 1985 despite the lack of high-stakes testing [9, 22, 54, 56, 57, 64]. The only exception to the lack of common testing is the National Matriculation Examination at the end of general upper secondary education. This examination, with its origins in the oral entrance examination of the University of Helsinki in 1852, has withstood time despite the educational reforms of more than 160 years and is currently expected to be fully computerized in spring 2019.

The last four curriculum reforms are briefly described in Box 8.2. In this case study, we concentrate on the basic education reforms of 2014.

Box 8.2. The four twenty-first-century curricula reforms in Finland

(1) NCCBE 2014

The core curriculum is a national regulation issued by the FNBE, based on which the local curricula are drawn up. The purpose of the core curriculum is to provide a common ground for the local curricula and thus promote equality and equity in education and the rights of the pupils within the whole country.

The core curriculum supports and steers the provision and implementation of basic education.

The NCC contains the guidelines for the provision of education as well as the objectives and key contents of instruction. The core curriculum also addresses development of the school culture and cooperation, implementation of education, instruction, and guidance, support for learning, pupil welfare, as well as assessment of learning. To support the work of the education providers, the core curriculum also contains references to the legislation that underpins the norms laid down in this document and the field of basic education as well as guidelines for preparing the local curricula.

Annexed to the core curriculum are the recommendations for the objectives and contents of instruction as well as assessment of pupil's learning in three subject syllabi (Sámi language, Roma language, and pupil's own mother tongue) that complement basic education.

(2) National Core Curriculum for Pre-primary Education 2014

The National Core Curriculum for Pre-primary Education is a national regulation. The local curricula for pre-primary education are prepared in compliance with the NCC. The National Core Curriculum for Pre-primary Education supports and directs the organization of pre-primary education and promotes the implementation of unified pre-primary education in different parts of Finland. The core curriculum includes references to the legislation governing pre-primary education and instructions for preparing and developing a local curriculum.

(3) National Core Curriculum for General Upper Secondary Schools 2015

The National Core Curriculum for General Upper Secondary Schools 2015 is a national regulation issued by the FNBE, based on which the provider of General Upper Secondary Education will take decisions respecting the local curriculum. The core curriculum constitutes a common foundation for drawing up the local curricula, thus promoting equality and equity in education in Finland. The National Core Curriculum for General Upper Secondary Schools 2015 determines the objectives and core contents intended for young people as referred to in the General Upper Secondary Schools Act, specifying the cross-curricular themes, subjects, subject groups, and other instruction within the remit of upper secondary education. It also addresses preparation and contents of the local curriculum, the mission and underlying values of general upper secondary education, implementation of education, guidance and support for students, as well as assessment of student learning.

(4) National Core Curriculum for Early Childhood Education and Care 2016

This National Core Curriculum for Early Childhood Education and Care is a national regulation issued by the EDUFI. It is used as the basis for preparing local curricula for early childhood education and care. The purpose of the core curriculum is to provide a common basis for local curricula. The core curriculum document steers the provision, implementation, and development of early childhood education and care as well as promotes the implementation of high-quality and equal early childhood education and care in the entire country. The core curriculum contains references to the legislation governing early childhood education and care as well as instructions for preparing and developing local curricula. The municipality, joint municipal authority, or other service provider shall prepare and adopt a local curriculum compliant with this core curriculum at the latest on August 1, 2017.

Source: Excerpts taken from the descriptions of the respective publications in English.
https://www.ellibs.com/fi/books/publisher/0/opetushallitus.

The core curriculum provides general guidelines, values, and goals of education as well as the more concrete goals and contents for the different subjects at all grade levels. With no inspection and only sample-based assessments as guidelines, the implementation of the core curriculum in schools can vary substantially despite the alignment of the municipal and school curricula with the NCC.

The providers of education are obliged to evaluate the education they provide (Basic Education Act, § 21, 21.8.1998, 30.12.2013) and participate in the national sample-based evaluation studies when included in them. When systematic between-school variation in school marks (grades) began to be observed in the national curricular assessments in the 1990s, descriptive criteria for marking were introduced in the next core curriculum of 2004. The aim was to guide teachers in their assessment of students' learning to promote uniformity and fairness, especially in view of the use of school marks in the form of grade point average (GPA) in choosing students for the different upper secondary schools and programs.

Municipalities differ somewhat in how school districts are formed, but all children are allocated a place at a nearby neighborhood school. There is no open achievement-based tracking or streaming in the Finnish basic school system. However, the parents' right to choose a school for their child and the increasing social segregation of neighborhoods, in conjunction with some selective schools and a wider offering of selective classes, have an effect comparable to open streaming, especially in cities [37]. Accordingly, classes based on student selection have lately emerged as a growing source of between-class differences. Whereas in the Organization for Economic Co-operation and Development (OECD) Programme for International Student Assessment (PISA) studies Finland has repeatedly stood out due to its small between-school differences, the results of the 2011 Trends in International Mathematics and Science

Study (TIMSS) study revealed the Finnish between-class differences to be manifold compared to those of its close neighbors Sweden and Norway [66]. This difference has also been found in national assessments [34].

Since the curriculum reform of 1985, the curriculum process is made up of four levels: (1) the Government of Finland gives the educational acts as well as the decree regarding the distribution of lesson hours, (2) the EDUFI prepares the NCC, (3) municipalities prepare their own local curricula in compliance with the NCC but adapt them to local circumstances, and (4) schools prepare their own detailed curricula based on the above. Despite the requirement for compliance, municipalities and schools have certain degrees of freedom regarding lesson plans (the decree only states the minimum to ensure the students' rights for education) and even wider freedom regarding the implementation of the curriculum. This multilevel structure is a typical modern solution in educational systems, due to the practical difficulties of providing detailed national curricula regulations, which would inform teaching to the smallest detail. Fullan's tri-level reform theory makes a distinction between state, district, and school, and this model has also been found relatively useful in analyzing the latest Finnish reforms [7, 51].

It is a separate research issue how to model the position of global trends in relation to national reforms. This means, in our case, how twenty-first-century discussions of key competences and new literacies are transmitted to national educational policies; to national regulations and reforms; to municipalities; and, finally, to schools and the classrooms. Developing a better understanding of this transmission or adaptation process is the key issue of the present consortium.

8.2 Toward Twenty-First-Century Education in the Finnish Basic School

The latest renewal of the NCC had its roots in a wish for a more comprehensive reform. Even if this reform did not get enough political support, it left its marks in the new curriculum of 2014 with its explicit orientation to the demands of the twenty-first century. In Box 8.3, there is a summary of the 2014 curriculum process, written by the then head of the NCC 2014 reform team.

Box 8.3. Curriculum reform 2012–2016.

In Finland, a significant reform concerning an innovative reorganization of disciplines was proposed in 2010. All subjects were to be regrouped as "themes" and the aim was to increase the share of optional studies. This suggestion faced a strong opposition from some of the parties in the government and did not proceed to the parliament.

In 2012, the government approved a new decree on the goals and allocation of teaching hours between subjects. Based on that, the EDUFI has drawn up new core curricula for pre-primary and basic education. These core curricula were given at the end of 2014. Municipalities, which are the main bodies responsible for providing education, have designed the new local curricula based on this NCC.

Teaching and learning according to the new curricula started in August 2016. The main goal of the reform is to improve pupils' opportunities for experiencing the joy of learning, for deep learning, and for good learning achievement. For the first time, transversal competences needed in the rapidly changing and complex world are described and a new tool for integrative teaching and learning, an **MLM**, is defined as obligatory.

Value basis and guiding principles for the development of the school culture

In the NCCBE, there is a strong emphasis on values as well as the development of school culture based on those values. The value basis consists of four value pillars, on which every school is expected to build its operating culture:

(a) Respecting the uniqueness of each pupil and guaranteeing the right to a good education.
(b) Promoting each pupil's growth as a civilized human being and as an active citizen of a democratic society.
(c) Valuing cultural diversity and regarding it as a richness.
(d) Understanding the necessity of a sustainable way of living.

The core curriculum also includes **seven principles** that guide the development of the operating culture in the basic education system as a whole and in each municipality and school. These seven principles are based on the four value pillars:

(a) Development as a learning community.
(b) Well-being and safety in daily life.
(c) Interaction, collaboration, and versatile working approaches.
(d) Cultural diversity and language awareness.
(e) Participation and democratic action.
(f) Equity and equality.
(g) Environmental responsibility and sustainable future orientation.

Transversal competences and MLMs

The NCCBE includes descriptions of **transversal competences**, which should be **promoted in teaching and learning in every school subject and in MLMs**. Transversal competence refers to an entity consisting of knowledge, skills, values, attitudes, and volition. Competence also means an ability to apply

knowledge and skills in a given situation or context. The manner in which pupils use their knowledge and skills is influenced by their values, attitudes, and their willingness (volition) to take action. These competences cross the boundaries of disciplines and link together different fields of knowledge and skills.

The seven transversal competences are defined based on the four value pillars, the seven development principles of the school culture, and the conception of learning that is also defined in the core curriculum. All seven competences are interconnected. It is emphasized in the core curriculum that it is particularly important to encourage pupils to recognize their uniqueness and their personal strengths and development potential in all these areas of competence and to appreciate themselves.

These competences have been taken into account in the definition of the objectives and main content areas of the obligatory school subjects. The **subject descriptions also point out the links between the objectives of the subject and the transversal competences.**

One of the main goals of the curriculum reform is to promote an **integrative approach in teaching and learning**. The reform made so-called **multidisciplinary learning entities** obligatory.

The purpose of this integrative approach is to enable pupils to see the relations and interdependencies between the topics to be studied in school and the phenomena of real life. It should help pupils link knowledge and skills of different disciplines, in interaction with others, to structure them as meaningful entities. Inquiry-based and exploratory study periods and projects create opportunities to apply knowledge and skills learned in different subjects, and to have experiences of participation and democratic action, problem-solving, and constructing and creating new knowledge together. This should allow pupils to perceive the significance of the topics they learn at school for their own life and for the community, the society, and the humankind. In the learning process, pupils are supported to expand and structure their worldview. The modules offer excellent opportunities for cooperation between different learning groups, between pupils of different ages, and between the school and the society around it.

The main principles given in the core curriculum regarding the multidisciplinary learning entities are few:

- Schools are responsible for planning and implementing at least one extensive MLM every school year (every pupil has a right to study at least one module in every grade of his/her basic education).
- Teachers collaborate in planning and implementing the module.
- Pupils participate in the planning, implementation, and assessment of these modules.

- The objectives and content of the modules must be interesting and meaningful from the pupils' perspective.
- Modules must be based on the values and development principles of the school culture and promote the development of transversal competences.

Everything else—the number of modules, the actual objectives, content, ways of working, use of learning environments and materials, organizing the cooperation, planning and assessment procedures, and so on—will be planned and decided at the local/school level. MLMs do not increase the learning time of pupils but instead use the lesson hours of the subjects involved in the planning and implementation of the module. Pupils' learning process and achievement in the module are assessed, feedback is given to the pupils (formative assessment), and the results of the assessment are taken into account when forming the grades in the year report (summative assessment).

The first school year based on the new curriculum and implementing transversal competences and MLMs is now nearly finished. The first experiences have been good. Teachers seem to be inspired by the new approaches (especially by the MLMs), but they also express the need to have more in-service training to better master the objectives of the new curriculum.

Source: Halinen 2017. Printed with the permission of Irmeli Halinen, Former Department Director of EDUFI, Head of the 2014 Curriculum Reform.

As explained earlier, the reforms take their true start, when the government officially gives the list of school subjects and the lesson hours. For the present NCC 2014 reform, Fig. 8.2 gives the distribution of lesson hours in basic education.

In the English version of the Finnish NCC 2014, the term "transversal competences" has been adopted for what is variously referred to in the literature as twenty-first-century skills, key competences, or new literacies. The "integrative instruction and multidisciplinary learning modules" mentioned in the excerpt in Fig. 7.4 are also an integrative part of the designed solutions to advance competences necessary for future working life. Yet, in the spirit of school autonomy governing all implementations of the core curriculum, the detailed design and evaluation of these have been left to the providers of education.

However, there have been precursors paving the way for the new 2014 core curriculum. Both the language and the new tools reflect the European and worldwide discussions of the past 20 years on cross-curricular competences, key competences, literacies, and twenty-first-century skills. Since the 1970s, Finland has participated in the International Association for the Evaluation of Educational Achievement (IEA) Science, Reading, and Math Studies (Progress in International Reading Literacy Study [PIRLS] and TIMSS), since the 1990s, in the European Union Key competences projects [36], and since 2000, in the OECD PISA studies. Finland also participated in the Assessment and Teaching of 21st Century Skills (ATC21S) project [5,

Subjects / Grades	1 2	3 4 5 6	7 8 9	Total
Mother tongue and literature	14	18	10	42
A1-language	----------	9	7	16
B1-language	----------	2	4	6
Mathematics	6	15	11	32
Environmental studies	4	10		
Biology and geography[1]			7	
Physics and chemistry[1]			7	
Health education[1]			3	
Environment and nature studies in total		*14*	*17*	31
Religion/Ethics	2	5	3	10
History and social studies[2]	----------	5	7	12
Music	2	4	2	8
Visual arts	2	5	2	9
Crafts	4	5	2	11
Physical education	4	9	7	20
Home economics	----------		3	3
Artistic and practical elective subjects		6	5	11
Artistic and practical subjects in total				*62*
Guidance counselling	----------		2	2
Optional subjects		9		9
Minimum number of lessons				222
(Optional A2-language)[3]	----------	(12)		(12)
(Optional B2-language)[3]	----------		(4)	(4)

--- = Subject is taught in the grades if stated in the local curriculum.

[1] The subject is taught as a part of integrated environmental studies in the grades 1-6.

[2] Social studies are taught in grades 4-6 for at least 2 hours per week and grades 7-9 at least 3 hours per week.

[3] The pupil can, depending on the language, study a free-choice A2 language either as an optional subject or instead of the B1 language.
The pupil can study the B2 language as an optional subject. The free-choice A2 and B2 languages can, alternatively, be organised as instruction exceeding the minimum time allocation. In this case their instruction cannot be organised using the minimum time allocated in the distribution of lesson hours for optional or B1 language as defined in this paragraph. Depending on the language the pupil receives instruction in a B1 language or optional subjects instead of this B1 language. The distribution of lessons hours would be a minimum of 234 annual lessons for a pupil studying the A2 language as instruction exceeding the minimum time allocation. The corresponding number of annual lessons is a minimum of 226 for a pupil with the B2 language. The total number of annual lessons would be a minimum of 238 for pupils studying both the A2 and the B1 languages as instruction exceeding the minimum time allocation.

Fig. 8.2 Distribution of lesson hours in basic education. *Source* Government Decree June 28, 2012

6]. Finland also participates in United Nations Educational, Scientific, and Cultural Organization (UNESCO) educational projects [9, 22].

The role of the European Network of Policy-Makers for the Evaluation of Education Systems has been significant for Finland in introducing the concepts of cross-curricular and basic or key competences at the time they were only just emerging in the international forums. The network aimed at introducing options to and establishing European comparisons of education using methodologies that would be relevant and sensitive at the national level [13]. In Finland, the history of the transversal competences introduced in NCC 2014 can be traced back to the 1996 Evaluation Framework for Education (English translation of FNBE 1999), which benefitted from the active Finnish participation in the Network.

In 2009, a special tool, 'The Future of Learning 2030 Barometer," was launched by the FNBE as part of the preparation for the new core curriculum [8]. As the authors point out, the barometer, based on the Delphi method, was one of the first occasions when such a tool was systematically applied in Finland in the curriculum reform process: "The Barometer offered new ways of proving opportunities for participation, knowledge-sharing, and collaborative design of visions. It was crucial to the FNBE to have the possibility to look beyond today's problems and conflicts. The objective was to recognise different developmental paths and to utilise the knowledge produced by the Barometer when making decisions on the core curriculum" [8, 22, 23, 25].

The next stage in the time line for preparing for the new NCC 2014 took place in 2012–2013. There was an open FNBE platform, where new versions of the outlines and details were put out for discussion. At the same time, the FNBE invited members to the 36 working groups established to work on the different parts and dimensions of the curriculum. The groups had more than 300 participants: teachers, researchers, education administrators, parents, and other stakeholders. There were also unofficial reviews and comments from municipalities and other education providers throughout the process. When the first version of the curriculum was published, requests were sent to providers of education and other stakeholders for their official views on it.

Workshops were held with teacher education departments of research universities and with providers of textbooks and other teaching materials. Before the final version was printed, regional workshops were held to introduce the new core curriculum and help regional authorities and municipal education providers understand the reforms and support the latter in writing their own local curricula.

The FNBE launched the NCCBE in December 2014 and published supporting material on their web pages. With the Ministry of Education and Culture, the FNBE provided financial resources for national and local organizations, including universities, to provide in-service courses on the new core curriculum (or curricula as the curriculum for general upper secondary education was renewed in 2015) and the new requirements it sets on teaching and assessment, a sector newly emphasized in the curriculum. During the preparations for the implementation of the new curricula in 2016, the FNBE supported municipalities with in-service training and publishing extensive new supporting materials on their web pages. Special attention was given not only to the new emphasis of and ways to describe the goals of school subjects, but also to assessment, how to plan and manage formative assessment as an integral part of teaching, and how to relate this to summative assessments at the end of the year, especially at the end of Grades 1–2, 3–6, and 7–9 with their specific criteria for assessment. The FNBE/EDUFI also provides extra materials for assessment, MLMs, and multiliteracy—itself a new concept in the core curriculum; all these can be downloaded from their website.

Schools started to implement the new curriculum in the school year 2016–2017 at Grades 1–6, followed by Grades 7, 8, and 9 in autumn 2017, 2018, and 2019, respectively. The general parts of the curriculum are, however, already effective at all grade levels while the subject-specific regulations and assessment criteria will be implemented stepwise according to the aforementioned schedule and students' progress through the assessment stages of Grades 1–2, 3–6, and 7–9. Accordingly, the first students whose basic school certificate will fully reflect the new curriculum will only graduate in spring 2020, so well into the twenty-first century.

Major educational reforms are to be followed (Box 8.2). The follow-up of the 2014 NCCBE reform is set up in three ways:

- First, the EDUFI has collected local curricula from 70 municipalities to see the variation in local adaptations and to have evidence on how municipalities have included or covered transversal competences in the local curricula and on the design of the MLMs. Unfortunately, the results of this inquiry are not presently available.
- Second, The Finnish Education Evaluation Centre (https://karvi.fi/en/) has launched a national evaluation of the assessment of learning and competences in basic education and upper secondary education. The results of the evaluation were published in 2018.[1]
- Third, the road to the 2014 NCCBE has been recorded and analyzed in a research project "School Matters" with several publications [50, 51, 55, 59]. The main reported result of these participant observation studies is that the 2014 NCCBE creation process can be read from a point of view of sustainability [22] and has been an example of an "interactive bottom-up-and-top-down approach" [50]. At the time of writing, the preliminary unpublished results of Pietarinen group refer to the strong role of knowledge and understanding sharing in the curriculum work at schools.

Based on [19] and [27] theories on educational change, [7] has presented a synthesis of the stages of reform using the Finnish Special Education Reform (for example, [58] as the empirical basis of her modeling. She summarizes the Fullan–Hargreaves model with five stages or categories: preparation, entry, objective, dissemination, and impact. Applying these to the adoption of the twenty-first-century skills in the Finnish education system, the preparation, entry, and objective stages can be said to have been activated and passed while the dissemination stage is being currently enacted in schools and classrooms across the country.

The "objectives" of the 2014 curriculum reform in terms of the twenty-first-century education is discussed in the next section. The true "impact" of the new curriculum remains an open issue until at least 2020 and very possibly beyond that. In view of the constant changes of the world outside of school, and the lack of an even quasi-experimental design in the reform, it will be hard, if not impossible, to evaluate or even recognize its effects. Therefore, a follow-up of the implementation of the

[1] https://oppimisenarviointi.karvi.fi/pa-svenska-in-english/.

reform will be valuable in indicating how the reform toward adopting the twenty-first-century skills as part of the curriculum is advancing. Given the cutting-edge situation of the Finnish 2014 NCCBE, this will have more than national interest. In addition, along with the 2014 NCCBE, the core curricula of the pre-primary or kindergarten year, general upper secondary education, and early education were renewed following the same principles.

8.3 A Note on Special Education

The current role of special education in Finland dates back to the origins of the comprehensive school reform in the late 1960s. The ideal of a new comprehensive school system as education for all replaced earlier ability-based tracking and meant the teaching of the same curriculum for the whole age cohort in non-differentiated classes. Due to the challenges of this requirement in view of the full extent of variance in an age cohort, special education was extended to cover (potentially) all students, and study counseling was introduced to lower secondary education. A major reform of Finnish special education took place in 2011, with a separate amendment to the Law on Basic Education and the then current NCC of 2004, introducing a three-tier model based on a strong emphasis of early intervention (see [53, 58]).

The reform also acted as a model for the NCC reform in terms of the importance of meticulous preparation and financial and other support for municipalities, ensuring the orientation to and acceptance of the reform. Reflecting the special education reform of 2011, the NCC 2014 includes a separate chapter on support for learning and special education, based on principles of neighborhood school attendance, early intervention, rules for decision-making, and continuous evaluation of the receiving student's response to intervention.

One tool for this is the multi-professional Student Welfare Group (SWG), obligatory in every school [53, 63]. There are reasons to believe that the well-established provision of support for learning and of special education has contributed to Finnish students' high achievement in the OECD PISA studies over the years [47, 65]. This is especially salient in the small percentage of poor performers, the main reason for the small variance in the Finnish results [29, 35]. The preparation, entry, objective, dissemination, and partial impacts of this reform on special education have been studied extensively [7, 58].

8.4 Objectives of the 2014 National Curriculum Reform in Relation to Future Competences and Skills

In the reform process leading to the NCC 2014, there were three major aims: (a) to increase the meaningfulness of learning, (b) to integrate teaching in basic subjects,

and (c) to change the culture of schooling (FNEB, presentation October 21, 2017: In Finnish: oppimisen mielekkyys, perusopetuksen eheys, toimintakulttuurin muutos). Within these planning objectives, two offered solutions or tools, to use a Vygotskian concept, are most relevant for the current discussion: (a) transversal competences and (b) integrative instruction and multidisciplinary learning modules.

Transversal competences are seen to relate to the personally experienced meaningfulness of learning and the integration of different school subjects. There are seven transversal competences, which are written in the NCC 2014 as aspects aligned with the different subjects through processes, which can be found and included in the teaching of each subject in its specific form of appearance. MLMs are the form in which the two latter aims of integrated teaching and a new culture of schooling are realized in school, integrating the teaching and learning of two or more subjects in one extended entity, bringing forth a change in the daily culture of school learning. Through shared planning and teaching, the MLMs also enhance and increase cooperation between teachers and make the transversal characteristics of the different school subjects visible, supporting the development of students' transversal competences.

8.4.1 Transversal Competences in the Finnish NCCBE 2014

The general definition given for transversal competences in the NCC 2014 is "Transversal competence refers to an entity consisting of knowledge, skills, values, attitudes and will. Competence also means an ability to apply knowledge and skills in a given situation. The manner in which the pupils will use their knowledge and skills is influenced by the values and attitudes they have adopted and their willingness to take action. The increased need for transversal competence arises from changes in the surrounding world. Competences that cross the boundaries of and link different fields of knowledge and skills are a precondition for personal growth, studying, work and civic activity now and in the future" (NCC 2014, Sect. 3.3: Aiming for transversal competence).

The NCC 2014 lists seven transversal competences:

- T1 Thinking and learning to learn.
- T2 Cultural competence, interaction, and self-expression.
- T3 Taking care of oneself and managing daily life.
- T4 Multiliteracy.
- T5 ICT Competence.
- T6 Working life competence and entrepreneurship.
- T7 Participation, involvement, and building a sustainable future.

The NCC 2014 provides a description for all the competences justifying their significance. In Box 8.4, the definitions for T1 (Thinking and learning to learn) and for T4 (Multiliteracy) are given as an example.

Box 8.4. The NCC 2014 definitions of two transversal competences, T1 and T4

T1 Thinking and learning to learn

Thinking and learning skills underlie the development of other competences and lifelong learning. The way in which the pupils see themselves as learners and interact with their environment influences their thinking and learning. The way in which they learn to make observations and to seek, evaluate, edit, produce and share information and ideas is also essential. The pupils are guided to realize that information may be constructed in many ways, for example by conscious reasoning or intuitively based on personal experience. An exploratory and creative working approach, doing things together and possibilities for focusing and concentration promote the development of thinking and learning to learn.

It is crucial that the teachers encourage their pupils to trust themselves and their views while being open to new solutions. Encouragement is also needed for facing unclear and conflicting information. The pupils are guided to consider things from different viewpoints, to seek new information and to use it as a basis for reviewing the way they think. Space is given for their questions, and they are encouraged to look for answers and to listen to the views of others while also reflecting on their personal inner knowledge. They are inspired to formulate new information and views. As members of the learning community formed by the school, the pupils receive support and encouragement for their ideas and initiatives, allowing their agency to be strengthened.

The pupils are guided to use information independently and in interaction with others for problem-solving, argumentation, reasoning, drawing of conclusions and invention. The pupils must have opportunities to analyze the topic being discussed critically from different viewpoints. A precondition for finding innovative answers is that the pupils learn to see alternatives and combine perspectives open mindedly and are able to think outside the box. Playing, gameful learning and physical activities, experimental approaches and other functional working approaches, and various art forms promote the joy of learning and reinforce capabilities for creative thinking and perception. Capabilities for systematic and ethical thinking develop gradually as the pupils learn to perceive the interactive relationships and interconnections between things and to understand complex issues.

Each pupil is assisted in recognizing their personal way of learning and in developing their learning strategies. The learning-to-learn skills are improved as the pupils are guided to set goals, plan their work, assess their progress and, in an age-appropriate manner, use technological and other tools in learning. During their years in basic education, the pupils are supported in laying a good foundation of knowledge and skills and developing an enduring motivation for further studies and life-long learning."

T4 Multiliteracy

Multiliteracy is the competence to interpret, produce and make a value judgement across a variety of different texts, which will help the pupils to understand diverse modes of cultural communication and to build their personal identity. Multiliteracy is based on a broad definition of text. In this context, text refers to knowledge presented by systems of verbal, visual, auditive, numeric and kinaesthetic symbols and their combinations. For example, text may be interpreted and produced in a written, spoken, printed, audiovisual or digital form.

The pupils need multiliteracy to interpret the world around them and to perceive its cultural diversity. Multiliteracy means abilities to obtain, combine, modify, produce, present and evaluate information in different modes, in different contexts and situations, and by using various tools.

Multiliteracy supports the development of critical thinking and learning skills. While developing it, the pupils also discuss and reflect ethical and aesthetic questions. Multiliteracy involves many different literacies that are developed in all teaching and learning. The pupils must have opportunities to practice their skills both in traditional learning environments and in digital environments that exploit technology and media in different ways.

The pupils' multiliteracy is developed in all school subjects, progressing from everyday language to mastering the language and presentational modes of different ways of knowing. A precondition for developing this competence is a rich textual environment, pedagogy that draws upon it, and cooperation in teaching and with other actors. The instruction offers opportunities for enjoying different types of text. In learning situations, the pupils use, interpret and produce different types of texts both alone and together. Texts with diverse modes of presentation are used as learning materials, and the pupils are supported in understanding their cultural contexts. The pupils examine authentic texts that are meaningful to them and interpretations of the world that arise from these texts. This allows the pupils to rely on their strengths and utilize contents that engage them in learning, and also draw on them for participation and involvement."

T6 Working life competence and entrepreneurship

Working life, occupations, and the nature of work are changing as a consequence of such drivers as technological advancement and globalization of the economy. Anticipating the requirements of work is more difficult than before. Basic education must impart general capabilities that promote interest in and a positive attitude toward work and working life. It is important for the pupils to obtain experiences that help them to understand the importance of work and enterprising, the potential of entrepreneurship and their personal responsibility as members of their community and society. School work is organized to

allow the pupils to accumulate knowledge of working life, learn entrepreneurial operating methods and understand the significance of competence acquired in school and in leisure time for their future careers.

The pupils are familiarized with the special features of businesses and industries and key sectors in their local area. While in basic education, the pupils are introduced to working life, and they gather experiences of working and collaborating with actors outside the school. On these occasions, the pupils practice appropriate conduct required in working life and collaboration skills and understand the importance of language and interaction skills. The pupils also get acquainted with skills in employing oneself, entrepreneurship, risk assessment and controlled risk-taking through various projects. The pupils learn team work, project work and networking.

The pupils must have opportunities to practice working independently and together with others and acting systematically and over a longer time span. In shared tasks, each pupil can perceive his or her own work as part of the whole. They also learn about reciprocity and striving for a common goal. In functional learning situations, the pupils may learn to plan work processes, make hypotheses, try out different options and draw conclusions. They practice estimating the time required for a task and other preconditions of work and finding new solutions as circumstances change. At the same time, they also have opportunities for learning to anticipate any difficulties that they may encounter in the work and to also face failure and disappointments. The pupils are encouraged to show tenacity in bringing their work to conclusion and to appreciate work and its results.

The pupils are encouraged to grasp new opportunities with an open mind and to act flexibly and creatively when faced with change. They are guided to take initiative and to look for various options. The pupils are supported in identifying their vocational interests and making reasoned choices regarding further studies from their own starting points, conscious of the impacts of traditional gender roles and other role models."

Source: FNAE (Finnish National Agency for Education). 2015. *National Core Curriculum for Basic Education 2014*. Section 3.3 Aiming for transversal competence (34–41). Printed with the permission of FNAE.

In essence, the heart of the NCC 2014 is the idea that transversal competences are not separate school subjects but are embedded in the curricular objectives of each subject. The practical tool for supporting the implementation of the identification and formation of transversal competences is a matrix model, a kind of mapping table that has entries as given, as an example, in Table 8.1. These mapping tables contain the subject, specified for a grade transition period; the objectives of instruction; content areas related to the objectives; and, then, the list of those transversal competences considered to be aligning with content areas/the objectives. In the example, we do not write out the contents, but in the NCC 2014 the contents are also given.

Table 8.1 An example of the way transversal competences are presented and tied to the objectives and content to the different subjects in the FCC: objectives of history in Grades 4–6

Objectives of instruction	Content areas related to the objective	Transversal competences
Significance, values, and attitudes		
O1: To guide the pupil to become interested in history as a field of knowledge and a subject that builds his or her identity	C1–C5	T1–T7
Acquiring information about the past		
O2: To guide the pupil to recognize different sources of history	C1–C5	T1, T2, T4, T5, T7
Understanding historical phenomena		
O4: To help the pupil to perceive different ways of dividing history into eras and to use historical concepts related to them	C1–C5	T1, T2, T3
O8: To teach the pupil to perceive the continuity in history	C1–C5	T1, T2, T4, T7
Applying historical knowledge		
O9: To guide the pupil in finding reasons for changes	C1–C5	T1, T2, T4
O11: To guide the pupil to explain human activity	C1–C5	T2–T4, T6, T7

Source Printed with the permission of UNIFI, 496

These tables, taken all together with the lists of transversal competences, also allow empirical studies, like the separate study applying graph theory in analyzing the connections between T1 and T7 in different subjects and grades. Two of these seven transversal competences are more frequent: Thinking and learning to learn and Multiliteracy. Furthermore, these two are often presented together.

8.4.2 MLMs in the Finnish 2014 NCCBE

MLMs are described in Box 8.5.

Box 8.5. MLMs in the NCC 2014

MLMs promote the achievement of the goals set for basic education and, in particular, the development of transversal competences. A precondition

for integrative instruction is a pedagogical approach to both the content of instruction and working methods where phenomena or themes of the real world are examined as a whole in each subject and, especially, in multidisciplinary studies. The manner and duration of integrative instruction may vary depending on the pupils' needs and the objectives of the instruction. The objectives, contents, and implementation methods of MLMs are decided in the local curriculum and specified in the school's annual plans. The duration of the modules must be long enough to give the pupils time to focus on the contents of the module and to work in a goal-oriented and versatile manner over a longer term. The local curriculum and annual plan may also contain other forms of integrative instruction.

The integrative instruction may take place by

- Parallel study, that is, studying a single theme in two or more subjects simultaneously.
- Sequencing, that is, organizing topics related to the same theme into a sequence.
- Functional activities, including theme days, events, campaigns, study visits, and school camps.
- Longer MLMs, which are planned and implemented in cooperation between several subjects and which may contain some of the aforementioned integrative instruction techniques.
- Selecting content from different subjects and shaping it into integrated modules.
- Holistic, integrated instruction where all instructions are provided in an integrated form similar to pre-primary education.

Source: NCC 2014, p. 32–33. Published with the permission of the EDUFI.

These specifications imply two relevant issues:

(a) The introduction of transversal competences and MLMs does not affect the distribution of lesson hours allocated to the different subjects. Instead, transversal competences are presented as features or contents to be embedded within the teaching of different school subjects (see Sect. 8.5). The MLMs do not add to the distribution of lesson hours either. Yet, the NCC 2014 mandates schools to offer every student at least one MLM per year through basic education. No specific content for the MLMs is given in the NCC, but these are to be included in the local curricula and annual plans to allow for their topicality. The cumulative set of MLMs must be such that all subjects are part of at least one MLM during each student's basic education.

(b) Transversal competences are to be evaluated within subjects and the outcomes and students' level of participation in the MLMs will be taken into account in the grading of the respective subjects. Accordingly, there are two fundamental details, where, as William Blake would say, the devils are: what are the

transversal competences and how to assess the transversal competences as part of the formative and summative assessments of the subjects.

Transversal competences are meant to be embedded in, and assessed as, parts of the different school subjects. To guide this process, a new intellectual tool has been introduced in the NCC 2014: The Subjects, Objectives, Contents, and Transversal Competences Model (SOCTC) to help schools introduce twenty-first-century skills in the curriculum. The name SOCTC is provided by us, to name and to refer to the role of these descriptions of the intended goals for the NCC 2014 reform. The distribution of lesson hours specified in the Government Decree determines the transition points that divide basic education into the units of Grades 1–2, 3–6, and 7–9. In the NCC 2014, these units are used in presenting the wider objectives, the more specific contents, and the assessment criteria for the different subjects. In the NCC 2014, one side of the contents is related to each objective, and the distinct transversal competences included in them are listed.

8.5 The Assessment of Transversal Competences in Basic Education

Assessment is a powerful tool to introduce changes in educational systems: change the final examinations, and the teaching will follow and change as well. In the NCC 2014, a distinction is made between formative and (a final) summative assessment: "Under the Basic Education Act, the aim of pupil assessment is to guide and encourage learning and to develop the pupil's capability for self-assessment. The pupil's learning, work and behaviour shall be variously assessed. […] In basic education, two types of assessment are carried out: assessments during the studies and a final assessment" (NCC 2014, p. 49). The formative role of all assessment and feedback is strongly emphasized: "The school plays a crucial role for the self-concept the pupils form of themselves as learners and persons. The feedback given by teachers has a particular significance. Versatile assessment and the provision of instructive feedback are the key pedagogical means used by teachers to support the pupils' overall development and learning" (NCC 2014, p. 50).

The linking of all assessment to curricular objectives is also emphasized: "Assessment of a pupil's learning, working skills and behaviour and the provision of feedback to a pupil must always be based on the objectives set in the core curriculum and the more detailed objectives of the local curriculum. The pupils and their achievements are not compared to those of other pupils, and the assessment shall not focus on the pupil's personality, temperament or other personal characteristics. The teachers ensure that the pupils are aware of the objectives and assessment criteria. Reflecting on the objectives and examining their personal learning in proportion to the objectives is also an important part of developing the pupils' self-assessment skills" (NCC 2014, p. 49).

Regarding the summative assessment, the NCC 2014 states: "When assessing a pupil's knowledge and skills for the purpose of issuing reports and certificates, assessment criteria derived from the objectives defined in the core curriculum are used. Assessment criteria have been drawn up for the transition point between grades 6 and 7 and for the final assessment to support the teachers' work and to promote more uniform assessment. Rather than being targets set for the pupils, the criteria define the level required to receive a verbal assessment that describes a good achievement level or the level required for the grade 8 [in a scale of 4–10 where 4 = fail and 10 = excellent]." In 2020, FNBE introduced new criteria for the final evaluation of basic education in all subjects, which were put into use on August 1, 2021. The student has achieved the objectives of the syllabus according to a grade of 5, 7, 8 or 9, when the student's competence corresponds to the level of competence described in the criteria for that grade. It is to be noted that the NCC requires schools to issue numerical grading only from Grade 7 onward; until then (just) descriptive grading is allowed in all subjects. At all grade levels, the yearly report shall also provide an assessment of the pupil's behavior and contain a decision on the pupil's promotion to the next grade or his or her retention (NCC 2014, 2016).

However, even if the NCC meticulously lists the transversal competences involved or covered in the learning objectives of the different subjects, there are no concrete guidelines as to how this should be done or how they should be assessed as part of the learning toward that objective. Likewise, as no contents for the MLMs are given in the NCC, no guidelines for their assessment as part of the involved subjects are or can be given either. Hence, the burden of finding solutions to the assessment of transversal competences and MLMs can be seen to lie with municipalities and schools and can hardly contribute to fair and comparable assessment and grades across the country—critical for students' transfer from basic school to upper secondary studies. Additionally, without such guidelines, there is a danger that despite the formative spirit of the NCC's chapter on assessment, the actual assessment in schools will continuously center on the more easily measurable parts of each subject. This, in turn, threatens to weaken the attention that teachers pay to the transversal competences meant to be included in their teaching and learning. As a consequence, the goal of offering students a basis for transfer across the different subjects might be lost.

The question remains: Is it possible to assess or give guidelines for the assessment of transversal competences—the ones included in the NCC or more generally—either independently or within subjects in a way that would fulfil the requirements set for all assessment: fairness and a transparent relationship to the objectives stated in the core curriculum? The task is not easy but might be the only way to truly incorporate them in the different national syllabi. Current efforts toward their assessment (for example, Hautamäki and Kupiainen [31]) have a weakness in their merely speculative claim regarding the role of school in their formation. Consequently, new research is needed, maybe including the replacement of the constructs listed in the current NCC with ones based on a stronger theoretical foundation. Because this issue is important, we will present more details given in the NCC 2014 to advance a fair assessment protocol.

8.5.1 An Example. Criteria of Verbal Assessment in Finish NCC (Grade Value 8)

Table 8.2 is an example of assessment criteria for good knowledge and skills (verbal assessment) or a grade value of eight (numerical assessment) at the end of Grade 6 in Finnish language and literature. We have included in this example only one topic—language-learning skills—with two objectives (O5 and O6) and each with one content (C2) and have deleted other objectives and contents. However, the FNAE, Regional Authorities, Finnish Education Evaluation Centre (FINEEC), and university-based studies in educational assessment are supporting this work, and the success of this work is critical for the national success of NCC 2014.

Table 8.2 Defining educational standards for mark 8 for selected objectives and contents in Finnish language and literature for Grade 6

Objectives of instruction	Content	Assessment targets in the subject	Knowledge and skills for the verbal assessment good/numerical Grade 8
Growth into cultural diversity and language awareness			
O1: To encourage the pupil to pay attention and develop an interest in the variety and selection of Finnish material that supports his or her own learning and to help the pupil become familiar with the typical characteristics of Finnish-language culture	C1	Perception of linguistic environment	The pupil is able to describe the typical characteristics of the Finnish-language culture and knows where Finnish-language material that interests him or her can be found
Evolving language proficiency, text interpretation skills			**Level of proficiency B1.1**
O9: To offer the pupil opportunities for listening to and reading versatile texts that are meaningful to him or her in standard language and popularized texts from various sources and to interpret them using different strategies	C3	Text interpretation skills	The pupil understands the main ideas and some details of clear, nearly regular-tempo, standard language speech, and popularized written text. The pupil understands speech or written text based on shared experience or general knowledge. The pupil is able to find the main ideas, keywords, and important details without preparation

Source NCC 2014, p. 246

8.5.2 Search for Solutions for Measuring Transversal Competences

The objectives, contents, and assessment criteria given in the NCC for each subject act as binding guidelines for municipalities and schools in outlining their local curricula and rules of assessment—just like in the previous NCC of 2004. However, what has changed is the new weight given to assessment by dedicating a whole chapter for it in the NCC 2014. This has given rise to an unprecedented discussion on assessment and calls for in-service training on the topic. The UNIFI and regional authorities as well as subject-specific Teacher Associations have responded to this call by offering widespread in-service training for basic school and general upper secondary school teachers. The emphasis has been on formative assessment and diverse subject-specific questions regarding the different dimensions of assessment (the relative role in assessment of the general and subject- or course-specific objectives, knowledge, and skills). These discussions and training have also addressed the question of how to interpret the NCC 2014's introduction of transversal competences and the MLMs into assessment in relation to students' advancement in the traditional subjects.

However, a problem arises from the NCC giving instructions regarding factors that have to be taken into account in assessment (learning, working habits, and behavior—including its "level" and progress) without any indication as to their respective weight in assessment. In addition, the requirement to tie summative assessment to the criteria given for grade 8 (good) seems not to give space but for the dimension of learning. The task can be formalized for any subject as (in the formula, w stands for unknown weight and constant could be the lowest value 4 in the grading scale of 4–10):

$$School\ Mark^{4-10}ijk = constant + w11Learning\ Criteria + w12Change\ in\ Learning + w21Working\ Criteria + w22Change\ in\ Working + w31Behaving\ Criteria + w32Change\ in\ Behaving + w4Transversal\ Competences + w5MLMij + error$$

School Mark$^{4–10}$ijk = constant + w11Learning Criteria + w12Change in Learning + w21Working Criteria + w22Change in Working + w31Behaving Criteria + w32Change in Behaving + w4Transversal Competences + w5MLMij + error

In addition, for each subject, the formula should include the same for the transversal competences listed as relevant for the subject's objectives and the MLMs involved. As stated earlier, there are no recommendations for the weights of these either. However, this formula is our interpretation of the issues and complexities related to Finnish and to any reforms of curricula in the light of twenty-first-century skills.

The results of the national sample-based assessments of learning outcomes in the different subjects have repeatedly shown that the constants and weighting in the formula differ by municipality, school, and probably even class. This school dependency of grading has probably been one of the reasons for the new emphasis on assessment in the NCC 2014. However, taking into account the hard-to-define dimensions

to be assessed (working habit, behavior), the lack of indicators for their respective weights, and the descriptive nature of the criteria against which the student's achievement should be assessed, it is hard to see that the NCC 2014 would succeed in alleviating the problem [48, 49]. The earlier empirical evidence of the national assessments shows that the descriptions given for the assessment criteria are interpreted without taking into account the context of the class within which the assessment takes place, leading to stricter assessment in classes of more able students and a more lenient approach in classes of weaker students. The requirement to take into account the change or development in the respective dimensions further obscures which of the directives of the NCC are concerned with just formative assessment and which ones are concerned with summative assessment as well. As mentioned earlier, the problem is further complicated by the transversal competences, which get tied in the NCC to specific subjects and learning objectives only in relation to the assessment criteria for Grades 6–7 and 7–9.

Therefore, the question remains: How to assess the transversal competences? One solution could be that within some set of lessons, the teacher should ensure that the preordained transversal competences have been present in teaching and learning and can therefore be assessed as part of students' achievement for that course entity. Even this is not a trivial task, but it would give the transversal competences the same status as the subject-specific content of the respective lessons. All other solutions are bound to lead to a diversity of interpretations and hence to less commensurate results. One such solution would be to have measurable descriptions for the different transversal competences within the contexts of the different subjects, but this would obviously lead to an impossible task for both the national authorities (uniformity) and the local providers of education (implementation). However, the situation would be fatal in terms of commensurability due to too many un-unified parts, leading to possibly an even aggravated between-school variation in students' final grades, which have a high-stakes value in the choice of upper secondary education. The same arguments are valid for the MTMs if the communal themes are not drawn from the actual objectives and contents from the participating subjects.

Another alternative for the assessment of transversal competences is the introduction of independent indexes for them as integrated parts of a traditional subject-based curriculum or as independent entities in the curriculum. The current Finnish NCCs of early, preprimary, basic, and general upper secondary education represent the former, and to our knowledge there is no education system that would currently represent the latter, even if the division of subjects in the different national syllabi was not always the same. Regarding the current Finnish NCC, any step toward an independent assessment of transversal competences would require a critical evaluation of the totality and formulation of the seven transversal competences with detailed descriptions of their contents to allow for applicable criteria for assessment. Even if this could be done (see NBE 1999; [28]), it clearly runs counter to the expectations set for transversal competences in the NCC 2014 as common contents or dimensions embedded in the teaching and learning of the different subjects.

8.6 National and Local Support for the Implementation of the NCC

8.6.1 National Support

In Finland, employers have legal responsibility for their employees' professional development. In education, this primarily means municipalities' responsibility for providing necessary in-service education for teachers and principals. Furthermore, as professionals, teachers themselves can be seen to have a responsibility to update their knowledge and skills and to follow the overall development of the teaching profession and the national education policy. As part of their employment contract, teachers are obliged—or allowed—to participate in three professional development days a year. Some municipalities and schools allow teachers more freedom in how to fulfil this requirement whereas some others may have a common policy and plan for shared practices [26, p. 46]. Government-allocated resources for teachers' in-service education are managed by the EDUFI. Universities, teacher associations, and other organizations in the field act as providers of the education.

It is too early to say how municipalities have solved the new assessment requirements of the NCC 2014. Random case explorations indicate that municipalities and schools have looked for and taken advantage of the additional material provided by the EDUFI and other actors to clarify and enrich their own curricula on assessment. However, at least for now, we have found no local solutions for the assessment of transversal competences or the local MTMs. The EDUFI is currently following the advancement of the implementation of the NCC with first results expected in 2018.

The Ministry of Education and Culture together with the EDUFI has launched several programs to support the NCC reform by allocating resources for in-service education for its implementation:

- The Teacher Education Forum.
- The Tutor Teacher Program.
- The Innovative Schools Network.

The unifying catchphrase for these programs is The New Basic School, maybe carrying in it an echo of the aborted attempt for a much more radical reform in 2010.

The Teacher Education Development Programme of 2016–2018, which carries in Finnish the more succinct name of the Teacher Education Forum, is a multisite program to develop and enhance transition of teacher education departments to assist in the implementation of the NCC and, equally important, to modify teacher education programs for the twenty-first-century requirements in line with the new curricula. The forum is made up of several networks and developmental projects to design and share information, experiences, and results.

Tutor Teachers (2017–2019) is also a national program, supported with extra money to municipalities, to nominate and train some of the teachers to work as mediators in implementing the new curriculum.

The Innovative Schools Network, financed and supported by the EDUFI, was established to act as a vanguard in implementing the NCC 2014. The network, covering 265 schools in 53 municipalities, has already come up with innovative solutions to enhance student participation and co-operational teaching, ideas for MTMs and the use of information and communication technology (ICT) in schools, and ways to support building a new education culture in schools and municipalities. The network shares experiences using an e-platform supported by the EDUFI and a limited-access social platform run by the network.

8.6.2 Global, International, and Research-Based Support to Schooling in Finland

In education, a pandemic has been brewing since the last decades of the last century—the search for a definition and understanding of twenty-first-century education. All nations and other actors with a stake in education have entered the discourse: the OECD and the World Bank, the European Union and UNESCO, global corporations from Microsoft to major banks, teacher and parent unions, universities, and think tanks. The participants have different interests, ranging from concerns about the future workforce to financial interests regarding investments in technology solutions, knowledge constitution to solutions to the present pervasive issues of global climate change, renewable energy, politics, and markets. No country or nation can stay removed from these discussions. The discourse on twenty-first-century skills is one effort by the education establishment to help find a sustainable solution to these and other global problems.

Already before the launch of the concept of twenty-first-century skills or competences, the OECD entered the field with the Definition and Selection of Competences (DeSeCo) Project [52]. Soon after, the OECD continued with the introduction of the PISA, currently the most powerful tool for setting the agenda for discussions on global trends in education. To close the gap between the work of the DeSeCo and schools, the OECD developed (or extended the coverage of) the concept of literacy to refer to an individual's ability to apply and adapt school learning to situations outside of the class. However, to be able to use the assessments as indicators for the effectiveness of national education systems, the concept was adapted to cover the key subjects of reading, mathematics, and science. Later, the OECD extended the coverage of PISA deeper into the realm of transversal skills through the subfields of problem-solving, complex problem-solving, and collaborative problem-solving, in 2003, 2012, and 2015, respectively, while the adoption of computer-based assessment can be seen to represent another salient strand of the "new" twenty-first-century skills.

Finland has participated in international assessments since 1958, first in the strictly curricular assessments of the IEA and later in the OECD's PISA. In addition, Finland was a central contributor to and participated in probably the first ever effort to measure

transversal competences at a transnational level in a project financed by the European Commission to study the measurability of learning to learn, one of the key competences according to the European Union [18, 33, 36].

The English sociologist of education Basil Bernstein [11] makes a distinction between singulars, regions, and generics. Applying his concepts, the twenty-first-century discourse is a search for generics. The concerns of the business world, if based on accurate observations of unfulfilled needs, are thus valid demands for a workforce with a new type of generic competences received through education. Educational discourse, on the other hand, with its disciplines and subjects represents singulars, the other end of the Bernsteinian scale. The competences needed in working life cannot be directly conceptualized using the singular, subject-related contents of education, making the middle field of regions necessary to bridge the gap met by students when entering the workforce. Regions are in the middle, reconceptualizing singulars as units, which operate both in the intellectual field of disciplines and in the field of external practice. In this framework, the literacies of PISA can be understood as regions bridging the respective school subjects and their application in the "life like" contexts of the PISA tasks while the Finnish transversal competences represent the generics even if tied in the curriculum to specific disciplinary contents. This interpretation opens an understanding of transversal competences as stemming from working within the singularities of school subjects while simultaneously representing generic processes that could be conceptualized independently from the outcomes of the learning of the subjects.

One solution for measuring transversal competences is represented in the work of the Centre for Educational Assessment, University of Helsinki. The center has theorized and executed large-scale assessment on learning to learn as one of the key transversal skills since 1996 with a test comprising a cognitive and an affective dimension [28, 30, 62]. Lately, the work has been extended to collaboration with the University of Szeged in Hungary regarding computer-based assessment of inductive reasoning [14, 15] and with the University of Luxembourg regarding complex problem-solving [20]. The center has also made a pilot study on combining a sample of open PISA tasks with its own "learning-to-learn" test to study the relations of the two approaches. The results showed that a large portion of the variance in Grade 9 students' performance in the PISA sample tasks could be explained by their earlier and concurrent achievement in the "learning-to-learn" tasks [32]. The question is whether the measurements of transversal competences, be it in the form of PISA, learning to learn, or complex problem-solving, still show reliable unexplained variance after curricular evidence (learning, working, and behaving together with school marks) has been accounted for. Only then would a quest for separate indicators for transversal skills be worth pursuing.

Whereas the Finnish study aimed at predicting students' attainment in PISA, the Canadian study "Pathways to Success" [44] followed students who had taken part in PISA 10 years earlier. The predictive power of PISA was ambiguous due to the confounding factors of family and school characteristics and of many of the best performers still at university at the time of the study. Yet, there was a (weak) positive

correlation between girls'—but not boys'—PISA scores and future earnings even after controlling for family background and educational attainment [44]. The Canadian follow-up did not include school achievement, but the writers note that PISA scores correlate highly with it. Regarding the predictive power of PISA, the report notes that the timing of the study was too early to disclose the potential full effect of students' performance in PISA on their later success in the labor market [44, p. 6]. Thus, the results do not give a definite answer to whether the competences measured in PISA offer predictive power that would surpass students' school achievements as indicated by GPA.

Without clear evidence of the predictive value above school marks of PISA, learning to learn, or complex problem-solving, a reform such as the NCC 2014 can only be seen as a brave attempt to reach something more by going beyond the traditional discipline-oriented education. Yet, the venture is supported by research at least regarding the first of the NCC's transversal competences, thinking and learning to learn. For example, [2] have shown that it is possible to enhance cognitive development through science education, where different forms of scientific thinking are taken into account [1, 3, 16]. To support the adoption of the new transversal skills in schools, a book on thinking skills [25] was published as a joint venture of experts from the EDUFI and the University of Helsinki, offering both theoretical backing and concrete ideas for their advancement in class through differentiation and MLM projects. Yet only time will tell how well the new constructs will be incorporated into daily schoolwork and whether they will help today's students meet the future any better than the old discipline-oriented syllabus assisted their peers. As in all reforms, there are potential threats—but possible victories as well.

8.7 Challenges in Implementing the New Curriculum

Implementation of the NCC 2014 can be seen to face three major challenges:

(a) The lack of concrete advice on how to incorporate the transversal competences listed in the tables for the objectives and contents of the different subjects (TOCs) into teaching.
(b) The lack of concrete guidelines on the assessment of the transversal competences and MLMs to ensure the commensurability of assessment across municipalities and schools.
(c) How well-prepared teachers and education administrators are to accommodate and adapt the principles from educational and development psychology required by the full implementation of the new NCC.

The NCC 2014 reform did not threaten the structure of the distribution of lesson hours. Yet the new weight given to transversal competences and the introduction of the MLMs are both expected to and inevitably will bring about changes in the implementation of the lesson hour distribution. Something new will be done and emerge, and something old will disappear or change. The lack of concrete indications

as to how the transversal competences should be brought into the respective contents as implicated in the TOCs will lead, by default, to widely varying practices across the country with repercussions to the time spent on the subject-specific content of the lessons. The same is true for the MLMs as the actual objects or contents as well as the involved subjects of the modules are left in the NCC to be decided on at the local level. There are already examples of innovative projects enhancing learning in different subjects and collecting whole schools to work around a common theme. It remains to be seen whether the modules succeed in just providing students with an understanding of the complexity and multidisciplinary nature of actual phenomena or also providing them with a sound understanding of the integrity and internal logics of the different disciplines. Regarding the lack of common guidelines, a concern for the quality of the modules to be built across schools and for different grade levels is thus warranted. The MLMs can also be seen as a concern in terms of assessment due to their varying content, length, and involved subjects and as a result of problems related to the assessment of group work, especially in view of the high stakes the basic school grades play in students' transition to upper secondary education.

Discusses how an academic (in this case pedagogical) field can accept rather general interpretations from another field [11]. Developmental or even educational psychology cannot give prescriptions on how to teach generic and transversal competences. By definition, generic is formed through the specific, by mastering the contents and intellectual frameworks of the different scientific disciplines. Currently, effective intervention programs for the advancement of thinking are available, the most successful embedded in traditional school subjects (physics, chemistry, mathematics, history, and arts,see [1, 2, 39]. Furthermore, psychological sciences can inform education of possibilities and mental frameworks, which assist teachers in gaining a deeper understanding of learning processes, learning difficulties, and factors that support transfer of learning, expanding its coverage from one content area to another. In this spirit, participation in international studies such as the TIMSS and PIRLS, PISA, and the UNESCO surveys is accompanied by reporting that offers a possibility for professional training for teachers.

To support the implementation of the NCC 2014, the Ministry of Education and Culture and EDUFI have supported local, regional, and national projects for designing and testing practical ways to integrate the transversal competences into learning and to build meaningful and age-appropriate MLMs. For example, the City of Helsinki Education Division has decided on two major points of emphasis for its work on the local curriculum: phenomenon-based learning (MLMs) and thinking and learning to learn. The division's web pages (ops.edu.hel.fi) parcel out the two main novel dimensions of the NCC, transversal skills and the MLMs, into grade-appropriate subthemes. However, these are best understood as just interesting attempts to interpret and adapt the new understanding of basic education for a city with a rapidly diversifying student population. The evidence of this and other local adaptations indicates careful work in breaking the NCC into smaller pieces for more detailed local guidelines aiming at a relatively uniform implementation. At the same time, these adaptations are a way to inform teachers, parents, and students of the

goals of the present reform and in this manner enhance the commitment of the city to advancing educational institutions toward the renewed goals.

8.8 Conclusion: Halfway There?

The MLMs and the mapping of the objectives, contents, and transversal competences in the subject-specific TOC tables of the NCC 2014 are new tools intended to loosen the strict borders of school subjects while also preserving their academic integrity and structure. The goal is to advance conceptual and competence-related integration between different sources and kinds of knowledge. The reason behind the goal is a new understanding of the labor market's need for skills to integrate and apply different kinds of information, knowledge, and competences—and a belief that the current discipline-based syllabus does not provide students with these skills. The need is for a new mind-set of work (FYA 2017) comprising interest, habits, and manners, which support collaborative work toward the economy of the twenty-first century.

The idea of a "new school" for a "new society," visible in the frameworks of the OECD PISA and the IEA TIMMS, and in the recommendations of UNESCO and of the World Bank, is an example of Bernstein's generics, an external power to push countries to change their singulars, the traditional syllabi, and curricula. The concepts of key competences, literacies, cross-curricular competences, and transversal competences can be understood as regions, mediators to bring in changes in the understanding of the traditional subjects and curricula. These tools do not aim to refute or demolish academic subjects but to complement them by widening the understanding of their singularity and encouraging teaching to cross the boundaries between them. In the NCC, this is made through the introduction of transversal competences and MLMs. These can be seen to aim at revising the understanding of subject-specific learning goals and even a competence when transversal competences are viewed through the lens of—or infiltrate—each subject. However, just adding these to the different subjects might not cover all the aspects of the transversal skill. For example, multiliteracy has different forms and practices in science, history, languages, and mathematics, just like the rules, even if not the requirement for validity, of reasoning differing in mathematics, different natural sciences, and history [39].

The pedagogical means to take into account transversal competences and ways to build MLMs into concrete contributions to school subjects, as well as tools for their valid and reliable assessment, are still waiting for a solution. Thus, the final verdict is that Finnish basic education is on its way to twenty-first-century schooling and society but is not yet there.

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Chapter 9
Poland: The Learning Environment that Brought About a Change

Maciej Jakubowski and Jerzy Wiśniewski

Abstract Poland is among countries which have made the biggest progress in the development of student competences as measured by the PISA international comparative study based on the concept of key competences needed in contemporary society and economy. Therefore, the country has been considered as a top performer in development and promotion of key competencies in school education. Yes, a coherent and manifest "key competence strategy" has never been adopted in Poland—but key competences, even if not with that label, were introduced in the national core curriculum (2007) and promoted by several programs and initiatives. Poland offers an example that change of a broadly defined learning environment could make a significant impact on students' outcomes, although such objectives were not clearly articulated and operationalized. However, the lack of a long-term strategy agreed across the political spectrum makes the reform programs vulnerable to political changes. This case refers to Poland's education policy, changes and their effects, accomplishments and failures within the last twenty years.

Keywords Curriculum reform · Key competences · Key skills · New core curriculum · Lowering the school age · KREATOR project · Assessment of key competences · Poland in PISA

A note from the editors:

Outstanding specialists of the Warsaw Evidence Institute, who have experience in high positions in the national Ministry of Education, tell about the Polish educational experience. Perhaps that is why a feature of the material is the attention to the political process of education renewal. This experience is extremely interesting, since Poland has undergone a reversal of educational reform, and to a large extent this topic resonates with the discussion in the chapter on England. Nostalgia for "powerful knowledge" forced the reformers to abandon some of their innovations. Another important feature of the Polish case is the systematic use of the PISA study to promote new educational results.

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Highlights

- Poland is one of the countries which has made the biggest progress in the development of student competences measured by the Programme for International Student Assessment (PISA). As a result, the country has been considered a top performer in the development and promotion of key competences in school education.
- In Poland, a clear and coherent 'key competence strategy' has never been adopted—but key competences, even if not labelled as such, were introduced into the national core curriculum (2007) and promoted by several programs and initiatives.
- Poland demonstrates that a change in a broadly defined learning environment can have a significant impact on students' outcomes, even though such objectives were not clearly articulated and operationalized.
- The lack of a well-planned information campaign and a public discussion often brings about a negative social reaction and can stop even an objectively efficient initiative.
- Teaching key competences within special projects (e.g., with the help of European and non-governmental organizations) may help individual learners, but hardly can bring about a sustainable change.

9.1 Basic Data on the School Education System of Poland

The structure of Poland's school system includes the following elements:

- Primary level: 8-year primary school
- Secondary level: 3 options
- 4-year general education (*licea*)
- 5-year secondary vocational schools (*technika*)
- 3-year sectoral vocational school of the First Stage (*szkoła branżowa pierwszego stopnia*) with the possibility of continuing education at a 2-year sectoral vocational school of the Second Stage (*szkoła branżowa drugiego stopnia*).

From 1999 to 2017 Poland also had a system of lower secondary schools (*gimnazja*), which was phased out by structural reform of the educational system (on the basis of an act of December 14, 2016, Law on School Education), which is described in this chapter.

Special education is an integral part of the Polish education system. Children are eligible for suitable school arrangements based on psychological, pedagogical, and medical examinations. More than half of all children with special educational needs are taught in special schools or special classes in mainstream schools, and the other half attend mainstream schools' integrated or standard classes.

Table 9.1 Preschool education in Poland

Type of institution		Number of institutions	Number of pupils
Kindergarten *(przedszkola)*	Urban	8,202	820,080
	Rural	3,944	260,782
Preschool classes in primary schools *(oddziały przedszkolne w szkołach podstawowych)*	Urban	1,977	76,595
	Rural	6,053	167,291
Preschool centers *(zespoły wychowania przedszkolnego)*	Urban	758	13,666
	Rural	970	21,423
Preschool units (*punkty przedszkolne dla dzieci starszych*)	Urban	8	184
	Rural	68	1,162

Table 9.2 Number of schools for students and number of students (2016)

Type of school	Number of schools		Number of students	
	Public, run by local authorities	Non-public	Public, run by local authorities	Non-public
Primary	11,505	1,244	2,158,481	96,034
Lower secondary	6,364	881	988,524	50,052
Basic vocational	1,393	177	147,804	12,891
General secondary	1,662	448	446,139	26,678
Technical secondary	1,622	199	475,056	16,720

Kindergartens and other preschool institutions are supervised by the Ministry of National Education. Preschool education is optional for children ages 3–5 years and obligatory for 6-year-olds.

The tables below contain general facts and figures about the educational system of Poland, with data from the School Education Information System of the Ministry of National Education (Tables 9.1, 9.2 and 9.3).[1]

The school education system is managed centrally by the Ministry of National Education which, together with regional pedagogical superintendents, supervises schools and kindergartens. The ministry decides on educational policy, outlines the content of education defining the national core curriculum, sets the requirements for schools, and regulates the conditions of teacher employment. The Central Examination Board (an agency of the Ministry of National Education) organizes national tests and exams at the end of primary school (grade 6 till 2015 and grade 8 from 2019 on), end of lower secondary school (till 2019), and the final secondary exam (*matura*). The *matura* exam serves as an entrance examination to higher education programs.

Local authorities are responsible for administration and management as well as funding allocation for kindergartens and schools. Communes—the lowest level of

[1] https://icein.gov.pl/archiwalne-dane-statystyczne/ads-uczniowie/.

Table 9.3 Key facts and figures of Poland's educational system

Number of schools	**27,906** (without special education, including artistic schools) 89%—public schools (run by local governments), 11%—non-public schools (private, run by associations or by religious organizations)
Number of teachers	**497,534** (full-time equivalent)
Number of pupils	**4.75 million**
Key laws regulating education in general	The Constitution of the Republic of Poland School Education Act of September 7, 1991 (with further amendments) replaced by The Law on School Education and an act introducing the Law on School Education (both of December 14, 2016) The Teachers' Charter (with further amendments)
Key laws regulating curriculum	The Ordinance (Regulation) of the Minister of National Education on Core Curriculum for General Education (*Podstawa Programowa Kształcenia Ogólnego)* The Ordinance (Regulation) of the Minister of National Education on framework teaching plans (*ramowe plany nauczania*) The Ordinances (Regulations) of the Minister of National Education on Core Curricula for Vocational Education (*Podstawy programowe kształcenia wzawodach*)
Documents that schools use to regulate their own activities	The school care, moral educational, and preventive program approved by both Teacher Board and Parents' Council of the school; The school organization chart, accepted by the regional school superintendent (*kurator*) and the authority running the school (local government for public schools)

public administration—are responsible for public kindergartens and primary and lower secondary schools, while districts are responsible for public upper secondary schools. The greater part of school financing comes from the public budget. The amount of general spending for all local government units is defined annually in the budgetary act.

Teacher employment in public institutions as well as their salaries and promotion are regulated by the Teacher's Charter—a parliamentary act which grants teachers a unique professional position.

9.1.1 Non-public Schools

Non-public schools first appeared on the educational scene of modern Poland after the reforms of 1989–1990. Most of them were initially set up by groups of teachers and parents involved in foundations or associations. Such schools in Poland have a right to offer qualifications equivalent to public schools provided they follow the national core curriculum and employ qualified teachers. These requirements are controlled by the regional school superintendents (*kurator*).

Non-public schools have more freedom in teaching programs and methods of instruction. They apply curricula developed by teachers, often with the active involvement of parents and students. Such innovative approaches are spread through the whole system of school education, influencing public schools teaching as well.

9.1.2 Teachers' Training

There are two types of initial teacher training in Poland. Teachers of preschool and elementary education are trained in integrated BA or MA courses at education departments (faculties) of higher education institutions. Secondary school teachers start their education from subject-specific faculties (that is, mathematics, biology, and so on) and then (consecutively) take relevant teacher training courses (pedagogy, psychology, and didactics), which are considered a minor specialization.

Key competences are not specified in any of these teacher training programs. Moreover, when new ideas are promoted and introduced into school programs (like teamwork projects in lower secondary schools) the change in teacher training programs usually lags behind or remains unchanged.

Teacher studies are popular among secondary school graduates. However, this is not a result of the prestige of these studies nor the prospects for a future career. Teachers' salaries, particularly in big cities are not competitive. Studies on pedagogy are considered not difficult, so it is a relatively easy way to obtain a higher education diploma. They are often offered by small private universities which charge relatively low fees (Table 9.4).

Table 9.4 Teacher age group distribution 2017

Age	35 years or less	36 to 45 years	46 to 55 years	56 to 65 years	More than 65 years
Rural schools					
	24.60%	30.50%	33.90%	10.60%	0.40%
Urban schools					
	24.20%	30.60%	30.60%	13.40%	1.30%

Source Calculations on the data from School Education Information System

9.2 Employers' Expectations

Polish employers often complain in the media that school graduates are not prepared for the jobs they apply for, especially mentioning the attitudes of young people and lack of skills in areas such as communication, the ability to work in a team, readiness to learn and master new skills, and the ability to act in a changing environment.

Among the few representative studies into the opinion of employers, the most important is 'The Study of Human Capital' research project (the *BKL* Study[2]). This has been conducted annually since 2010, by the Polish Agency for Enterprise Development in cooperation with the Jagiellonian University of Kraków. This systematic research allows the monitoring of changes in the competences in Poland's labor market. According to this study, Polish employers expect the following competences from candidates:

- Self-organization (indicated by 44% of employers), involving independent organization of one's work and its effectiveness—self-starting, independence, time management, decision making, initiative, and resilience to stress
- Interpersonal skills (important for 40% of employers), including contacts with others, communication, team cooperation, and the ability to solve problems
- Professional skills (mentioned by 26% of employers).

9.3 Major Milestones in the National Curriculum Transformation

9.3.1 1989–1990: Transition to Democracy and Market-Based Economy

Following the great political and economic changes when Poland passed from a former Eastern Bloc country to a democracy, some changes in the curriculum were introduced. They affected such disciplines as history (elimination of 'blank spots') and Russian language (this stopped being compulsory and received equal status with other foreign languages).

Soon English became the most in-demand foreign language at schools, and the lack of English teachers forced the Ministry of National Education to launch programs to attract native speakers as schoolteachers. In collaboration with foreign organizations such as the Peace Corps, British Council, and Voluntary Oversees, such programs attracted people of very different backgrounds, from retired teachers to young enthusiasts. They influenced Polish schools with a different organization culture and alternative pedagogical ideas.

English learning materials also came to the country, as complete sets of student textbooks, workbooks, and manuals for teachers (in contrast to the previous practice

[2] Bilans Kapitału Ludzkiego. https://www.parp.gov.pl/publicationslibrary/ebook/762.

of Polish publishers). Attracting teachers as clients, international publishers provided teacher training, promoting new learning methods and developing, in particular, communication skills (language as a tool for communication).

During the same period, non-public schools started to be established, demanding flexibility in the application of the rigid and detailed national curriculum and other regulations (number of lessons for each discipline, interdisciplinary coordination, even class size). Responding to this, the Ministry of National Education introduced the concept of 'authorship programs'. This opportunity has been used by a relatively small number of schools and teachers and such programs have not been properly evaluated, attracting critics of the national curriculum regulations.

At the beginning of the 1990s the Polish economy suffered from a major economic crisis. The public sector budget was slashed, along with the budget for education. The Ministry of Education needed to reduce the number of compulsory learning hours at schools, as well as the curriculum content. A minimum curriculum was provided, containing the core knowledge or the most important content necessary for all schools. At the same time, schools and local governments were allowed a certain degree of independence in defining their own curricula. Head teachers obtained several teaching hours to use for the school's specific needs. Between 1991 and 1998, attempts to make the curriculum less detailed continued, offering more freedom to schools and teachers in deciding on learning methods, resources, and even content.

9.3.2 1998–1999: Comprehensive Educational System Reform

The government formed after the parliamentary elections of 1997 decided to launch a comprehensive reform of the whole educational system of Poland with the following targets:

- Raising educational attainment in society by increasing the number of graduates with secondary and higher education qualifications
- Ensuring equal educational opportunities
- Improving the quality of education.

To achieve these objectives, the Ministry of Education introduced a major system reform in 1998–1999 to change the structure of the school education, redesign the core curriculum, introduce new pupil assessment tools, and modernize the school inspection system.

At this time, the discussion on key competences was at its initial stage internationally (Council of Europe seminar in Bern took place in 1996 and the launch of the DeSeCo project happened in 1997) and did not directly affect the policy debate in Poland [1].

Curriculum reform was a key element of these changes. The new core curriculum replaced previous detailed and uniform curricula and opened opportunities for

teachers to use various programs, methods, and approaches. Schools could choose from curricula available in the market or develop their own curricula. The textbook market was liberalized, and teachers were able to decide which textbook to use from a ministry approved list.

By extending the autonomy of teachers, and giving them more freedom, the ministry sent a clear message that it trusted their professional competences.

To measure learning achievements, a system of national tests and examinations was introduced, covering all pupils at the end of successive stages of education (primary, lower secondary, and upper secondary education). The responsibility for examination preparation, administration, and evaluation was given to the newly established central and regional exam boards.

The reform can be described as a revolution since it led to a visible change in the school system structure and, in particular, the introduction of new lower secondary schools (grades 7 to 9) and the reduction of primary education from 8 to 6 years. After graduating from a lower secondary school, students can continue their education in 3-year general secondary schools (academic track), technical secondary vocational schools (4 years) or in 3-year basic vocational schools (not offering full secondary education). Most students aspired for general education with the prospect of continuing their education at the university level. Basic vocational schools had low prestige and were considered the worst option.

The biggest impact on learning outcomes (or delivered curriculum) was the introduction of external exams at the end of each level of schooling: primary, lower secondary, and upper secondary. In particular, that impact was made by high-stakes exams: the one at the end of lower secondary school (selection to general or vocational secondary schools) and the final secondary school exam—*matura*, which replaced entrance exams for universities.

After 2000, Poland has continuously and noticeably improved student competences measured by PISA. Rigid data analysis showed that the improvement was an effect of the 1999 reforms, especially the extension of comprehensive general education as a result of the newly created lower secondary schools [7] and the postponement of tracking to different types of secondary programs by one year.

Undoubtedly, this has not been the only success. The whole idea of lower secondary schools and new opportunities released the energy of teachers, school directors, and local authorities. New curricula opened market opportunities for educational publishers who then invested in teachers' professional development. Also, NGOs found a niche for their activities both in formal and non-formal education. All these factors (and many others) were important, but structural reform was probably the key one.

The 1999 reforms were introduced within a very short time frame and one which did not allow a wider debate, both among experts and the public. It was therefore not surprising that discussions started almost immediately after the launch of the reform.

Communicating the reform, the Ministry of Education focused on convincing teachers that the change was feasible and would bring good results. There was not enough promotion of the main goal of the reform: equal access to good quality

education at all levels, especially in rural areas, where new schools well equipped with human and material resources could make an impact.

However, public discussions focused on the problems of lower secondary schools and stereotypical views on teenagers misbehaving—that reflected in public opinion polls. At the early stage of the reform it was difficult to argue, as there were real problems with the organization of new schools, development, and implementation of new curricula, provision of textbooks, and so on.

Real results in learning outcomes and participation rates were seen after a couple of years and sound evaluation procedures. An opportunity to promote this success story appeared when the 2003 PISA results were released. However, this was a time of big political change in Poland, and there was no one taking ownership of the 1999 reform. So, despite evidence of the success of the reforms, public opinion remained unchanged, continuing to see lower secondary schools as problematic.

The debate became more heated when new external exams were introduced in 2002. The most discussed issue was the level of detail in the core curriculum and in the examination standards, which were described in two separate documents. These debates led to the revision of the national core curriculum in 2007–2009.

9.3.3 2007–2009: New Core Curriculum

Improvement in the average PISA results could not cover the difficulties Polish students had with PISA test items that required a non-standard, problem-solving approach. Young Poles were very good at applying algorithms, but most of them were hopeless when facing a new, unfamiliar problem. Taking this into account, the Ministry of National Education decided to initiate work on the modification of the national curriculum, which would:

- Describe the expected learning outcomes for each stage of education;
- Indicate the main objectives of teaching each school subject; and
- Define the requirements of central assessments.

Joining the European Union in 2004, Poland also joined the European debate on the role and quality of education and training in the Union within the framework and limits of the ‘open method of coordination’. In 2006, the European Parliament adopted recommendations on key competences for lifelong learning [4]. However, this debate at the European level did not influence national policy directions.

Following intensive work by experts and public consultation, a new national core curriculum was introduced in 2008.[3] It was characterized by a shift toward learning outcomes which were linked to examination standards integrated into the core curriculum [2, 8].

[3] Regulation of the Minister of National Education of December 2008. https://isap.sejm.gov.pl/isap.nsf/download.xsp/WDU20090040017/O/D20090017.pdf.

The core curriculum was organized into two layers:

- The basic layer comprises 3–5 general requirements for each discipline, defining the main objective for learning a certain discipline at a certain education level. For example, for mathematics at lower secondary school, the general requirements include mathematical modeling, strategic thinking, and mathematical reasoning and argumentation. This implies that the whole teaching process should be oriented toward developing these skills.
- The second layer consists of detailed requirements, describing the specific knowledge and skills to be mastered by students, that is "a student can solve simultaneous equations." However, these specific requirements serve only as a tool for achieving the more general aims, as defined by the general requirements.

9.3.4 2013–2015: Lowering the School Age

A new reform initiated by the ministry aimed to raise the preschool enrolment rate by lowering the starting school age of compulsory education from 7 to 6. This decision triggered strong opposition among parents, and the ministry was not able to offer convincing arguments.

Lowering the School Age in Poland

Parents were concerned about the readiness of school buildings, teaching programs and methods, and especially the quality of after-school activities for 6-year-olds. In kindergartens, children were properly cared for and educated 8–9 h a day, allowing parents to work normally, while at many schools the only option for a student to stay after 4 h of study was to join a big group with a very limited program of activities

Protesters launched a campaign 'Save the kids' and organized a civic movement in 2014 which collected more than 1 million signatures calling for a national referendum about the educational reform. This proposal was supported by the opposition, but Parliament rejected it, arguing that its questions were too specific for a national referendum

Eventually, school education in Poland became compulsory for 6-year-olds in 2015. However, just few months later, following parliamentary elections where the opposition came to power, the new government started to reverse this educational reform. It was very clearly explained by the Prime Minister in an interview in November 2015:

"In the context of education, as well as the problems of Polish families, it is important to talk about the compulsory education of six-year-olds introduced against the will of parents. Our government will reverse these changes. Polish parents will have the right to choose, because they know their children best.

Parents will decide whether their child will go to school at the age of six or seven. This change will be carried out within the first hundred days of our government"

9.3.5 2017: Next Initiatives to Transform Poland's Educational System

Poland's current government came to power in 2015 with a promise to reverse most of the previous education reforms and, most importantly, to bring back the old system with 8 years of primary schooling, removing lower secondary schools. The authors of this reform referred to the widespread opinion of the population, which was demonstrated by the aforementioned support for a referendum. In their view, this was a stronger argument than expert comments based on the results of international studies like PISA.

In the first months of office, the government amended the School Education Act returning the mandatory school starting age to 7 years. This reversed the decision of the previous government to start primary schooling at the age of six years.

In December 2016, despite the protests of teachers, parents, local governments, and key opposition parties, the government passed a new Law on School Education, eliminating lower secondary schools.

The Ministry of National Education used surveys of public opinion as the main argument to support the proposed changes, with virtually no sound rationale for the changes being presented. The ministry used as 'arguments' small, one-sentence quotations from various studies and papers, presenting them out of context. Some 200 researchers submitted a letter to the minister protesting against the misuse of their studies, but there was no official response to this.

Poland's largest trade union of teachers, ZNP (Związek Nauczycielstwa Polskiego), collected almost 1 million signatures and submitted a motion to Parliament calling for a referendum. Parliament deliberated on the proposal until the summer holidays of 2017 and then rejected it, arguing that it was now too late to organize a referendum. From the beginning of the school year 2017–2018, intake to lower secondary schools (gimnazja) has been suspended.

This reform has been accompanied by changes to the national core curriculum. This started in September 2017 in grades 4 and 7 of primary schools and changes were introduced, grade by grade, until 2023. The curricula for general and vocational secondary schools have been changed as well.

The updated curriculum put more emphasis on knowledge acquisition within narrow disciplines. Such focus is motivated by public opinion on the overall low quality of secondary schools, offering easy access to low-quality tertiary educational

institutions. Reformers insist that more centralized and strict regulations, as well as a discipline-based focus, should structure the curriculum as it is easier for assessing.

As the changes are still in progress, it is too early to draw any firm conclusions on the possible impact on students' competences and performance of the system.

9.4 The Core Curriculum and Its Framework

The core curriculum for general education is discipline-based. It focuses mostly on specific, discipline-related results, but also includes some more general learning outcomes. For each level of education, the core curriculum defines objectives, key skills, and tasks for schools and teachers.

The educational objectives are threefold and encompass the acquisition of knowledge and skills, as well as the development of attitudes for living in the modern world. The attitudes are not described in detail.

Key skills are defined for each educational level. For example, for primary education they comprise.

(a) **Reading**, including understanding the text and the use of knowledge permitting intellectual, emotional, and moral development and social participation;
(b) **Mathematical thinking**, which includes at primary level the use of basic mathematical tools as well as basic mathematical reasoning in everyday life;
(c) **Scientific thinking**—the ability to formulate conclusions about the natural and social world;
(d) **Communication in mother tongue and foreign languages**;
(e) **Information and communication technology (ICT) use**, including searching for information;
(f) **Ability to learn**, including the pursuit of natural interest in the world, discovering one's interests, and preparation for further education; and
(g) **Teamwork**.

The key skills for secondary education are similar, but the requirements are more advanced.

A new element was introduced in the core curriculum concerning the development of key competences and social skills. It was a requirement for each lower secondary school student to participate in a team project. This was the only example in the core curriculum when a specific learning method was defined (suspended in 2017).

The tasks for schools and teachers refer to transversal, interdisciplinary competences and are described in general terms, including:

- Development of the ability to use the Polish language, with a rich vocabulary;
- Preparation for living in the information society, developing the skills to search, select, organize and use information from various sources using ICT;
- Media literacy;

- Health education—taking care of one's own health and the creation of a healthy environment; and
- Development of attitudes important for social life, such as honesty, reliability, responsibility, self-esteem, respect for others, intellectual interests, creativity, entrepreneurship, cultural awareness, individual initiative, teamwork, civic attitude, respect for tradition and national culture, respect for other cultures and traditions, and preventing discrimination.

Clearly, although the term 'key competences' was not explicitly used, they are defined in the core curriculum.

The core curriculum also defined the **requirements for centralized exams**. Based on analysis of the PISA results, more focus was put on scientific reasoning and problem solving. For example, each mathematics exam task should contain a problem starting with words "prove that…" to evaluate the level of mathematical reasoning and argument. Scientific tasks also require analysis and arguments, not only quoting facts and numbers. One of the general requirements for history was "critical analysis of information sources."

Following the change to the structure of the school education system introduced in 2017, the core curriculum was modified as well. The changes mostly concentrated on the subjects and distribution of the content (themes) among grades. The description of the general requirements (in the introductory part) remains almost unchanged but the 'names' of key competences (scientific reasoning, mathematical thinking, team work, and so on) were removed.

9.5 Practices of Key Competences Development and Evaluation in Poland

When Poland joined the European Union (2004), funding from the European Social Fund became available for schools and other educational institutions. Key competences (defined in the European Parliament's recommendation) were mentioned in several documents. However, the calls for projects were focused on 'traditional', domain-based competences: math, science, ICT, and foreign language. The projects selected through competitive procedures offered organization of additional—after-school or out-of-school—activities but were not integrated into the curriculum. This therefore contributed to the knowledge and skills of some students but probably failed to change school culture and the provision of key competences in 'mainstream' schools.

9.5.1 Projects for Key Competences Promotion in Schools

School practices and the learning environment are crucial for the development of key competences. These aspects are very generally mentioned in the Polish core curriculum and other official documents, but no coherent strategy or program has been proposed and implemented. The development of key competences in school has never been evaluated or inspected. There was neither broad public debate on key competences nor consultations with stakeholders.

However, there have been a number of small, independent initiatives, contributing to the key competences promotion and understanding. The KREATOR project (see Box 9.1) is particularly interesting, as it successfully translated the broad concepts of policy debates at the European level into recommendations and guidelines for daily school practices.

Box 9.1. KREATOR Project [5]

In 1995, the Ministry of National Education began implementation of the KREATOR Project, supported by European Commission funds (PHARE[4]), the aim of which was to "include key competences into the teaching process."

The KREATOR project used as a starting point the conclusions of the Council of Europe symposium on 'Key competences in Europe' [3] and proposed the following list of key competences:

- Planning, organization, and assessment of self-learning
- Effective communication in various situations
- Effective team work
- Problem solving in a creative way
- Efficient use of computers and IT

The project was implemented by a group of teachers working in teams in several Polish towns. Several guidebooks were prepared, describing ways to introduce key competences and organize classes and school operations. It is worth quoting an extract from of one of these guide books:

If, in your school, you want to undertake the task of including key competences into your teaching, remember some issues that seemed important to us

- *Think together, what do your students need key competences for? Develop the school's own task, considering the actual needs of your students after graduation and what you can and want to give them instead of looking only into regulations. Doing anything against self mostly leads to time losses, serving no purpose.*
- *Remember, if you require your students to use their key competences, you need, first, to use these competences yourself. We have, many times, found*

ourselves breaking the rules of discussion or effective team work. We are aware that it is more difficult for teachers to communicate with students than for students to communicate between themselves.

- *A teachers' working style during classes is the most important thing. Key competences can be acquired by students only when performing their tasks independently. The so-called 'hints' are only cheating our own conscience and making real learning practically impossible for students. This change of our own role can become a nightmare, but without it we are only reciting beautiful slogans while the essence remains the same.*
- *We do not have to move away from skills and knowledge in subject teaching if we want to shape key competences. Each group task should begin with an understanding of one's role in a team; each exchange of views should follow the rules of effective communication. If a teacher, after the task performed, asks not only for results but also for methods applied, the students will think in terms of the learning process. This reflection becomes—for both the student and the teacher—a source of planning the development of key competences*
- *Assessing the use of key skills by the students is the most important and, at the same time, the most difficult process. There are no ideal methods of assessing key skills. The teaching staff in each school has to agree on their own ways and means. This debate has an extremely high value that justifies undertaking efforts toward key skills at schools.*

When the European Commission PHARE financing stopped (in 2000), the team was dissolved and the process of defining key competences was discontinued. The project results were used only to a minor extent in further curriculum reform work

9.5.2 NGO Initiatives

NGOs have played an important role in promoting competence-based learning in Poland. Several powerful organizations were established in the early 1990s, such as the Polish Children and Youth Foundation (PCYF, *Polska Fundacja Dzieci i Młodzieży*),[5] the Centre For Citizenship Education (CEO, *Centrum Edukacji Obywatelskiej*),[6] the Junior Achievement Foundation of Poland (*Fundacja Młodzieżowej*

[4] https://ec.europa.eu/neighbourhood-enlargement/instruments/former-assistance/phare_en.

[5] http://www.pcyf.org.pl/index.php?lang=en&s1=fundacja&s2=onas.

[6] https://glowna.ceo.org.pl/english.

Przedsiębiorczości),[7] and many others on a smaller scale. Inspired by western best practices, they carefully honed their programs and sought financial support, and courted media coverage.

One of the most innovative examples of an NGO's work in partnership was the CEO's campaign **Classy School** ('*Szkoła z klasą*'). It was co-run by CEO and Poland's biggest daily newspaper, 'Gazeta Wyborcza'. The idea was that the pedagogic framework and guidance were provided by educational experts from CEO, but all the operations were carried out at and by Gazeta Wyborcza. The aim was to promote the initiatives of students, individual teachers, and schools. When the project started in 2002, it was initially planned for 400 schools, but eventually the campaign involved over 5,000. Because of its success, several phases were undertaken, and the project developed into a complex, multi-stage system of facilitating change in education, with sub-programs focused on whole schools, individual students, informal student groups, individual teachers, and student–teacher teams.

Successful participants of the project got the opportunity to take part in further training in the 'Classy School Academy'. Two innovative features of this program were its 'online-only' format (all tasks were reported via online forms and most communication was via email) and social control as the main form of validation (the reports were published on the web; no one formally checked what happened, but all activities were transparent for all the community). Thus, the project contributed to promoting ICT competency and building a spirit of trust (possibly the most important effect). CEO also runs several other comprehensive programs promoting innovation at schools (improving teaching, school environment, and school leadership).

Educational Research Institute (IBE, *Instytut Badan Edukacyjnych*) also developed and runs an open database of 'good practices and didactic tools',[8] involving history, Polish language, mathematics, and science. Although mainly addressed to teachers, students and parents can also benefit from it. User comments show it is highly appreciated by teachers as a helpful tool for their everyday work. The database development was funded by the European Social Fund in 2007–2014 (since then, the scope of activities has been reduced).

Another program that explicitly promoted competence-based learning was PCYF's projects 'Life Skills for Employability' (2006) and 'Life Skills: Social Skills Coaching' (2007). They were delivered as part of an international program run by the International Youth Foundation and supported by General Electric. The program was directed to vocational and technical secondary schools. Students were trained in three areas:

(a) Personal development, understood as the skill of appropriately evaluating one's resources, setting goals, and leadership
(b) Problem solving, consisting of communication skills, the ability to reach agreement, and conflict management

[7] https://junior.org.pl/pl.

[8] http://bnd.ibe.edu.pl/.

(c) Development of work-related skills, understood as the ability to work in teams, work ethics, self-evaluation, the ability to take risks, project management, and time and money management.

The program consisted of teacher training and offered syllabi that could be adapted and used in vocational schools. It also provided microgrants for student projects.

9.6 Key Competences Evaluation: Poland in PISA

Before 2000 and the first PISA study, Poland did not participate in any international comparative assessment of student achievements (except for the International Association for the Evaluation of Educational Achievement Civic Education Study in 1997). The decision on joining PISA was taken at a very advanced stage of its conceptual framework and the development of instruments. Hence, Polish experts neither contributed to that work nor were the concepts and assumptions debated in Poland.

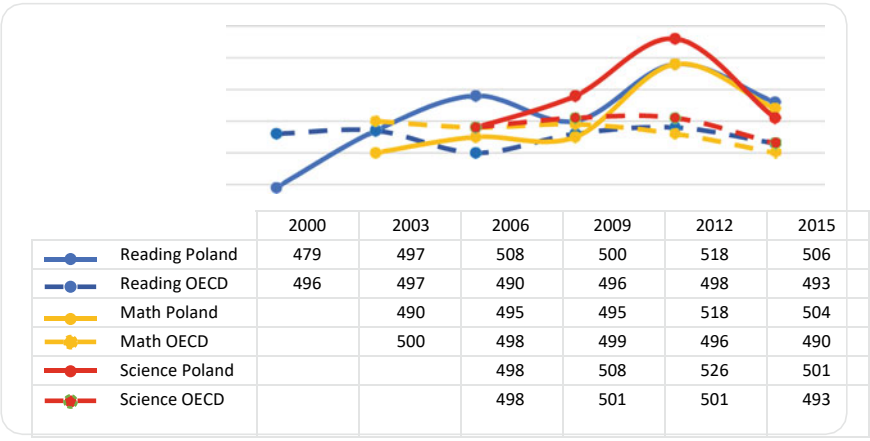
No systemic monitoring focused on key competences has been undertaken in Poland in recent years. As a result, PISA remains the main and most reliable source of data on the key competences of Polish youth.

Figure 9.1 shows significant improvements in Polish students' performance in PISA [1, 6]. The results in all areas (reading, math, and science) improved from a level below the Organisation for Economic Co-operation and Development (OECD) average (500 points) to well above that average in 2012. The scores in 2015 were lower (but still slightly above the OECD average). This is probably the effect of the change from traditional paper tests to computer-based tests. Earlier additional components of PISA which used computers have shown that Polish students had difficulties responding to computer tests.

The results of PISA 2000 show the competences of 15-year-old secondary schools' students had not yet been affected by the system reform of 1999, while 15-year-olds in 2003 were the first group attending lower secondary schools introduced as a result of the reforms. The results in 2000 varied hugely depending on the school type: the mean score of vocational schools' students was 358 points, while the mean for general academic schools was 543. The significant progress between the first and the second cycle of PISA was the effect of the delay in general versus vocational track selection by students, as they continued in lower secondary schools, and this helped to improve the results of low-achievers.

The pupils covered by the following wave of PISA in 2006 had been part of the reformed education system for most of their school years. They took the final primary school test in 2003 and were prepared for the final lower secondary school exams a few weeks after PISA in 2006.

In math, Poland improved its score from 470 points in 2000 to 495 in 2006. Reading scores improved from 479 to 508, while science scores increased from 483 to 498 (see Fig. 9.1).



	2000	2003	2006	2009	2012	2015
Reading Poland	479	497	508	500	518	506
Reading OECD	496	497	490	496	498	493
Math Poland		490	495	495	518	504
Math OECD		500	498	499	496	490
Science Poland			498	508	526	501
Science OECD			498	501	501	493

Fig. 9.1 Poland's PISA scores (compared with OECD)

The next significant leap in Poland's PISA results occurred between 2009 and 2012. This was probably the effect of the new core curriculum being introduced in 2009, which promoted such skills as problem solving, critical analysis of information, scientific reasoning, and argumentation. These skills/competences are similar to those measured by PISA and are widely recognized as relevant for the twenty-first century. If we agree that developing such competences is one of the priorities of education, we can argue that PISA results provide support for a positive evaluation of the 2009 curriculum reform and appropriate modification of national exams. It is important to note, however, that there is no strong evidence to confirm this evaluation.

After PISA 2003, experts in the Ministry of Education claimed that the improvement in results was caused by the extension of comprehensive general education. Based on this, the ministry decided to use the so-called 'national option of PISA'. The PISA test was applied to assess Polish first-grade students in upper secondary schools (they are one year older than the PISA standard target group).

This test, applied with the main PISA study from 2006, revealed significant differences in achievement among students of various types of upper secondary schools (see Table 9.5). In 2006 and 2009, upper secondary school students performed better than lower secondary school ones. However, in 2012 younger pupils had similar results to the older group.

Students at basic vocational schools were getting lower results, thus confirming that selection, although postponed by one year, still affected negatively student achievements. In any case, the results of students in vocational education were still considerably better than those of similar students in PISA 2000, demonstrating the long-lasting effects of an additional year of comprehensive education, a positive implication of the 1999 educational reform. The negligible differences in the results of 15- and 16-year-olds in 2012 resulted from a significant increase in the scores of the younger group. This could be linked to the introduction of the new core curriculum

Table 9.5 International PISA results for 15-year-olds and national PISA test for 16-year-olds[9]

	2006			2009			2012		
	Math	Reading	Science	Math	Reading	Science	Math	Reading	Science
General upper secondary	566	581	572	559	565	565	571	570	575
Technical upper secondary	495	503	496	495	487	505	506	502	507
Basic vocational	410	389	410	402	392	413	417	409	430
16-year-olds (1st grade of secondary schools)	514	520	516	506	503	514	519	516	524
15-year-olds (international PISA, 3rd grade of lower secondary schools)	495	508	498	495	500	508	518	518	526
Difference in PISA scores at 15 and 16	19	12	18	11	3	6	1	−2	−2

[9] Results of the PISA international survey in Poland and national option for testing with the same PISA instruments first grade students of upper secondary schools.

in 2008 and new type of lower secondary school exam (2011), both of which affected this group of students.

9.7 Evaluation of New Core Curriculum Implementation

Between 2009 and 2014 Poland's Educational Research Institute carried out several studies to evaluate the implementation of the new core curriculum. Two of them are particularly of note, as they relate to key competences:

- 'The school of independent thinking' (problem solving, reasoning, and argumentation in reading and mathematics).
- 'The laboratory of thinking' (inquiry in science education)

The aim of the study 'The School of independent thinking' was to diagnose the competences of pupils in the fourth year of primary schools, first year pupils in lower secondary schools, and first and last year students in secondary schools. The study covered complex skills applied in the Polish language and mathematics: formulation of problems, creating strategies for problem solving, interpretation, reasoning, arguing, analysis, and synthesis.

The inspiration for this study came from the results of PISA 2009, which showed that Polish students do better in regular, imitative tasks while they have problems when independent, critical thinking is required.

The study discovered that the biggest progress in the development of the complex skills occurred between grades 4 and 6 of primary schools. At the higher levels of education, students mainly use and master those skills and do not learn new ones. The other finding is the big difference between vocational school students (who have a very basic level of competences) and students of general secondary schools. Although even in that group there was the tendency to follow the methods proposed by teachers.

The study 'The Laboratory of Thinking—Diagnosis of Science Education in Poland' aimed to measure the level of scientific knowledge of lower secondary schools' graduates who had been taught according to the new core curriculum. It focused on such key skills as reasoning in science, formulating hypotheses, designing experiments, searching for and critical analysis of information, and scientific inquiry. The study assessed whether students were able to distinguish facts from opinions.

Standardized testing tools were used, covering core curriculum subjects: biology, chemistry, geography, and physics. Additional student questionnaires concerned, among others, the forms and methods used in science lessons by teachers. The study was carried out in four cycles—in 2011, 2012, 2013, and 2014, each year involving 7,200 pupils from around 180 schools.

In 2011, the tested students followed the old core curriculum and the results of that group were standardized to set a mean score of 500, to be used as a benchmark to measure the effects of the curriculum modification. Based on the students' results, 6 levels of competences were defined: level I: <350; level II: 350–449; level III:

Table 9.6 The results of 'The Laboratory of Thinking'

Discipline	% of students below level II			% of students at levels V and VI		
Year	2011	2014	Change	2011	2014	Change
Biology	21.5	20.3	−1.2	15.9	23.4	7.5
Chemistry	21.7	18.0	−3.7	16.3	24.6	8.3
Physics	21.9	20.4	−1.5	16.2	21.4	5.2
Geography	21.5	20.0	−1.5	16.2	22.0	5.8

450–549; level IV: 550–649; level V: 650–749; and level VI: >750. For each level the characteristic competences were identified and described.

The mean results in every discipline increased between 2011 and 2014, reaching 516 in biology, 523.5 in chemistry, 513 in physics, and 515 in geography.

At the same time the share of lower achieving students (level II or below) remained the same (approximately 20%), except chemistry where the change was small, but statistically significant. The share of students at top levels, levels V and VI, significantly increased (see Table 9.6). Thus, the core curriculum modification caused an increase in the share of higher-performing students, while the share of low achievers remained the same.

The lesson from Poland is complex and interesting. On the one hand, PISA was used by experts, researchers, and policy makers to defend reforms and to propose new policies that seem to have been successful in further improving the key competences of Polish students. However, the reformers were not that successful in convincing the public that the changes were beneficial. In effect, a popular and nostalgic sentiment toward the old system and the forceful encouragement of negative emotions about the type and speed of the reforms introduced in 1999 are in large part driving popular opinion supporting a reversal of the post-1999 changes.

9.8 Conclusion

Polish experience is challenging and interesting. Yes, the results of PISA were used by experts and policymakers to advocate reforms and drive new changes that helped successfully develop learners' key competences. However, the reformers failed to convince the public that these changes were beneficial. In practice, the widespread nostalgic attitude toward the old system and the powerful encouragement of negative sentiments in relation to the idea and pace of the 1999 reforms largely determined the subsequent turn of educational policy in the opposite direction.

To sum up, we would like to list the challenges that need to be addressed if Poland is going to develop an overall key competences strategy (it is very likely that this would be called a 'skills strategy' in line with the present OECD trend).

- A comprehensive key competences strategy should encompass curriculum, teaching methods, and teachers' professional development as well as good information and promotion activities.
- The scope of such a strategy should not be limited to narrowly defined key competences like literacy, numeracy, and ICT.
- Key competences cannot be 'taught' as traditional school subjects. They need to be developed in a student-centered, democratic, pro-innovative learning environment. To create and foster it schools must enjoy a level of autonomy, and teachers need to feel trust in their professional skills.
- The crucial issue is getting the support of all stakeholders through a well-prepared information strategy containing two-way communication and solid, evidence-based arguments. Lessons should be learned from Poland's efforts to extend its general education: the introduction of lower secondary schools and the lowering of the school starting age.

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Chapter 10
Twenty-First Century Skills and Learning: A Case Study of Developments and Practices in the United States

Michael Russell, Henry Braun, and Binbin Zhu

Abstract The authors of this chapter faced a difficult task of summarizing the experience of one of the largest and most diversified school systems in the world. The US experience, as shown in the chapter, demonstrates that, in such diversified systems, the strongest signal is given through assessment. While most state education systems include information about twenty-first century skills in their curricular materials, none has adopted a formal set of standards on which students are summatively assessed. While most states have not aggressively prioritized twenty-first century skills in their standards, curricular guidance, assessment programs, and professional development programs, there are a few states that have done so. Efforts to introduce 21 century skills to schools can be quite diverse, and paths to success can be rather non-standard—like the North Carolina's Digital-Age Learning Initiative which is discussed in detail in the chapter. This statewide comprehensive initiative aimed to prepare students for an increasingly competitive workplace by capitalizing on a variety of digital technologies to personalize student learning and develop an expanded array of skills and knowledge. This case demonstrates how digital instruments help translate disciplinary learning onto a new level: isolated content

A note from the editors

This chapter was prepared by leading American expects in educational assessment from the excellent Boston College. They were faced with the difficult task to summarize the experience of modernizing the content of education in one of the largest and most diversified school systems in the world. This diversity has led to the fact that, in the United States, there are now schools that have become world leaders introducing innovations and developing key competences and new literacies, but there are also super-conservative schools that stick stiffly to the curricula of the early twentieth century.

The US experience, as shown in the chapter, demonstrates that, in such diversified systems, the strongest signal is given through assessment.

It is also very interesting to explore the case of North Carolina discussed here in detail. It reveals that thoughtful technological modernization can have a strong modernizing effect on the content of education.

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is conceptually intertwined into a coherent picture in project-based and community learning activities.

Keywords Twenty-first century skills · Twenty-first century learning · Educational standards · Student assessment · Digital-age learning · Career and technical education · Race to the Top program

Highlights

- Education in the United States is decentralized and diverse, both across the states and within the states.
- While most state education systems include information about twenty-first century skills in their curricular materials, none has adopted a formal set of standards on which students are summatively assessed. While most states have not aggressively prioritized twenty-first century skills in their standards, curricular guidance, assessment programs, and professional development programs, there are a few states that have done so.
- Integration of twenty-first century skills into school subjects is more noticeable in mathematics, science, and languages. In mathematics and science, attention is given to practical real-life skills and problem-solving, as well as interdisciplinary concepts; while languages emphasize communication skills.
- Efforts to introduce twenty-first century skills to schools can be quite diverse, and paths to success can be rather non-standard—like the North Carolina's Digital-Age Learning Initiative. This statewide comprehensive initiative aimed to prepare students for an increasingly competitive workplace by capitalizing on a variety of digital technologies to personalize student learning and develop an expanded array of skills and knowledge.
- Digital instruments help translate disciplinary learning onto a new level: isolated content is conceptually intertwined into a coherent picture in project-based and community learning activities.

10.1 Introduction

The phrases 'twenty-first century skills' and 'twenty-first century learning' are frequently used by schools, business leaders, and politicians throughout the United States. The focus on twenty-first century skills and learning is driven largely by a desire to remain economically competitive and provide today's students with opportunities to thrive in a changing workplace. The root cause of this drive for twenty-first century skills and learning is a perception that digital technologies and the Internet have fundamentally altered the ways in which businesses function. In turn, these changes in the business world demand a new set of core competences people entering

the workforce must possess to succeed. In addition, it is up to U.S. schools to help today's students develop these new competencies.

At first glance, the rhetoric regarding twenty-first century skills and learning employed by schools, business leaders, and politicians across the United States creates an image of unity regarding the nature and importance of these new competences. Upon closer inspection, however, the story is more complex and disjointed. In part, this complexity results from the decentralized structure of education in the United States. In turn, this decentralized structure results in several different definitions of twenty-first century skills, different approaches to developing these skills, and a lack of consensus about how to assess the achievement of these new competencies.

Given the decentralized nature of education in the United States, it is impossible to tell the full story of twenty-first century skills and learning across the nation succinctly. Instead, this case study is a brief attempt to tell one part of the story of twenty-first century learning in the United States.

The story begins by providing an overview of general developments that have occurred nationwide. We then focus on efforts made by one of the nation's 50 states to establish the support required for twenty-first century learning in schools. To understand how these supports translate into practice, we then provide a brief overview of the ways in which public high schools are addressing the development of twenty-first century skills by their students. The case study ends by highlighting what we see as the most significant developments to date and areas in which further progress is likely to occur next.

10.2 An Overview of Education in the United States

Education in the United States is decentralized. The federal constitution delegates authority for education to each individual state and each U.S. district and territory. This designated authority results in 56 different educational systems. The level of authority for education delegated to the state government, however, varies further across states. In some cases, individual states, such as Texas and Florida, retain considerable authority over educational practices across their districts and schools. Other states, such as Massachusetts, New Hampshire, and Michigan, grant considerable authority to local districts and schools for making decisions about the curriculum, learning resources, and administrative functions.

This decentralized and diverse structure has several implications for education across the nation. Two of the most visible products of this diversity are the structural features of each state's education system and the funding for education provided within each state.

Structurally, the U.S. education system can be conceived of as a set of branches. Within each branch, a top organization provides funding for education that is tied to regulations. The top-most branch has the federal government at the top and state governments below. At the state level, the state government is at the top and local

school districts are below. And, in some cases, at the local level, the district office is at the top and each school in the district is below.

At the national level, a set of federal laws and programs make funding available to states contingent on the states adhering to federal guidance. As an example, the federal Elementary and Secondary Education Act establishes policies regarding a variety of educational practices and provides funding to states contingent on their adherence to those policies. Federal acts, such as Title I, the Individuals with Disabilities Act, and the Perkins Act, provide funding for specific subgroups of students and programs such as students living in poverty, students with disabilities and special needs, and students pursuing a career and technical education (CTE) paths, respectively. Because authority for education resides at the state level, many of these federal programs are binding only if states elect to accept the funding associated with them. In almost all cases, however, states accept the funding and thus agree to adopt and implement the regulations linked to that funding.

At the state level, the state education department is the highest authority and school districts operate at a local level. The manner in which districts are defined, however, differs noticeably among states. In many states, particularly those in the south and western areas of the nation, districts are defined at the county level. Each city or town operating within a county belongs to a single district. In other states, districts are defined at the town or city level. This difference in the structure of local districts results in two notable differences. First, in those states with county districts, there tend to be significantly fewer districts, but these districts serve a much larger geographic region and often a larger number of students. As an example, the state of Florida has a student population of approximately 2.8 million students. In contrast, Vermont has only 89,000 students. Florida is a county-based system that has 74 districts[1] and Vermont is a town-based district system containing 361 districts. In effect, these structural differences result in Florida's districts serving approximately 37,500 students, on average, while Vermont's districts serve an average of only 246 students.

A second important effect of these structural differences is the variation in local policies and practices that occur across districts in a state. Since county districts represent a larger geographical region and a large population of residents, the specific policies and practices tend to be homogenous across districts because a wider diversity of views must be accommodated within each district. In effect, this structure tends to produce a consensus approach to district-level decision and policy making. In contrast, the smaller number of people represented by town-based district systems coupled with more homogeneity that tends to occur within a smaller region results in more diversity among local policies and practices. In extreme cases, this leads to some local districts opting to embrace policies that differ greatly from the other districts in their states, such as teaching about evolution and creationism or permitting time for prayer during the school day.

[1] Florida has 67 counties, four laboratory schools that operate as independent districts, the Florida School for the Deaf and Blind, the Florida Virtual School, and the Okeechobee Youth Development Center that serves students in the state juvenile system.

These differences in the structure of state systems also affect the authority of the state over education within each district. As an example, some states, such as Texas, California, Florida, and North Carolina, review and approve textbooks and other learning materials, which limits the use of materials in each district to those materials on the approved list. In effect, this approval process provides a partial control over the curriculum employed within each district. In contrast, other states allow each district to make its own decisions about the curriculum and curricular materials.

Perhaps the most visible difference among state educational systems is the wide variation in the amount and sources of funding that support public education. One way to represent this diversity is to examine per pupil expenditures among states. Per pupil expenditures represent the amount of funding per student provided by a school system to support all aspects of schooling. These expenditures support a variety of expenses associated with the provision of education for each student and include items such as teacher salaries, the principal's and superintendent's salaries, administrative and janitorial staff salaries, special education services, maintenance of school buildings, text books, computers, heat and air conditioning, snow removal, busing to and from school, and so on. In 2015/16, the mean per pupil expenditure across the nation was US$11,787. Yet, in states such as Vermont, New York, and the District of Columbia, the mean expenditures were US$23,557, US$21,606, and US$21,297, respectively. In contrast, mean expenditures in Idaho and Utah were US$6,538 and US$6,843, respectively.[2] This represents a difference exceeding US$15,000 per student.

Another way to represent the variation among state educational systems is to compare the sources of funding for education. The source of funding for schools is an important factor that influences the amount of funds available to schools and the flexibility schools have to use those funds to support the purchase of curricular materials and technology and provide professional development. In effect, the more funding is provided at the local level, the more flexibility schools have in using those funds. But dependence on local funding often also contributes to inequities in the amount of funding available. In the United States, there are three primary sources of funding for schooling: (a) federal tax revenue, (b) state tax revenue, and (c) local (for example, city, town, and/or county) tax revenue. Across the nation, the percentage of federal funding for all educational expenses ranges from a low of 4.1% in New Jersey to a high of 16.4% in South Dakota. Similarly, the percentage of education funding coming from state expenditures ranges from 27.6% in Illinois to 85.7% in Vermont.[3]

Examining one level lower in the system, the variation in spending within each school system also differs widely among states. In some states, strategies are adopted at the state level that attempts to equalize funding across districts, regardless of

[2] National Education Association. 2017. "Rankings of the States 2016 and Estimates of School Statistics 2017." http://www.nea.org/assets/docs/2017_Rankings_and_Estimates_Report-FINAL-SECURED.pdf.

[3] IES: National Center for Education Statistics. Web released in January 9, 2018. "Revenues and Expenditures for Public Elementary and Secondary Education: School Year 2014–15 (Fiscal Year 2015)." https://nces.ed.gov/pubs2018/2018301.pdf.

differences in the local tax base. As an example, Vermont employs a formula-based approach in which local tax dollars from districts that have a higher tax base are transferred to districts with a lower base. This results in approximately equal per pupil expenditure within districts across the state. In contrast, in states such as Arizona local expenditures differ widely and there is no attempt by the state to equalize per pupil expenditures among districts. This results in wide differences among districts, such that in some districts (even those that boarder each other) the per pupil expenditure ranges from more than 40% above the national average to 40% below that average (a difference of approximately US$8,000 per student).

The decentralized nature of the U.S. education system also affects the availability of digital technologies in schools. In 2016, it was estimated that 54% of public school students had access to a school-issued computing device. Some states, such as Maine, have a decade-long history of investing in programs that provide a digital device for each student. Other states, however, have been less aggressive in supporting access to technology. As a result, the student to digital device ratio differs among states, although this difference has become less pronounced in recent years.

In summary, the decentralized structure of the U.S. educational system results in considerable differences at both state and local levels in funding, policies, and practices. While many people in the United States see local control as an asset, the diversity that results makes it challenging to characterize educational practices within the United States at a national level.

10.2.1 Educational Standards and Student Assessment

Standardized testing has a long history in the United States that dates back to the late 1800s. National and state-level efforts to assess student learning also have a well-established history dating back to the late 1960s and early 1970s. At the national level, the National Assessment of Educational Progress (NAEP) was launched by the federal government in 1969. During the 1970s, some states also began testing students in specific grades, in some cases requiring students to pass tests to earn a diploma. In the 1990s, state testing expanded significantly and in the early 2000s, the federal No Child Left Behind Act (NCLB) further increased the volume of testing within each state by requiring all students in Grades 3–8 and in at least one grade in high school to be tested annually in language arts and mathematics. While the details of these programs have evolved over the past 15 years, these general policies remain in effect. In the two sections that follow, we briefly describe the National Assessment of Educational Progress (NAEP) and state-level assessment programs.

10.2.1.1 National Assessment of Educational Progress

Technically, the NAEP is a voluntary assessment program. The federal government, however, requires states that receive Title 1 funding (which supports students from low-income families) to participate in the NAEP. Given that all states rely on Title 1 funding to support public education, this requirement results in all states participating in the NAEP.

It is important to emphasize that the NAEP is a national assessment program. However, because there is no national curriculum and instead each state develops its own curriculum, the NAEP is not designed to assess the achievement of a curriculum. Rather, it focuses more broadly on knowledge and skill that was identified as important for students to develop at the time the NAEP was first implemented.

The NAEP employs a sampling approach to periodically assess student learning in English language arts, mathematics, science, history, and the arts. The primary goal of the NAEP is to examine trends in student achievement over time. Initially, the trend focused on the national level. But, in the early 1980s, the focus was expanded to provide information at the state level. While the details for each subject area differ, the NAEP typically selects a sample of approximately 5,000 students per state in Grades 4 and 8 and one grade of high school. Selected students then perform one of several versions of the test, each of which contains a combination of selected-response and short open-response questions. Students do not receive individual scores. Instead, student performance is aggregated and reported at the state level, as well as at the subgroup level within states (for example, male/female, race and ethnic groups, and socioeconomic status). Because the NAEP is designed to document trends in student learning, it is conservative in making changes to the content assessed within each subject area and in the design and structure of the test. In the past two years, however, the NAEP has begun to transition from a paper-based to a digital mode. This transition has allowed the program to begin experimenting with new items and task types, including simulated experiments in science and the assessment of problem-solving. More recently, the NAEP also convened a panel of experts to explore the development of an assessment focused on collaborative problem-solving. It should be emphasized, however, that these newer foci have not yet been used operationally.

10.2.1.2 State-level Assessment Programs

The story of today's state assessment programs begins in 1983. Still, in the Cold War and concerned about increasing economic competition from Japan, the federal government convened a panel to examine how to increase U.S. economic and global competitiveness. The result was a report, titled 'A Nation at Risk', that raised concern about the quality of education provided by the nation's K-12 public education system. In response to this report, efforts were made to establish and implement standards for the content and skills students were expected to achieve at each grade level. Again, because the federal government could not demand what was taught in each state,

nonfederal but nationwide organizations, such as the National Council of Teachers of Mathematics, worked with representatives from other national and state organizations to develop national standards. In some cases, states adopted these national standards directly. In many cases, states modified the standards to create state-specific versions. In a few cases, states developed their own standards (although they were often similar to the national version). In all cases, these content standards were organized by content area and took the form of descriptive lists of knowledge and skills that were expected to be the focus of instruction within each grade level.

To measure the achievement of these standards, several states developed summative tests that were administered to students in select grades. As an example, in the 1980s Massachusetts developed the Massachusetts Educational Assessment Program (MEAP). Like the NAEP, the MEAP employed a sampling approach to test students in Grades 4, 8, and 10 in select subject areas each year. With the establishment of common standards, in the 1990s, several states revised their assessment programs so that the tests employed were aligned with the content standards adopted by a given state.

One challenge with this state-level approach to what was termed standard-based assessment was differences in what each state's standards entailed and how they were assessed. Because each state had the autonomy to design and develop its own assessment program, and nearly all did, results were not comparable across states. In response to this shortcoming, during the 1990s there were multiple calls for developing a national test that was aligned with national standards. It is important to note three aspects of this effort. First, because the federal government could not compel states to adopt a national test, the proposed testing program would be voluntary. Second, because there were no federal standards, the testing program would be aligned with standards established by these nationwide organizations. Third, despite strong interest among national leaders in this program, the program was never implemented.

Instead, the 2002 reauthorization of the Elementary and Secondary Education Act, also known as the NCLB, included a requirement for all states accepting Title 1 funding to establish achievement standards for Grades 3–8 and high school for language arts and mathematics and to assess student achievement of those standards each year. Again, because all states depended on Title 1 funding, this requirement led to the adoption of this assessment practice by all states. However, because the federal government could not mandate the content of the standards adopted by each state, the NCLB allowed variation in standards and the tests used to assess achievement of those standards to persist.

To address this disparity, the 2010 federal Race to the Top (RTTT) program provided grants to states that agreed to adopt common standards for language arts and mathematics. In the years just before this program, two nationwide organizations developed what was known as the Common Core Standards.[4] Again, these were not

[4] The Common Core Standards were developed through a partnership involving content area experts and organizations interested in improving student achievement. The development effort was spearheaded by the National Governors Association (NGA) that convened two teams, one that focused on

federal standards, but rather intended to be nationwide. Although the federal RTTT program could not mandate the adoption of the Common Core, because the Common Core was the only nationwide set of standards, it was understood that states that opted to participate in the program would adopt the Common Core.

Shortly after launching this program, the federal government then launched a second program called the Race to the Top Assessment (RTTTA) program that provided substantial funding for states to work together as a consortium to develop tests aligned with common standards jointly adopted by participating states. In addition, the RTTTA program required these assessment programs to focus on assessing high school students' readiness for college or careers and elementary- and middle-school students' progress toward readiness. In addition, the program encouraged states to capitalize on digital technologies to develop next-generation educational tests. This program led to the formation of two consortia of states, namely, the Smarter Balanced Assessment Consortium and the Partnership for Assessment of Readiness for College and Careers (PARCC). Initially, all but four states became members of one or both consortiums and participated in the initial effort to develop new tests. When the first round of testing was launched four years later, however, this number had decreased by about half, and today stands at less than 30 percent of states. In many cases, states left a consortium for political reasons, often due to pressure within the state to drop support of the Common Core Standards or to develop tests over which the state had more direct control.

Collectively, the federal programs and nationwide efforts implemented over the past 40 years have produced several results. Most notable among these outcomes are as follows:

(a) All states have developed and/or adopted content standards that detail the knowledge and skills students are expected to develop in each grade level.
(b) All states administer summative tests annually to students in Grades 3–8 and at least one grade in high school to assess achievement of their state's standards.
(c) Nearly all states have transitioned or have begun to transition their assessment programs to a digital format.
(d) Some states have expanded the types of items and tasks employed by their test to include new item response types and, in a few cases, simulation-based scenarios.

As detailed next, despite these advances, all state assessment programs remain focused on the achievement of content-based standards in traditional subject areas (for example, language arts, mathematics, science, and social studies), without reference to twenty-first century skills. It is also important to note that annual testing in these subject areas has raised concerns among some educators, parents, and the public about the amount of time required for testing each year. This concern creates an obstacle toexpanding the range of knowledge and skills addressed by state testing programs (Table 10.1).

English language arts and the other on mathematics. The effort was also supported by the Council of Chief State School Officers (CCSSO) that represents state-level education leaders and initiatives at a national level.

Table 10.1 Initiatives to develop nationwide content standards

Content standards	Developers	Year released	Adoption
Common Core Standards in Mathematics	NGA and CCSSO	2010	Initially adopted by 46 states, but dropped or modified by about half over time
Common Core Standards in English Language Arts	NGA and CCSSO	2010	Initially adopted by 46 states, but dropped or modified by about half over time
Next Generation Science Standards	26 states working with National Science Teachers Association, American Association for the Advancement of Science, National Research Council, and Achieve, Inc	2013	19 states and the District of Columbia

10.2.2 Twenty-First Century Skills Learning Expectations and Assessment

The first effort to establish formal standards for student learning in the United States began in the 1980s and was soon followed by the development of tests to assess the achievement of those standards. This first effort focused on traditional content areas and took the form of lists of discrete knowledge and skills students were expected to develop at each grade level or grade span (for example, Grades 3–5) within a content area.

Since the turn of the century, two important developments regarding student learning standards have occurred. First, the focus of content standards for language arts, mathematics, and science has shifted from discrete knowledge and skills to a more comprehensive and integrated application of those skills. This shift is most pronounced for science where the Next Generation Science Standards[5] emphasize three aspects of science. The first aspect, termed core concepts, is similar to previous science standards and focuses on the core knowledge students are expected to develop. The second aspect, termed scientific and engineering practices, emphasizes the skills required to apply knowledge in specific areas of science and engineering. The expansion to include engineering, rather than simply science, is also noteworthy. The third aspect, cross-cutting concepts, focuses on ideas, habits of mind, and approaches to exploring problems that are common across areas of science and engineering. By addressing all three aspects of science and engineering, the standards

[5] Similar to the Common Core Standards, the Next Generation Science Standards were developed by nationally recognized experts in science but are not national standards. Instead, similar to the Common Core, many states have opted to adopt the Next Generation Science Standards. However, other states have retained their own standards or have modified the Next Generation Standards.

aim to develop not just student knowledge of science, but also the ability to conduct scientific inquiries and to understand and critically interpret inquiries performed by others.

More recent mathematics standards have also expanded to place greater emphasis on mathematical practices and problem-solving. Language arts standards, however, still place considerable emphasis on developing reading comprehension and writing skills, but these skills are now expected to be applied across disciplines (for example, science, mathematics, and history) rather than only with literary texts (for example, fiction). In addition, the language arts standards have expanded to include spoken communication and listening skills. All these changes reflect the view that simply developing knowledge and core language arts skills are not sufficient for success in a workplace that now places greater demand on collaboration, communication, and creative problem-solving within and across disciplines.

In addition to these changes in the foci of content area standards, the United States has witnessed several efforts to expand the focus of learning expectations from traditional content areas to what is commonly referred to as twenty-first century skills. Like the U.S. educational system itself, these efforts have been diverse and have occurred without the active participation of the federal education system. Instead, various business and educational interest groups, and in some cases, scholars have taken the lead in developing and propagating these twenty-first century skills standards.

As listed in Box 10.1, at least 12 different efforts have been made to establish 21st learning expectations. Across these efforts, the focus of the resulting frameworks varies. All consider the development of content knowledge and skills important, but not sufficient for twenty-first century learners. To be competitive in the new workplace, these frameworks add additional skills and abilities that fall into five broad categories:

- Use of digital technologies
- Research and communication skills
- Collaboration and creativity/innovation
- Life skills
- Social/emotional skills

Box 10.1: Efforts to Establish Twenty-First Century Learning Standards, Frameworks, and Expectations

- Occupational Information Network (1999)
- EnGauge (2003)
- OECD (2005)
- Neomillennial Learning Styles (2005)
- New Media Literacy (2006)
- Partnership for twenty-first Century Skills (2006)

- Liberal Education and America's Promise (2007)
- International Society for Technology in Education (2007)
- Digital Literacy Standards (2007)
- 21st Century Skills (2010)
- National Research Center Taxonomy of twenty-first Century Competencies (2012)
- Assessment and Teaching of 21st Century Skills (2012)

Within each of these broad categories, the specific focus of the various frameworks also differs. As an example, some frameworks that highlight the use of digital technologies focus on the development of coding skills while others focus more generally on the use of the many digital technologies now available in homes, schools, and the workplace. Similarly, those frameworks that include creativity and/or innovation focus on the ability to approach problems from multiple perspectives while others focus more narrowly on entrepreneurship with the aim of preparing students to create new solutions that have economic potential. In these frameworks, innovation is coupled with leadership and business skills.

As one might expect, some of these efforts have gained more traction than others. In terms of impacting K-12 educational practices, perhaps the most influential to date is the Partnership for 21st Century Skills (P21). Founded in 2002, the P21 was a coalition of business leaders, education leaders, and policy makers who aimed to increase twenty-first century readiness of K-12 students. Figure 10.1 presents a visual representation of the P21 framework for twenty-first century learning. As indicated by the green arch, content knowledge in key subject areas serves as the foundation of the framework. For P21, key subject areas include English, reading and language arts, mathematics, world languages, arts, economics, science, geography, history, government, and civics. In other words, the framework calls for a well-balanced and comprehensive grounding across traditional disciplines.

Around this core knowledge, there are three additional areas of focus. Life and career skills include flexibility and adaptability, initiative and self-direction, social and cross-cultural skills, productivity and accountability, and leadership and responsibility. These skills are not taught in isolation but are expected to be embedded in instruction throughout the curriculum.

Learning and innovation skills focus on creativity and innovation, critical thinking and problem-solving, communication, and collaboration. In effect, the development of these skills is also embedded throughout the curriculum. However, these skills also require students to actively engage with and apply knowledge developed in the core content areas. That is, the content area knowledge serves as the 'what' with which students engage as they solve problems, communicate, collaborate, and think critically.

Finally, information, media, and technology skills focus on students' ability to be literate with each of these elements and to be selective about when and how specific instances of these elements are employed.

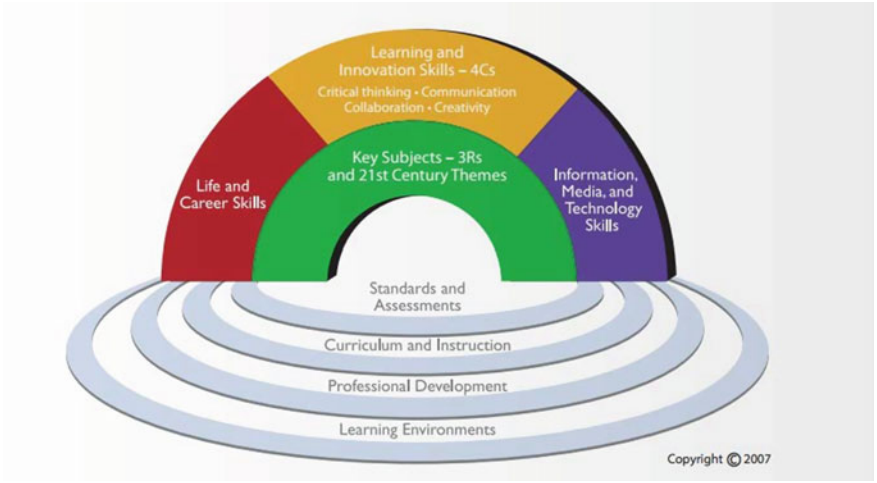

Fig. 10.1 P21 framework

Below this four-component arch, the P21 framework identifies supports required to help students develop this knowledge, skills, and habits of mind. It should be noted that P21 did not develop these supporting elements, but rather acknowledged that educational systems must be intentional in adopting and/or developing standards, curriculum and instructional practices, and assessments that support these learning outcomes.

To aid in the implementation of the P21 Framework, several founding members of P21 formed a not-for-profit organization called EdLeader21. In addition to advocating for the adoption of the P21 framework, EdLeader21 works directly with schools and educational systems to support the implementation of the framework. Rather than providing a prescriptive approach to implementation, EdLeader21 works collaboratively with school leaders, educators, and the local community to refine their school mission, establish key learning outcomes aligned with the framework, and develop a strategy and plan for modifying practices to help achieve these new outcomes. This flexible approach tailored to locally defined priorities is well aligned with the locally controlled structure of the U.S. educational system.

To date, EdLeader21 has established working relationships with more than 200 districts across the nation. While EdLeaer21 has been highly effective in supporting the implementation of the P21 Framework, it should be noted that there are more than 13,000 school districts in the United States.

The leading yet limited outreach achieved by EdLeader21 highlights an important challenge that results from the U.S. local-control approach to education: shifting the focus of learning is a slow and arduous process that must occur state by state and often district by district. It should also be noted that although most school districts are not members of EdLeader21, many have embraced the concept of twenty-first

century learning and have expanded their curricular focus to include several of the learning outcomes represented in the P21 framework.

10.2.2.1 Assessment of Twenty-First Century Skills

While there has been notable progress in expanding the focus of curriculum from traditional content areas to also include components of twenty-first century skills, the development of instruments that assess the development of these skills has been less robust. In contrast to assessments in traditional subject areas, for which all states administer summative tests each year in several grade levels, no state has introduced a summative assessment that focuses on any of the non-content area twenty-first century skills. Instead, efforts to develop assessment of twenty-first century skills have largely taken the form of research-based efforts that explore how one might assess these new skills. As noted below, in one case, however, research has resulted in an assessment that is used by some school districts, but not at a state level.

Efforts to develop assessments of twenty-first century skills fall into three general categories: (a) federally funded research projects, (b) experimental extensions to existing programs, and (c) institutional development projects. Select examples within each of these categories are described briefly in the following subsections.

10.2.2.2 Federally-Funded Research Projects

Federal agencies, such as the National Science Foundation (NSF) and the Institute of Education Sciences (IES), have funded several moderate-size research projects that explore methods for assessing select twenty-first century skills.

As an example, the Calipers Project has explored the use of technology-based simulations to assess problem-solving in science. Funded by the NSF, this project was based at WestEd, a not-for-profit research organization. In one assessment task, students use a simulation in which they must apply their knowledge of motion and forces to help dispatch a back-country rescue team. In this scenario, two rescue teams take different paths to reach injured skiers. Initially, the student must evaluate features of the terrain associated with a given route to estimate travel time. Once an estimate is made, the simulation modifies conditions and the student must refine his/her estimate. Throughout this activity, students must use data about factors affecting the motion of the snowmobiles on which the rescue teams travel to make recommendations to the teams. Another example focuses on life sciences and uses a simulated fish ecosystem in which students must explore factors that affect populations of various fish found in the region.

A second example of a federally funded research effort is the Virtual Performance Assessment (VPA) project led by Chris Dede at Harvard University. The VPA focuses on the assessment of science inquiry skills. In each example, students control an avatar

to play the role of a scientist exploring an issue occurring in a local environment. In one example, the scientist avatar is situated along the Alaska coastline where the kelp (a form of seaweed) population is rapidly declining. In another example, the scientist's avatar is located in a system of ponds in which frogs with mutated legs are found. Playing the role of the avatar, students encounter other people who reside in the area from whom they can collect observational and historical data. Students also have access to various instruments that they can use to collect data from different areas of the virtual environment. As students explore the area, they can maintain a data log and can create plots and tables displaying select data. In these virtual worlds, students can move through the environment in any manner desired and have autonomy with respect to what actions they take or do not take. In this way, the VPA provides an opportunity to perform an open inquiry into the problem presented. The assessment focuses on the actions students opt to take, the analyses undertaken, and ultimately the conclusions and recommendations reached based on those analyses.

10.2.2.3 Extensions to Existing Programs

The NAEP has explored the assessment of student ability to solve problems in technology-rich environments. These experimental assessments focus on the intersection of content and technology environments to examine student ability to solve problems within a specific content area using technology-based tools. Depending on the problem scenario, students can use tools to conduct simulated experiments, consult digital resources to learn more about a topic, and/or use tools, such as databases, spreadsheets, and graphical displays, to both explore the problem and communicate solutions.

As an example, one problem scenario requires students to explore factors that affect the payload capacity of helium balloons. In this scenario, students are able to access and explore digital information related to the problem. They are then able to conduct a variety of simulated experiments in which several variables are manipulated such as the size of the balloon, volume of helium in the balloon, temperature, and the size of the payload. Using data generated through these simulated experiments, students are asked to conduct analyses and reach a conclusion about the problem. This scenario has been used with small samples of students to begin exploring psychometric issues and understand its utility as a tool for assessing student problem-solving in the digital age.

A second example is the California Information and Communication Technology (ICT) Digital Literacy assessment and curriculum framework. As part of its state content standards, the state of California includes a section on ICT Digital Literacy. Key elements of the standards focus on students' ability to work with digital information and include their abilities to access, manage, integrate, evaluate, create, and communicate digital information. To assist schools in assessing these skills, the state developed a set of performance indicators along with guidelines on how to assess the achievement of each indicator. It should be noted that the state did not develop

an actual assessment task for any of the indicators but instead provides recommendations to schools on the focus of assessment tasks that might be developed locally to assess the achievement of each indicator.

10.2.2.4 Institutional Development Projects

The Council for Aid to Education (CAE) is an independent not-for-profit organization that advances corporate support for higher education. Recognizing the growing importance of twenty-first century skills, the CAE initiated an effort to develop assessments that schools and institutions of higher education can use to assess student development of these new skills. As one example, the College and Work Readiness Assessment (CWRA) employs a performance assessment and a set of selected-response items to assess critical thinking, communication, critical reading, and scientific and mathematical reasoning skills. In the performance task, students are required to demonstrate the following types of abilities:

- Recognize when information is relevant or irrelevant to the task at hand,
- Analyze and understand data in tables and figures,
- Evaluate the credibility of various documents,
- Distinguish rational arguments from emotional ones,
- Determine the difference between facts and opinions,
- Identify questionable or critical assumptions,
- Deal with inadequate, ambiguous, or conflicting information,
- Spot deception, possible bias, and logical flaws in arguments,
- Identify additional information that would help resolve issues,
- Weigh different types of evidence,
- Organize and synthesize information from several sources,
- Marshal evidence from different sources in a written response.

The end product is a written essay that is assessed on three dimensions: analysis and problem-solving, writing effectiveness, and mechanics. In effect, the last two dimensions are similar to those found on many current state summative writing tests. The analysis and problem-solving dimension, however, aims to assess a component of twenty-first century skills.

Today, more than 700 schools and institutions have administered the CWRA to their students but have not yet been employed for a state-level summative assessment program.

10.2.3 Summary of National Landscape

Across the United States, there is general agreement that the range of skills students develop in school must expand for the nation to remain an economic leader. The

non-centralized, locally controlled nature of the U. S. school system, however, has resulted in diverse perspectives on what exactly this fuller range of skills should entail. In turn, this diversity has led to the development of several frameworks and sets of standards for twenty-first century skills. While most state education systems include information about twenty-first century skills in their curricular materials, none has adopted a formal set of standards on which students are summatively assessed. While there have been several efforts to develop assessments of some twenty-first century skills, these efforts have been smaller in scale and have not yet produced assessment instruments or methods that are employed by a given state or by a significant number of schools. Finally, while organizations like EdLeader21 are working with several schools to modify curriculum and instructional practices to support the development of targeted twenty-first century skills, efforts to develop a truly twenty-first century skills-oriented curriculum are in an early stage and, where it exists, stands as an exception rather than a rule.

Again, this nationwide pattern is not surprising given the limited power the federal government has to directly influence educational practices. And, while most states have not aggressively prioritized twenty-first century skills in their standards, curricular guidance, assessment programs, and professional development programs, there are a few states that have done so. It is one of these states, North Carolina, that we focus on next to understand one approach taken at the state level to promote and support the development of twenty-first century skills.

10.3 Digital-Age Learning: The Story of North Carolina

10.3.1 Introduction

In 2015, North Carolina launched a statewide Digital-Age Learning Initiative. This comprehensive initiative aimed to prepare students for an increasingly competitive workplace by capitalizing on a variety of digital technologies to personalize student learning and develop an expanded array of skills and knowledge. To date, the initiative has helped connect every school across the state to high-speed broadband; placed hundreds of thousands of digital devices in the hands of students and teachers; provided training to school leaders, technologists, coaches, and educators; provided access to a wide variety of digital tools and resources; provided flexibility and freedom for schools to experiment with new approaches to teaching and learning; and helped personalize learning for millions of students. While there remains much work to do, North Carolina's initiative represents one of the United States' most comprehensive, coordinated, and well-funded state-level initiatives to support learning in the digital age.

The story of Digital-Age Learning in North Carolina, however, began 15 years ago and is built on a strong foundation established through a series of programs

and initiatives that function in a complementary manner. These programs and initiatives have focused on several aspects of education including expanding access to the Internet and to digital learning resources (for example, devices, software, and online tools and repositories), expanding educators' skills in teaching with digital resources, providing tools and training for schools to self-evaluate their progress toward implementing digital-age personalized learning and supporting leadership within schools to guide change. North Carolina's 15-year story is presented below in a chronological order that documents the various programs that have contributed to the state's transition to digital-age learning. Many of these programs focused on just one or two components of digital-age learning. Yet, collectively, this string of programs and initiatives has created a context that provides essential conditions for the equitable implementation of digital-age learning across the state.

As also revealed through this chronological presentation of the state's various programs and initiatives, the state's path to its current position was not linear or prescribed, but rather was grounded by a vision that guided the state as it capitalized on opportunities as they arose. It is for this reason that North Carolina's path to digital-age learning is unlikely to be replicable in other contexts. However, the vision and principles that undergird the strategic decisions made over the past 15 years can serve as a vehicle for moving a large and diverse educational system toward digital-age learning.

10.3.2 Background on the State

North Carolina is a moderate-size, diverse state that serves approximately 1.3 million K-12 students. The state is located along the southern Atlantic coastline of the United States, and its geography is diverse, with a moderate-size coastline, several moderate-size urban areas, expansive rural areas, and mountainous regions in its west. With a population of just over 10 million people, North Carolina is the 10th largest state in the nation.[6] North Carolina also ranks 10th in its gross domestic product; yet, its per capita personal income ranks 39th.[7] At the turn of the century, there were considerable differences in the distribution of economic opportunities across the state, with several urban and suburban areas experiencing rapid growth, while expansive rural regions were stable. On average, though, both the population and economic productivity have increased steadily over the past 30 years. Most notable is the rapid economic growth that has occurred in what is known as the Research Triangle, an area connecting two cities and three major research universities located in the north-central region of the state. As described below, North Carolina's research universities have contributed to their digital learning initiatives in multiple ways including providing a digital network that served as a backbone for connecting K-12 schools to the Internet and

[6] https://upload.wikimedia.org/wikipedia/commons/f/f3/US_state_historical_population_FRED_SMIL.svg.

[7] https://www.bea.gov/regional/bearfacts/pdf.cfm?fips=37000&areatype=STATE&geotype=3.

providing resources and expertise to assist in training and the evaluation of the state's programs.

North Carolina has a tradition of strong state leadership for its K-12 education. Before the turn of the century, the state maintained relatively tight control over the education system. The state also has a well-established history of establishing content standards and performance standards for its students. Between the early 1990s and 2010, the state developed its own standards. In 2010, the state adopted the Common Core State Standards and began working with the Smarter Balanced Assessment Consortium to develop achievement tests aligned to those standards. Shortly thereafter, however, the state added several extensions to the Common Core State Standards that focused on additional mathematics and language arts skills not addressed by the Common Core State Standards and established the North Carolina Extended Common Core Standards. In turn, North Carolina resumed control of developing achievement tests aligned with its standards.

Despite its relatively strong economy, its per pupil expenditure ranks as the 7th lowest in the nation,[8] and its student-to-teacher ratio is 25th.[9] In terms of student achievement level, North Carolina ranks 16th out of 50 on the 4th grade NAEP reading test and 36th on the 8th grade NAEP reading. The state has a long history of establishing content and performance standards, maintains tight control of its student assessment program, and uses test scores for accountability purposes at the school, but not at the teacher level.

10.3.3 Supporting Digital Learning

Shortly after the turn of the century, North Carolina's state leaders became acutely aware of disparities in educational and economic opportunities that had emerged between its rapidly growing research triangle and its more rural regions. In response, the then-Lieutenant Governor Beverly Perdue crafted a vision of learning in which all students had access to the same high-quality education. To enable this access, Perdue believed digital technologies were key to the solution. In turn, she challenged state leaders by asking "What must be done to fully integrate technology into the education system?"[10] To help address this question, the state's General Assembly (that is, the legislative body) established the Business Education Technology Alliance (BETA). This alliance brought together key legislators, business leaders, academics, and educators from across the state. To help lead this alliance, Perdue enlisted the assistance of Myra Best, the then-Chair of BETA. Through Best's leadership, a shared vision emerged for transforming teaching and learning across the state. Over the next decade, this transformation focused on creating equity across the state with respect to

[8] http://www.governing.com/topics/education/gov-education-funding-states.html.

[9] http://www.statemaster.com/graph/edu_ele_sec_pup_rat-elementary-secondary-pupil-teacher-ratio.

[10] Strategic Policy Playbook, 2017, page 2.

students' access and opportunity to learn, increasing learning opportunities through the use of digital tools and resources, and expanding the focus of student learning and depth of student learning in response to new demands in the workplace and the world.

Three aspects of BETA are important to note. First, Perdue's strong leadership established a clear focus on increasing equity in educational opportunities through the strategic use of digital technologies. Second, a working committee was established that comprised not just stakeholders from various sectors of the state, but stakeholders who had the power to support initiatives that would be launched in future years. Third, members provided a strong commitment to use their influence among their constituency to support these initiatives. Collectively, strong leadership, strategically selected membership, and lasting commitment by participants created not just a vision, but a support structure for expanding the state's capacity and capability to apply digital technologies to support learning in the twenty-first century.

10.3.3.1 North Carolina Virtual Public School

The North Carolina Virtual Public School (NCVPS) initiative contributed to two components of the state's digital-age learning. These components include expanding connectivity in and between schools and developing online resources to support learning. The NCVPS was initiated in 2005. At that time, an important challenge faced by the state was the provision of access to a diverse array of courses for all students across the state. With higher concentrations of students and access to more resources, many urban and suburban schools were able to provide a wider range of courses and learning opportunities for their students than could schools located in more rural and remote regions of the state. To help equalize access, one of BETA's first recommendations acted upon by the state focused on establishing the NCVPS.

To establish the NCVPS, four key steps were requisite. First, every school required access to a high-speed Internet connection. Second, a diverse set of online course offerings had to be developed. Third, educators who could teach in a virtual environment had to be recruited and trained. Finally, schools had to be given the freedom to experiment with integrating virtual learning with the established face-to-face learning that was the current practice in schools across the state.

To address the need for a robust statewide digital network that could provide access to digital course content to all students, the state partnered with the Friday Institute. Three aspects of this collaborative effort are of note.

First, the Friday Institute had been recently established within the North Carolina State University to help support state educational initiatives through research- and data-based guidance. Partnering with the Friday Institute provided personnel with technological expertise who could focus their attention on the challenging issue of equitable connectivity across the state.

Second, rather than launching a new and independent initiative to connect public K-12 schools to a common network, the state capitalized on an existing network

established to connect the higher education research and education community. By partnering with the North Carolina Research and Education Network (NCREN), the state was able to capitalize on existing infrastructure to begin providing lower-cost connectivity to schools in an efficient manner.

Third, rather than attempting to address connectivity across all schools in the state at once, a pilot study involving strategically selected schools from across the state was undertaken. This pilot study served multiple purposes, which included providing a proof of concept, identifying potential challenges with scaling, and, perhaps most importantly, demonstrating the potential for the initiative to benefit schools in all regions of the state (not just those in the more affluent regions). In turn, this pilot informed the creation of the state's School Connectivity Initiative to which the state legislature allocated US$22 million in recurring funds. This investment rapidly increased school access to the Internet, which enabled the NCVPS to reach more than 15,000 students by 2009 and 60,000 students by 2016.

Over the years, efforts to connect all schools to the Internet have evolved in two important ways. First, as access to the Internet has expanded, demand for the use of online resources has also expanded. In turn, this has required the state to continually expand the capacity of its broadband network to support the increased flow of content in and out of schools. Second, as described below, increased access to personal digital devices in schools by students and teachers not only increased demand for connectivity to external networks, but also created challenges for the flow of content within school networks. In turn, to meet this emerging need, the focus of digital connectivity efforts has expanded to include creating robust networks both between and within schools.

A more recent outgrowth of this effort to support robust connectivity to and within schools is the creation of a cooperative process for purchasing digital resources. Specifically, the state has established purchasing agreements with several technology providers that capitalize on the size of the state to negotiate lower rates. In turn, districts are encouraged to purchase technological resources and services through the state pricing agreement. In many cases, the technology purchases made by districts are supported by the federal e-rate program. This federal program establishes reduced pricing for several technology purchases based on the economic needs of students served by the school. Depending on the characteristics of the student body, these discounts range from 5 to 80%. In turn, the state technology acquisition program reimburses the district for the cost not covered by the discount if the district agrees to apply those funds for additional technology purchases. By decreasing the initial cost of resources and services, capitalizing on e-rate discounts to further decrease the costs, and providing additional funding to support further technology purchases, this approach has allowed the state to rapidly increase bandwidth connectivity to all schools, improve connectivity within schools, and expand student access to digital devices. While connectivity and device access alone does not yield digital-age learning, they are a necessary prerequisite that the state has aggressively and successfully provided.

10.3.3.2 Golden LEAF Foundation and the IMPACT Model

Tobacco is a significant crop produced in North Carolina. As a result of a major legal settlement with cigarette manufactures, several tobacco-growing states received sizable financial awards. Rather than spending the awards to meet immediate needs, North Carolina opted to use the funds to create a foundation whose focus was on supporting the economic well-being of its citizens and transforming its economy. Education was viewed as a critical contributor to both of these foci.

The Golden LEAF Foundation's contribution to digital-age learning focused primarily on increasing student access to digital devices in schools. Following the BETA Commission's recommendations regarding virtual learning and infrastructure development, the Golden LEAF Foundation invested considerable funds to provide students with computing devices in school. Initially, device purchases focused on laptops and the foundation's investment allowed several schools across the state to acquire a laptop for each high school student. More recently, device purchases have allowed schools to acquire significant numbers of Chromebooks and tablets. In addition, funding has supported professional development focused on using digital devices to support teaching and learning.

At the same time, the Golden LEAF Foundation helped increase access to digital devices, the state launched the IMPACT Model whose key contribution to digital-age learning was the provision of professional development to support the use of technology for educational purposes and tools to evaluate changes in their instructional practices. At its core, the IMPACT Model provides a road map and resources to help schools integrate technology into teaching and learning. Key components of the model include:

- Hiring and training full-time technology and media coordinators,
- Providing targeted professional development that exposes educators to models for employing technology to support teaching and learning,
- Providing access to high-quality educational software, and
- Creating flexible access to technology on an as-needed basis.

Each year, a subset of schools applies and is selected to participate in IMPACT Model training. During this time, the schools gain access to professional development and receive support implementing the key features of the model. In addition, schools undertake self-assessments of their instructional technology needs, challenges, and successes to inform continuous improvement.

Collectively, the BETA Commission, the Virtual Public School, the School Connectivity Initiative, the Golden LEAF Foundation's investment in digital devices, and the IMPACT Model helped provide a strong foundation for North Carolina's more recent efforts to support digital-age and personalized learning.

10.3.4 Career and Technical Education

In North Carolina, most students, particularly those aspiring to attend four-year colleges and universities, attend high schools that focus instruction on the core content areas. While these schools provide a variety of elective courses that expose students to fine arts, technical arts, business, and social sciences, these courses supplement the primary curriculum, which focuses on English/language arts, mathematics, science, and history. For students whose interests focus on technical areas, North Carolina offers a CTE curricular program. While both programs receive strong support from the state, they have traditionally operated independent of each other. Nonetheless, the effort to prepare students for the twenty-first century workplace through the use of digital technologies is valued equally in both settings. In addition, over the past decade, efforts to advance CTE has helped advance personalized and digital learning across the state. These advancements are most apparent in the several plans and initiatives developed and undertaken since 2008.

10.3.4.1 2008 Comprehensive State Plan

In 2008, North Carolina launched a five-year plan for CTE. The 2008 five-year plan was developed in response to an opportunity to receive federal funds provided by the Perkins Act. This federal act, which amended the Vocational Educational Act of 1963, aims to strengthen and expand the economic base of the nation, develop human resources, reduce structural unemployment, increase productivity, and strengthen the nation's defense capabilities by assisting the states to expand, improve, and update high-quality programs of vocational-technical education, and for other purposes. To meet these aims, the act provides funding, through a competitive grant process, the purpose of which is to develop fully the academic and career and technical skills of secondary students.

A core goal of the plan was to 'improve the academic and technical skills of students by strengthening the academic and career and technical components…through the integration of academics with CTE to ensure learning in core academic subjects and CTE subjects'. To accomplish this goal, several actions were detailed including:

- Strengthening state coordination of programs of curriculum and assessment,
- Developing up-to-date competency-based curriculum and assessments that emphasize the integration of academics with CTE,
- Updating content standards to reflect the integration of English language arts, mathematics, science, and social studies competencies with technical competencies, and
- Aligning the competency-based curriculum, including course blueprints, instructional support materials, and assessments (both formative and summative) with updated standards and competency expectations.

The state plan also emphasized the need to deepen students' experience in and understanding of all aspects of the industry including planning, management, finances, and principles of technology. As part of this effort, emphasis was placed on infusing entrepreneurship across the curriculum.

To support implementation at the school and classroom levels, the plan called for extensive support for professional development. To this end, the state enlisted the support of colleges, universities, and other professional organizations to provide a variety of professional development opportunities. These ranged from traditional workshops and courses to online and virtual classroom experiences. In addition, the state capitalized on its Centers of Teaching Excellence located in community colleges in three geographic areas of the state. Through these centers, educators working in CTE schools received professional development focused on expanding the technical competencies students are expected to develop and more tightly integrating the core curriculum into technical and career training.

Efforts were also made to update preservice education to prepare incoming teachers to provide instruction and learning opportunities aligned with the new standards, curriculum materials, and learning outcomes. Specific emphasis was placed on increasing educators' and preservice educators' skills in:

- Reinforcing core academic skills, like reading, writing, speaking, and mathematics, during the teaching of career and technical content;
- Incorporating hands-on and contextual opportunities for knowledge and skill development; and
- Using assessment results to design instruction and target remediation.

A final aspect of the plan focused on updating assessments of student learning to focus on both attainments of core academic competencies and the development of technical skills. While students in CTE schools are required to take the state's English/language arts and mathematics tests, assessments focused on the development of technical competencies are optional. As part of the plan, the state aimed to increase the percentage of students who took and succeeded on the technical competencies assessments.

Given that the state's plan was developed in response to the Perkins Act, the plan had a strong emphasis on enhancing technical education to meet the needs of the twenty-first century workforce. This plan, however, focused the state on twenty-first century learning and established a foundation for the development of the state's 2009 CTE Strategic Plan and 2015 Digital Learning Plan.

10.3.4.2 2009 Career and Technical Education Strategic Plan

The 2009 Career and Technical Education Strategic Plan extended the previous year's plan by emphasizing the personalization of learning and the importance of informing the public and marketplace of student preparation through active marketing.

The primary aim of the plan was to reinvent and reposition North Carolina's CTE system. As the plan states, "our state [North Carolina] and nation face global economic challenges that will only be met successfully through a dynamic, agile and continually calibrated secondary and postsecondary education system." The report then states "…90% of the fastest growing jobs and over 60% of all new jobs will require some postsecondary education or training, but not necessarily a bachelor's degree…Very simply, jobs are changing. But how we educate today's students to be tomorrow's workers has not kept pace with that shift."

To align the state's education outcomes with its economic outcomes, the plan called for CTE to

- Develop critical math, science, and technology knowledge and skills through a focused curriculum; and
- Build strong employability foundation skills, soft skills, problem-solving skills, teamwork, and organization.

Many of the suggested paths to these ends were consistent and overlapped with those detailed in the 2008 plan. A notable addition, however, was the development of a marketing plan to inform the business sector and the general public of this shift in the preparation and skill development of CTE students. This marketing aimed to strengthen connections between school and work and bolster support for this shift in emphasis on schooling.

There are three aspects of North Carolina's CTE plan and programs that are notable. First, the 2008 and 2009 plans highlight an awareness that the economy and workplace in North Carolina were changing. To remain competitive, the state's technical and career program needed to fully integrate core content with technical content to develop communication, problem-solving, and a spirit of entrepreneurship as well as the technical skills required for a given trade. Second, this expansion of goals led to an increased focus on developing both core and technical competencies. Third, the 2009 plan in particular recognized the importance of personalizing learning and the role technology can play in facilitating personalization.

10.3.4.3 Race to the Top

In 2010, the federal government launched the RTTT program. This program was part of the federal economic stimulation program and provided US$4.3 billion to states through a competitive grant process to spur innovations and reforms to educational practices. The program placed a strong emphasis on the adoption of rigorous learning standards, evaluation of school and teacher effectiveness, data-based decision-making, and innovative uses of technology to support teaching and learning. In addition, the 2010 federal RTTT program expanded the focus to college and career readiness of students in all educational programs.

North Carolina was one of 19 states to receive an RTTT grant, the value of which was US$400 million. As described above, before the RTTT program, North Carolina had established a clear vision for supporting the learning of all students through the use of digital technologies and had taken several important steps toward that vision. Chief among those steps were expanding school connectivity to the Internet across the state, launching professional development programs, such as the IMPACT Model, to increase teacher and school capability to use technology to support student learning, and establishing the Virtual Public School to provide all students with access to rigorous and advanced coursework. For North Carolina, the RTTT program provided a valuable opportunity to accelerate progress toward that vision through strategic investments in several areas.

Chief among North Carolina's focus was the development of the North Carolina Education Cloud (NCEdCloud). The School Connectivity Initiative had established a backbone that connected all schools to the Internet. The NCEdCloud initiative aimed to capitalize on this backbone by providing a variety of digital resources and tools for schools to use in a cloud server environment. In part, the concept was to decrease the burden on schools to purchase, install, and maintain these digital tools and resources on their own networked servers. Instead, the state could negotiate better pricing for these resources and tools and make them available to all schools through a state portal.

As part of its RTTT digital initiative, North Carolina developed Home Base. In reality, Home Base serves as a hub that links schools and educators to five digital tools that support personalized learning:

- Schoolnet. Allows educators to develop lesson plans, produce instructional and learning material, and access digital resources that support teaching and learning. Educators can also access and develop assessments and view student performance data.
- PowerSchool. A student information system that allows educators to tailor the instructional path for each student. It also supports course scheduling, transportation, and other administrative functions.
- Truenothlogic. Supports improvements in educator effectiveness by providing tools to evaluate educators and target professional development to meet their current needs.
- Canvas. A course management system used by educators to organize and deliver digital curricular materials to students and to assign, receive, and assess student work.
- NCWiseOwl. Provides subscriptions to a large repository of articles from periodicals, online encyclopedias and reference sources, and other sources. Used by educators to identify and assign reading aligned with instructional goals and/or personalized learning needs of their students. These tools are used by:
  - Educators to access student data, develop and distribute learning materials, and track student progress;
  - Students to access learning materials and receive feedback on their work;

– Parents to view attendance information, monitor their child's progress, and interact with teachers; and
– Administrators to monitor student progress and educator effectiveness, plan professional development activities for their school, and manage schedules.

Again, while schools are not required to use Home Base, its provision ensures all schools have access to tools that support the implementation of digital learning practices.

A separate component of North Carolina's RTTT program focused on expanding the course offerings provided by the Virtual Public School specific to science, technology, engineering, and mathematics. This effort exemplifies North Carolina's strategic effort to capitalize on various opportunities to build toward a common vision. In this case, the Virtual Public School was well established when the RTTT program was launched. Given that one focus of the RTTT grant competition was on science, technology, engineering, and mathematics (STEM) learning, North Carolina saw this as an opportunity to strengthen and expand its Virtual Public School program and included the development of additional courses as part of its proposal.

Similarly, North Carolina had long recognized the importance of access to digital devices for supporting personalized and digital learning. For several years, the state had been providing funding to schools to increase access to such devices. RTTT provided an additional funding source that helped increase the pace with which device access was provided for all schools.

Recognizing the value of data-based decision-making, North Carolina also employed RTTT funding to develop a state-level longitudinal data system. As part of this system, tools to assign and track unique student identifiers were acquired. Both the unique identifiers and the data system empowered the state and its schools to maintain better records about their students and to use this information to conduct data analyses that informed local decisions. This data system is also used to inform instructional decisions and courses of study for individual students in an effort to personalize the learning experience of each student. Although not directly related to digital-age learning, this data system also supports analyses by researchers at the Friday Institute and other organizations that support the state's education program. Ultimately, the longitudinal system became one of the many tools available through Home Base.

10.3.4.4 2013 Digital Resources Transition

A final act that added strength to the foundation for North Carolina's Digital-Age Learning initiative occurred in 2013. Recognizing the widespread access to digital devices and high-speed Internet connectivity, the General Assembly passed legislation requiring all schools to transition from paper-based textbooks to digital-based resources by 2017. To aid this transition, the legislature provided significant funding. More importantly, it created a demand for careful planning and thoughtful decisions

about the criteria used to select high-quality digital learning and teaching resources. This demand set the stage for the development of the state's Digital Learning Plan.

10.3.4.5 2015 Digital Learning Plan

Whereas the 2008 and 2009 plans focused on a subset of students attending CTE schools, the 2015 Digital Learning Plan addressed the need to prepare all students for the digital age. This plan continued and expanded the emphasis on personalized learning evident in the 2009 CTE Strategic plan. As the plan states, "North Carolina is committed to providing the personalized digital-age education its K-12 students need to be successful in college, in careers, and as productive citizens." It is important to recognize that personalized learning focuses on each student's development of the knowledge and skills articulated in the state standards and which are believed necessary for the student to succeed in the workplace. Many of these skills are located in traditional content areas, such as mathematics, science, and English language arts. However, workplace success also requires the development of twenty-first century skills such as collaboration, communication, and creative problem-solving. Personalized learning focuses on the totality of these traditional and twenty-first century skills and encourages educators to focus attention on the knowledge and skills most in need of further development for each individual student.

The plan highlights several legislative actions that occurred since 2012 that produced a strong foundation for the plan. Most notable among these actions was the provision of funds to support:

- Purchase of a variety of digital devices, software, and learning tools;
- Expansion of professional development to support adoption and implementation of digital learning tools and strategies;
- Increasing broadband access in schools and homes across the state;
- Expansion of the course offerings provided by the North Carolina Virtual Public School; and
- Support for innovative digital learning initiatives within local schools and districts.

The plan also advocated for several important shifts in the instructional model employed by schools and their teachers. Among these shifts were moving from:

- One-size-fits-all instruction to personalized learning,
- Advancement based on seat time to demonstrate mastery and competence,
- Fixed time and locations for learning to anywhere and anytime learning,
- Teacher-centered instruction to student-centered learning,
- Print-based learning materials to digital content and tools,
- End-of-course summative assessment to integrated assessment, and
- Isolated content focus to project-based and community learning activities.

The plan recognized the variation in progress schools had made toward implementing digital learning, and thus recognized that a differentiated approach was

needed to support schools. Strong emphasis was placed on developing professional development opportunities that were tailored to each school's needs. Two key components of the professional development plan were a focus on developing school and district leadership capacity and the creation of coaches to provide support to schools and teachers. The instructional coaching model supports the tailoring of support to meet the specific current needs of a school and its educators. The instructional coaching model required the state to invest in professional development and preparation for facilitators to ensure adequate access and consistent provision of support across the state.

Another important element of the plan was establishing a statewide procurement service for networks, devices, and digital content. While this service did not dictate what schools and districts must implement, it provided a mechanism to alleviate the need for specialized knowledge and skills at each local site and decreased costs.

To support personalized digital learning, the plan also invested in digital tools that support educators' use of data to identify the learning needs of each student. To help meet these needs, the plan supported the acquisition and use of high-quality open educational resources as well as teacher-developed resources that can be accessed by an educator across the state. In addition, the plan provided grants for schools and districts to develop local innovative digital learning models and strategies and to then disseminate those models to other schools.

To support the implementation of the many features of the plan, the North Carolina Digital Learning Collaborative was established. This collaboration entailed representatives from the state's Department of Public Instruction, the Golden LEAF Foundation, various school leadership associations, an advisory board with members from several stakeholder groups, and the Friday Institute. Of note, the Friday Institute, a not-for-profit research, development, and professional support organization located within North Carolina State University's College of Education, played a key leadership role in the development and oversight of several professional development aspects of the plan and the acquisition of digital access and tools.

To assist schools in advancing their digital learning practices, a rubric was designed to support self-assessment of a school's transition to digital learning. This rubric allowed schools to identify their strengths, weaknesses, and stage of progression and provided a vehicle for monitoring their progress toward digital learning over time. In addition, the rubric created a common language and expectations regarding digital learning and in effect established targets toward which all schools across the state now strive.

A final component of the plan focused on professional development. Considerable funding was allocated to supporting schools and educators in this transition to digital learning. The funds were used primarily to support two sets of professional development programs, one run through the Department of Public Instruction and another through the Friday Institute. While the details of each program differed, the aims were the same.

It is important to recognize that the development of the 2015 Digital Learning Plan and its subsequent implementation was a well-supported collaborative effort that included active involvement and support from the Governor, legislative leaders,

universities, the business sector, and the K-12 educational community. This level of active collaboration was exemplary and signals a high level of interest in maximizing opportunities to develop students for the twenty-first century workplace.

10.3.5 Key Accomplishments of North Carolina's 15-Year Effort

The most recent efforts have refined the focus to supporting personalized and digital-age learning of all students. An underlying theme of the various efforts focuses on a desire to maintain and improve the state's economic competitiveness by providing all students with the knowledge, skills, and habits of mind necessary to succeed in the workplace. Although the 2015 Digital Learning Plan has only had two years of implementation, several impacts have already occurred. Some of these impacts fall into four general areas that are summarized below.

10.3.5.1 Digital Infrastructure

As the various plans developed over the past decade specify, North Carolina has taken several steps to support the creation of a digital infrastructure that will support personalized and digital learning within each school across the state. Key accomplishments to date include:

- Providing high-speed broadband access to every K-12 school in the state;
- Establishing a centralized structure for procuring technology resources including devices, software, and online resources;
- Creating a centralized student information system that can be used by school leaders and educators to support data-based decision-making about student learning and to assist in personalize that learning; and
- Establishing a centralized repository of digital learning assets and resources, as well as a common digital content management system all educators across the state may use.

10.3.5.2 Professional Development

The Department of Public Instruction and the Friday Institute has provided professional learning opportunities for a wide variety of school personnel, each of which is summarized below.

Leadership. Professional development for leadership is divided into three categories: district leadership teams, superintendents, and principals.

District leadership team professional development requires a district to identify 5–8 people who participate as a team. The team then participates in five days of face-to-face sessions designed to develop participants' capacity to understand, model, and lead digital learning and to address four key areas of digital learning: human capacity, curriculum and instruction, data and assessment, and technology and infrastructure. The aim of this team approach is to create consensus within the district about critical needs and to begin identifying approaches to meeting those needs.

Superintendent support takes the form of cohorts of 50 people who participate in 4–5-day face-to-face sessions designed to build capacity to lead digital learning in their districts and create a network of superintendents implementing a common vision for digital learning.

Principal support occurs as a cohort of 75 principals meeting for five days to develop the capacity to use data to create goals for personalized and digital learning, establish a culture in their school community that supports personalized and digital learning, and be able to model digital learning in their schools.

In addition to these extended face-to-face sessions, a variety of just-in-time support is also provided. This takes the form of one-day in-person events and shorter web-based sessions.

Instructional coaches. A five-day in-person session for cohorts of 75 instructional leaders is provided to deepen understanding of personalized and digital learning, explore challenges encountered by educators as they implement these approaches to learning, and create instructional resources for teachers' daily use. Following completion of this session, just-in-time support is provided through a series of in-person and virtual sessions that focus on innovative approaches to teaching and learning in the digital age, innovative pedagogy that models digital learning, and approaches to personalize learning through digital resources.

Educator. In addition to the support provided by instructional coaches, sessions are provided throughout the year in which innovative educators share strategies and methods they have used when implementing personalized and digital learning.

These sessions provide mastery models of digital learning and provide opportunities for educators to explore challenges and approaches to implementing such practices in their classrooms.

In addition to the above programs, the Friday Institute formed an alumni network. This network allows past participants in a professional learning program to remain connected and to come back for shorter sessions in which they exchange lessons learned through their own work and explore potential next steps.

While the content of each professional learning program is tailored to the needs of its target participants, a key focus across programs is on organizational change management. This topic emphasizes the importance of developing a culture around a shared vision of what teaching and learning should look like in 3–5 years. This vision then serves as a foundation for identifying needs and developing a plan to meet each need. To help create a vision, considerable time is spent exposing participants to examples of digital learning that is occurring in other schools, both in North Carolina and in other areas of the country. Consideration is also given to flexibility

and responsiveness to changes in technologies that may occur while striving toward a given vision.

A second major focus across professional learning programs is the concept of personalized learning. For this focus, equity serves as a lens through which teaching and learning are viewed. The goal is not to create the same learning opportunities for all. Rather, by focusing on each student's individual needs, instruction is tailored so that each student's needs are met. Doing so requires flexibility in the pacing of instruction. In addition, educators must be sensitive to and aware of the specific learning needs, preferences, and interests of each student to effectively personalize teaching and learning. Given the access to a diverse array of learning resources and the ability to easily modify many resources, several uses of technology to personalize learning are explored.

10.3.5.3 Curriculum and Self-assessment

Over the past decade, North Carolina has revamped its standards for CTE to increase the integration of core content knowledge and skill with technical skills. It has also expanded its assessment of these skills and has set targets to both increase the number of students performing these assessments and improve performance on the assessments.

The state has also established new and more rigorous standards aimed at improving students' readiness for college and careers. New assessments were also developed to assess progress toward and achievement of these standards.

To support the achievement of the standards while also encouraging the adoption of personalized and digital learning, the state has provided a variety of curricular resources. (see the description above of PowerSchool, NCWiseOwl, and Canvas).

10.3.5.4 Flexibility That Supports Local Experimentation

While the state developed and has invested heavily in supporting the Digital Learning Plan, considerable flexibility has been provided to districts and schools regarding their implementation of personalized and digital learning. To support schools in developing and adopting new practices, a variety of grants have been awarded. These have been used in a variety of ways to meet schools' specific needs.

10.3.6 Summary of North Carolina's Digital Learning Initiative

As this case study details, North Carolina's path to its current state of support for digital-age learners was the result of many factors. Perhaps the most important factor was the establishment of a clear vision of learning in the digital age established by Perdue and embraced by a diverse range of leaders within the state. While the details of the vision evolved in response to a variety of developments, including the introduction of new technologies and the availability of new funding sources each with its own focus areas, recognition that digital technologies had the potential to both equalize and advance educational opportunities was a guiding force for the state's collection of initiatives.

The state also applied considerable ingenuity in responding to various funding opportunities in a manner that provided stepping stones toward its vision. As an example, the federal Perkins program, which focused on CTE, allowed the state to introduce a focus on personalized learning. The RTTT and the Digital Learning Plan was then used to expand personalized learning from schools focused on career and technical training to all schools.

Similar ingenuity supported the expansion of digital resources to schools across the state. To support Perdue's quest for virtual learning, the state initially capitalized on a digital backbone initially established to support university research and development to increase Internet access for K-12 schools. Later, the state capitalized on its expertise in digital technologies and experience acquiring technology services from providers to create a statewide purchasing system. By combining this approach with benefits offered by the federal e-rate program, the state decreased costs to schools for improving their access to digital resources and also decreased the need for every school to possess the technical expertise necessary to identify and negotiate the purchase and installation of specific digital resources. This tactical approach enabled schools to more rapidly acquire the resources necessary to support digital learning.

In summary, North Carolina provides an interesting example of a U.S. state that has successfully positioned itself to support learning in the digital age. While schools are in the early stages of capitalizing on the state's most recent digital learning initiative, the increased focus on personalized learning, coupled with access to a variety of digital resources and professional development, has positioned schools to develop both the traditional content knowledge represented in learning standards and the new competencies associated with twenty-first century skills.

The next section shifts focus to the school level and briefly describes the various ways in which high schools are responding to the recent focus on twenty-first century skills development.

10.4 Twenty-First Century Skills Development in U.S. High Schools

The opening section of this case study emphasizes the decentralized nature of the educational system and the diversity this structure creates. This diversity is clearly seen in the response of schools to twenty-first century skills development. As Fig. 10.1 details, several frameworks have been established that detail different, although overlapping, conceptions of twenty-first century skills. To date, none of these frameworks has come to dominate the nation's conception of twenty-first century skills. Moreover, while several states include elements of twenty-first century skills in their learning standards, none have explicitly established twenty-first century skills standards or assessments that focus specifically upon such standards. This lack of consensus, at both the national and state levels, leaves districts and schools with considerable flexibility with respect to their embrace of and efforts to support twenty-first century skills development.

The approach taken by U.S. high schools to incorporate twenty-first century skills into their educational programs can be classified into at least five categories. Some schools have largely ignored twenty-first century skills and have taken little or no actions to formally incorporate twenty-first century skills into their learning program. These schools are not discussed further here.

The remaining five categories of response are as follows:

1. **Embedded in typical instruction**. This category represents the lowest level of adoption of twenty-first century skills. While schools that fall into this category recognize the growing importance of twenty-first century skills and may make mention of such skills in their missions or other informational materials, they leave it to the discretion of teachers and/or content area departments to determine whether and how to integrate these skills into instruction. In many cases, these skills are developed through learning activities focused on traditional content areas and, in effect, are a secondary priority. As an example, collaboration, problem-solving, and/or media skills may be developed through group projects that are designed to develop student's knowledge or ability of traditional content. While students are required to work together to solve a problem or develop a media-based project, the primary intent of the project is not to develop twenty-first century skills, but traditional content knowledge and skills. In some cases, rubrics employed when assessing the group product may include criteria specific to collaboration, problem-solving, and/or media skills. However, here again, the primary focus of assessment is often on the demonstration of understanding of traditional content or skill development. Because the assessment of twenty-first century skills is a secondary component, these skills are not given priority in instruction or the learning activities in which students engage. In short, when twenty-first century skill development is embedded within typical instruction, focus on twenty-first century skills is left to the discretion of the individual teacher, both in terms of development and assessment of these skills.

2. **School-wide adoption**. This category represents the second-lowest level of adoption. In these schools, a commitment is made to embrace one or more aspects of twenty-first century skills. The agreement is also made for all teachers in a select content area department or across departments to employ one or more common assignments or activities that are specifically designed to develop the select twenty-first century skill(s). In many cases, the activities experienced by students may be similar to those employed by individual teachers in Category 1; however, all teachers employ the same or very similar activity. In addition, the assessment of students focuses specifically on the twenty-first century skill(s) selected by the school. Schools that adopt the P21 and work with EdLeader21 tend to fall into this category during their initial efforts to adopt twenty-first century skills.
3. **Career and technical schools**. This category focuses on a specific subset of high schools that are designed to support students with specific career interests. Often, these types of schools benefit from the federal Perkins program described in Sect. 1 and serve a subpopulation of students that have opted out of a traditional high school education. These high schools deeply value twenty-first century skills, particularly those associated with the career areas upon which they focus. As an example, a school that supports a focus on the automotive engineer will often deeply value the problem-solving and digital technology aspects of twenty-first century skills development. Similarly, a school that supports graphic design may embrace problem-solving, digital technology, and entrepreneurship skills. Often these schools structure instruction and learning as two tracks. During one track, instruction focuses on traditional content area skills and often occurs in a traditional classroom setting. During the other track, instruction and learning focus on the career skills that are of direct interest to the student. Some schools split the day into two parts, with each part focusing on a given track. Other schools organize the tracks by day of the week, and others alternate between tracks each week. In most cases, however, the tracks are treated in a coordinated but independent manner.
4. **Traditional school with career focus**. This category represents a blend between categories 2 and 3. In these schools, the primary focus is on developing students' content skills. All students participate in courses that focus on traditional content areas. In addition, students with a defined career interest also participate in courses that focus on developing twenty-first century skills specific to their career interest. As an example, a student interested in the food industry might participate in an extended course that focuses on all aspects of running a food service including food safety, food preparation (for example, cooking and baking), restaurant management, inventory management, client services, and accounting. Through these various foci, students develop fluency with digital tools, collaboration, media, inter- and intrapersonal, and problem-solving skills associated with the career field. Often, these courses occur during extended blocks of time. In addition, in many cases, the courses allow students to run fully functioning entities (for example, a school restaurant open to the public, a print shop supporting the school and public orders, and a mechanic shop providing services to the

public). In these schools, assessment within the courses focuses specifically on the twenty-first century skills, as well as traditional skills, associated with the career field.

5. **Restructured schools**. The final category represents the highest level of twenty-first century skills adoption. In these schools, twenty-first century skills are fully embraced, and the school is centered on the development of these skills. In many cases, the school is restructured such that traditional content area courses (for example, English class, algebra class, and U.S. history class) are replaced by seminars and/or courses that cross disciplines (for example, Evolution of Racism in U.S. Society or Impact of Digital Technology on U.S. Culture). In addition, the majority of learning is performed through extended group projects that require students to collaborate to conduct research on a topic, develop a theory or theme, and co-develop a product that communicates that theory or theme. Such projects occur over an extended period sometimes lasting several months. For both seminars and group projects, the teacher's role shifts from providing directed instruction to providing support and critical feedback on student's ideas and proposed solutions to the problems they encounter. Similar to the Coalition of Essential Schools in the 1990s, these schools focus assessment of student learning through exhibitions, demonstrations, and/or portfolios developed over an extended period. Often, the amount of traditional content covered through learning opportunities is reduced, but the depth at which students explore topics is increased significantly. In addition, students are often given more choices about the specific content they explore in depth. In these schools, teachers tend to serve as coaches or guides for students as they work on their projects rather than as the deliverer of knowledge.

Firm data do not currently exist regarding the percentage of schools that fall into each category of twenty-first century skill adoption and implementation. It is reasonable to assume, however, that a large majority of schools fall into the first and second categories (as well as the no-adoption category). The percentage of schools classified as a career and technical schools varies by state, but in all cases, several such schools exist within each state. The fourth category is an atypical exception but is likely significantly more prevalent than the fifth category. Schools that have restructured around twenty-first century skill development and/or learning in the digital age are indeed rare (less than 1 percent) but are garnering increasing public interest.

Again, concrete data on twenty-first century skills adoption do not exist. As noted above, at least 700 schools are currently working with EdLeader21 on the implementation of twenty-first century skills. Many others have incorporated verbiage about twenty-first century skills in their school missions and other informational materials. Nonetheless, it is fair to say that high schools that have aggressively implemented initiatives that support the implementation and assessment of twenty-first century skills represent a very small minority of U.S. public high schools.

10.5 Conclusion

In 1983, the federally sponsored report titled 'A Nation at Risk' sparked a drive for establishing content standards for the K-12 educational system. The formation of the committee that authored this report was driven by concerns about maintaining U.S. economic competitiveness in an economy that was becoming increasingly global. In short order, organizations responded to the report by developing content standards and states either adopted the standards outright or developed their own similar versions. States then followed by developing large-scale testing programs designed to assess student achievement of the standards. In addition, the federal government then established clear requirements for such assessment programs. In turn, states responded by modifying and, in many cases, further expanding their programs to meet these requirements. While standards and assessment programs still vary among states, the end result was the assessment of nearly every student each year in grades 3–8 and at least one year in high school.

In the early 2000s, similar concerns about U.S. competitiveness in an increasingly digital global market also arose. Like concerns 20 years earlier, these new concerns also led to efforts by several organizations to identify an expanded set of skills deemed essential for the twenty-first century. However, unlike the development of content standards in the 1980s, the United States has not yet seen widespread adoption of these standards, particularly at the state level. In turn, no formal assessment programs focused on student development of these new skills have been established.

At the state level, some states have launched initiatives to support learning in the digital age. As detailed above, North Carolina is among those states that have been proactive in establishing the conditions believed necessary to support digital-age learners. As an outgrowth of the leadership and vision established 15 years ago, the state has made significant progress in improving access to technology in schools and has provided a variety of resources and professional development programs that support the implementation of digital learning practices in schools across the state. However, even in this rich twenty-first century learning environment, the formal establishment of expectations specific to twenty-first century skills and assessments that measure progress toward developing these skills in all students has not yet emerged.

Consistent with the U.S. educational system's value of local control, adoption, and implementation of twenty-first century skills have been left largely to the school and district levels. In some cases, schools and districts are working with experts, such as EdLeaders21, to target twenty-first century skills and modify their educational practices to support the development of these skills. In rare cases, schools have fundamentally restructured themselves to create robust opportunities for students to work collaboratively with modern technologies to develop and demonstrate the achievement of such skills. However, concerted efforts such as these are currently clear exceptions. In the coming years, the number of exceptional schools may increase. However, if the standards-based movement serves as a model for creating change across the majority of U.S. schools, it will require federal regulations tied to financial

incentives to fully stimulate states and their schools to rapidly embrace twenty-first century skills as a focal point for teaching and learning.

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Chapter 11
Russian Federation: At a Conceptual Crossroads

Kirill Barannikov, Maria Dobryakova, Isak Froumin, and Igor Remorenko

Abstract The chapter covers almost a century of Russia's balancing between two competing models: knowledge-oriented education (aiming at memorization and reproduction of knowledge) and competence-oriented education (allowing to apply knowledge and solve real-life problems). Despite the competence-oriented curriculum, real school practice tends to stick to the soviet path: disciplinary contents to be memorised and reproduced is described in great detail. In the last 30 years, a number of independent attempts have appeared suggesting various ways to update the disciplinary contents, assessment, and teaching practice so as to integrate the task of developing key competences. Competence-based approach is impeded mostly by the system of interim and summative assessment, inadequate pre-service and in-service teacher training, as well as conservative expectations and ideas about education prevailing among certain social groups.

Keywords Key competences · Educational standards · Knowledge-oriented education · Competence-based education · Teachers' beliefs · Experimental pedagogy · Innovative teachers · Developmental education · TRIZ-pedagogy · Metadisciplinary learning outcomes

Highlights

- Over the past century, education in Russia has been balancing between two competing models: knowledge-oriented education (aiming at memorization and reproduction of knowledge) and competence-oriented education (allowing to apply knowledge and solve real-life problems).

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- In the 2010s, Russia adopted new educational standards, which emphasize the development of key competences and knowledge application skills along with subject knowledge acquisition. This is the current national curriculum.
- Despite the competence-oriented curriculum, real school practice tends to stick to the soviet path: disciplinary contents to be memorized and reproduced are described in great detail.
- Within the last 30 years, quite a number of independent attempts have appeared suggesting various ways to update the disciplinary contents, assessment, and teaching practice so as to integrate the task of developing key competences.
- Competence-based approach is impeded mostly by the system of interim and summative assessment, inadequate pre-service and in-service teacher training, as well as conservative expectations and ideas about education prevailing among certain social groups.
- Despite the poor implementation of the competence-based approach, some elements of key competences are increasingly attracting the attention of politicians, education officials, and teachers.

Russia is a federal state with a total population of 146.8 million people. The structure of Russia includes 85 territorial entities.

General education in Russia is made up of 4 levels: Preschool (ISCED 0) for children aged 3–7, elementary (ISCED 1) for 7–10-year-olds, basic (ISCED 2) for those aged 11–15, and secondary (ISCED 3) for 16–17-year-old pupils. There are 14.2 million children in total learning at all education levels. The total number of teachers is 3.47 million, and they work in 44,480 schools. More than 95% of schools are state-owned.

Until 2018, there was a Ministry of Education and Science in Russia that supervised both secondary and higher education. In 2018, the Ministry was divided into two administrative bodies, and today secondary education is controlled by the Ministry of Education. Every entity also has a regional ministry or department of education.

In Russia, there is a final examination (high-stakes examination) at the end of basic (9th grade) and secondary school (11th grade). Enrollment in universities is carried out according to the results of the state final examination (SFE-11, also called the unified state examination (USE)).

Russia ranks first in the PIRLS-2016 results. According to the results of PISA-2015, Russia was thirty-second, while a specific PISA study showed that Moscow schools rank among the top ten (2015) and even top five (2018) in the world.

Currently, the educational system of Russia is at a "conceptual crossroads." The reforms that have been introduced over the past two years (2016–2018) once again bring up the issue of curriculum content. Such a situation is reproduced in Russia fairly regularly and, as a rule, is associated with new teams of policy makers in education coming into power. The seemingly simple question of "What to teach" becomes the subject of heated debate. One of the topics most discussed now is "21st-century skills." Moreover, it is not only academics and politicians that are involved in the public debate but also parents and teachers.

11.1 Prehistory: Projects on Development of Competencies in the Soviet School

Labour education, project training, and cultural and historical concept of Vygotsky at school. In the 1920s, after the October revolution, the People's commissariat for education announced the policy of unified labour schools. In addition to the overall aim of eliminating illiteracy, this policy assumed that knowledge was mastered not by learning and memorization, but by the participation of children in activities, and the teacher's task was to involve children in such activities. Experimental pedagogical sites sprang up across the entire country. Eight schools in Moscow collaborated with D. Dewey and his pupils, and one school network was engaged in labor education (P. P. Blonsky, A. S. Makarenko, S. T. Shatsky, etc.). While describing his impressions of the Soviet Russia of the 1920s, John Dewey noted: in the post-revolutionary period, the Russian schools tested various approaches, the implementation of which was impossible in Tsarist Russia.[1] Special attention was drawn to interaction between the school and the family, with additional education of children taking place outside of school life and in summer camps, as well as through collective and group learning. However, this practice-oriented project training developed at a soviet experimental school had little influence on mass education.

Undoubtedly, Soviet education was closely connected with propaganda and the promotion of Marxist-Leninist ideology, bringing the forcible inculcation of communist values to all citizens.

In the same period, ideas of cultural and historical psychology by L. S. Vygotsky were developed, and the first field experiments of his concepts were conducted. As he argued, "pedagogy must be oriented not to the yesterday, but to the tomorrow of the child's development" ([35], vol. 2, p. 252). He considered this development (of thinking, of social skills) not as a prerequisite of learning, but rather as its possible and desirable outcome. A number of experimental attempts stemmed from his theory aiming at an updated curriculum for some disciplines. In terms of competence-based learning, it is the Vygotskian idea of "social situation of learning" that is most important: psychological development was described as a product of interaction between an individual and her social environment. The idea of the "zone of proximate development" is extremely important and instrumental for the development of social competences: it highlights the role of collective collaborative activity, the interaction between a student, her peers, and adults—this interaction becomes an initial stage for the development of any social skills. These ideas largely determined a methodological path for a whole class of education research focusing on the processes of psychological and social development—including research on thinking as embedded in its social environment.

However, in the 1930s, during the period of Stalin's industrialization, experiments in pedagogy ceased and the school system returned to the classical model, focusing on

[1] Impressions of Soviet Russia and the Revolutionary World, Dewey [28]. https://archive.org/details/in.ernet.dli.2015.169066/page/n9.

the transfer of knowledge. Yet, the school still held labor education, as well as activity-based personal and social development programs (offering a reflexive experience, and not rote memorization of the rules of conduct)—often in the form of self-governance opportunities and elsewise socially important collaborative activities. The task of mastering self-organization and collaborative skills was articulated explicitly and made part of such programs—beyond the disciplinary curriculum.

Children's political organizations at school should also be mentioned here: little octobrists, young pioneers, and young communists. Despite their evident political bias and strong association with the Marxist-Leninist ideology, these organizations involved children in real social activities that helped to develop skills of collaboration, interaction, collective action, collaborative problem solving, and others.

Thus, a 1967 instruction for children's political organizations specifies the following tasks to be pursued in primary school children's development: "In a little octobrists group, a child learns how to act together with her peers, and not entirely on her own, to help each other… A little octobrists group should foster such moral qualities and behavioural habits, as a desire to tell the truth, be fair, be brave, be exact: what was said and promised, must be then done; skills of self-organisation, obedience, politeness… Children get familiar with the idea of comradeship, learn the idea of collective work for the good of other people" ([18], p. 32).

For young teenagers, this program set the task of "gaining experience of autonomous organisation of collective activity, skills to plan the activity of the whole pioneer group, to distribute tasks between subgroups and temporary ad hoc groups, to check and review the plans. Each pioneer should develop organisational skills, gain experience of leading a group of peers or younger children, autonomous organisation of a fairly easy task or its fragment" ([18], p. 40).

It should be stressed that the development of these skills was seen as a mandatory element of teaching and learning, but was not assessed specifically.

The contents and efficiency of these activities strongly depended on the specific practices of individual schools. Some picked only the formal aspect of these politicized organizations. Yet, in many other schools teachers tried to really involve children in self-governance, created opportunities for them to organize and hold various events, and fostered their analytical skills. This is why, even in modern Russia, some schools still use pioneer traditions in their work (e.g., School 7 in the town of Troitsk, Chelyabinsk region; Primorskaya School 10, Volgograd region).

Besides these youth organizations, there was still another organizational form in the soviet era aimed at the development of social skills: state-supported summer pioneer camps with various specializations (recreational, sports, touristic, technical, etc.). It was a summertime immersion: children participated in all sorts of clubs while also learning the skills of self-governance, project training, self-discipline, collaboration, etc. By the time USSR collapsed, there were about 40 thousand such camps attracting annually over 10 million children.

Thus, by the end of the 1940s, a certain "division of responsibility" had come about: school lessons were responsible for the traditional (narrow, concrete) transfer

of disciplinary knowledge and skills, whereas state-supported extracurricular activities (youth political organizations, summer camps) were responsible for the development of social skills (collaboration, communication, self-regulation), as well as associated values and interests. This "division of responsibility" still remains a barrier which pushes back attempts to introduce the task of developing social competences into formal school learning.

"Developmental education". In the 1950s and 60s, after Stalin's death, pedagogical experiments resumed. The most interesting strand was directly associated with the development of key competences. In 1964, an influential Russian philosopher Ewald Ilyenkov published the paper entitled "School should teach thinking skills" which became an impulse to develop a new curriculum that would embrace the task of developing the competence of thinking and reasoning. It was assumed that the tasks solved by pupils should refer to their zone of proximate development and enhance their learning cooperation. In fact, this approach was a forerunner of what the Western tradition now calls inquiry-based learning. The process of solving such tasks should lead to the development of thinking, cooperation, communication skills, etc. In the course of such experiments, new curricula for mathematics, Russian language, natural science, and other school subjects were developed. However, these experiments were again stopped in the period of stagnation during the Brezhnev era (the 1970s—beginning of the 1980s were the "stagnant" period when the Communist Party was headed by L. I. Brezhnev).

At the same time, the impact of these innovations on Soviet schools turned out to be very significant. For example, it became a tradition for teachers to plan lessons that encompass not only academic tasks but also developmental objectives. School inspectors oversaw the teachers' efforts in nurturing the personal qualities of children during both classroom lessons and extracurricular educational activities. These were, of course, closely associated with Marxist-Leninist ideology underpinning the activity of Pioneer and Komsomol organizations in each school and education in general.

Innovative teachers, the "pedagogy of cooperation," and TRIZ-pedagogy in the era of perestroika (restructuring of the USSR). The next wave of innovative education development emerged in the period of perestroika. In the late 1980s—early 1990s, many innovative schools emerged in Russia. "Developmental education" became popular again. In that era, the more progressive teachers prioritized developing skills that closely aligned with the requirements of the twenty-first century. They used pedagogical techniques suited to these skills: collaborative syllabus creation by pupil and teacher (humanistic pedagogy of Sh. A. Amonashvili), competence of thinking (thinking based on the logical schemes of V. F. Shatalov), development of independence and teamwork skills (proactive training of S. N. Lysenkova), "big ideas" (aggregative didactic units of P. M. Erdniev), competence of interaction with other people and project training (collective training of V. K. Dyachenko), etc. Educational innovators drew up their key ideas in the "Manifesto of cooperation pedagogy," the basic principles of which include collaboration between teachers, children, and parents; the creative growth and development of a child's personality; and self-governance of schools. During this period, the Iron

Curtain was lifted, sparking active interaction between Russian teachers and their counterparts from other countries. As a result, schools in Russia began adopting pedagogical models like M. Montessori's, R. Steiner's Waldorf pedagogy, and the pedagogies of S. Freinet, A. Neill, and others.

It was also the time when TRIZ-pedagogy was gaining popularity.[2] The Theory of Inventive Problem Solving was first developed in Russia by Heinrich Altschuller in the 1940s. It reached the sphere of education in the 1960s entering various technical clubs for children. Since the 1980s, TRIZ has been evolving also as a pedagogical approach. TRIZ-pedagogy tasks are broader than its original theory of inventive problem solving. The main goal of TRIZ-pedagogy is to make students face new tasks that they have not met before. Toward this goal, children learn to make predictions and look for areas of possible change (i.e., to invent). TRIZ-pedagogy mainly seeks to develop creativity and critical thinking.

TRIZ-pedagogy is based on two principles (they clearly have a lot in common with what is today known as inquiry-based learning):

– "cognition is preceded by surprise"—this principle aims at students' learning motivation;
– "knowledge can become a tool only as a result of practical activity, and not as a result of rote memorization."

Ideally, according to TRIZ-pedagogy, children should acquire all their knowledge in open-ended tasks, and any school lesson should be based on a heuristic conversation between the teacher and the students, in the course of which the students come to a solution on their own.

TRIZ-courses were developed for children of different ages (from kindergarten to secondary school), and TRIZ elements were integrated into some traditional school subjects: Bukhvalov used the TRIZ approach in his courses of biology and environmental studies [21], Guin and Kamin in physics, Nesterenko in mathematics and computer science, and Murashkov and Floresku in arts. Theoretical aspects of TRIZ-pedagogy were developed by A. Guin, B. Zlotin, A. Nesterenko, N. Khomenko, et al. However, comprehensive courses based on TRIZ-pedagogy were developed only for a very limited number of school subjects [17].

Whatever the case, TRIZ-pedagogy remains but a peripheral strand in Russia attracting only some enthusiasts—which is all the more surprising against the recent broad discussion about twenty-first-century skills. Yet, TRIZ-pedagogy seems to be the only vein of the Russian pedagogical tradition (besides Vygotsky's legacy, of course) that has taken root elsewhere. First of all, TRIZ methodology is associated with engineering and design tasks that require innovative and interdisciplinary approaches (e.g., see on the application of TRIZ in Australia: [25], in France: [30], in Japan: [24], in the Netherlands: [33], in Czechia: [26], in Taiwan: [27]).

Again, however this diverse innovative activity largely bypassed mass education, which remained predominantly soviet in spirit, albeit without the ideological flavour.

[2] We are grateful to Elena Novikova for her expert comments on TRIZ-pedagogy.

Many Russians still feel nostalgic about the soviet mass education system, and one might question where, beyond the realm of ideological work, key competences were developed. It must be acknowledged that many school disciplines (like mathematics, natural sciences, and literature) offered quite complex tasks, which fostered key competences such as thinking and self-regulation. However, only about 30% of children[3] were tackling these complex tasks. The majority focused mainly on tasks that required only reproductive skills (though sometimes challenging ones). Placing more emphasis on key competences would mean that they become a basic learning outcome expected from every child, not just the most academically gifted. Accomplishing this task would have necessitated different educational materials and teaching methods.

11.2 After Perestroika—On the Way to the "New Education"

The main document regulating the content of education in Russia is the state educational standard. Since the start of perestroika, there have been several attempts to update it. At first, the system of education continued to follow the soviet path, therefore the first post-Soviet education standards remained narrowly focused on knowledge acquisition: curriculum was based on uniform basic teaching plans and "minimal units of contents" describing topics to be discussed in the lessons. Reforms of the past two decades, however, have mostly sought to integrate key competences into school education.

The concept of modernization of Russian education adopted by the Government of the Russian Federation between 2001 and 2010 can be considered as the starting point of systemic changes. It was this document that first mentioned the competence-based approach and specified the target for forming modern skills.

In the spring of 2004, the Ministry of Education approved[4] new state educational standards. These standards spoke of the need to develop modern skills and competences, but no specific qualities were named. To a large extent, this goal was set as a reaction to the poor performance of Russian students in PISA-2000. The main breakthrough of this standard was an attempt to formulate a list of measurable educational outcomes for each subject. However, the developers did not associate these disciplinary outcomes with the twenty-first century skills, and the new standard continued to focus on defining the "minimum content of education"—a detailed listing of topics for study across all academic subjects at each stage of education.

In 2008, amendments to legislation were adopted and the structure of state educational standards was renewed[5] again. A new important principle was the introduction of three groups of requirements: requirements for learning outcomes; requirements

[3] This estimate is based on the number of children who received good marks in most of the subjects.

[4] During the administrative reform, 4 days before the end of its existence.

[5] The project was developed by the Ministry of Education and Science of Russia and the State Duma of the Russian Federation.

for the structure of educational programs; requirements for the learning environment. The government tried to move away from regulating thousands of units of study materials (topics for study across all academic subjects) and focus specifically on learning outcomes. It was assumed that the topics for the study would become part of the exemplary (sample) educational programs (meaning they would not be mandatory, but recommended). At the same time, learning outcomes would be described in an activity-based form (what graduates will be able to do with the knowledge acquired), not just in the form of a list of items "to know, to be able to describe." It was expected that this would allow schools to supplement the curriculum with a competence-based shift and let teachers focus not only on disciplinary outcomes but also, for the first time, on extra-disciplinary (metadisciplinary) learning outcomes. Such standards would also make it possible to unload school curricula, freeing them from an obviously excessive amount of information to be memorized.

In 2012, the Ministry of Education and Science of the RF adopted new federal state educational standards (hereinafter—FSES) for primary, basic, and secondary general education, as well as the preschool education standard. This version of the educational standard is valid in Russia today.

Unlike many national curricula of a number of countries (for example, Finland, Canada, and Australia), the standards do not contain a clear list of competences. The term "competence" itself is not used in the document consistently and rigorously. Yet, the standards describe not only the expected disciplinary outcomes of education but also students' metadisciplinary and personal outcomes. The list of metadisciplinary (and partly also personal) outcomes, thus, becomes an equivalent for a list of key competences. However, the standards cannot be used by teachers directly in their teaching practice: they provide only a general outline of learning outcomes for each key stage (primary, secondary) but not for every year of studies.

Exemplary basic educational program (EBEP) developed on the basis of the state standards is a more practically oriented document. It provides recommendations as to how to develop a curriculum for a particular school. It was assumed that there would be several exemplary programs developed by different independent providers (e.g., universities, research institutions, and various associations thereof), commissioned also by the state. In reality, however, the Ministry of Education adopted only one exemplary program for each school subject. On the basis of this program, assessment instruments are developed which are then used nationwide.

Formally, the state standards are specificated even further—in the School's main educational program, i.e., a local document developed by each school itself, it is based on the exemplary program and describes goals, expected outcomes, and learning environment for a particular school. This document also includes teachers' syllabi for their academic courses.

Again, in practice, such a delegation of authority down to teachers did not really work. A great majority of teachers were not qualified to design their own syllabi on the basis of the exemplary program. Unfortunately, adequate methodological support was not organized at the national level to help teachers design their curricula around learning outcomes.

The exemplary educational program was meant as *an example* which could be creatively modified for a specific school or teacher. Teachers are not obliged to strictly follow the exemplary programs. In reality, however, a great majority of teachers use this exemplary program as a template and just copy its words into their own syllabi. It thus remains largely but a formal ritual.

Formally, post-Soviet transformations of education were aimed at an enhancement of schools' academic autonomy, at shifting the emphasis from "topics covered" to achieved learning outcomes, also in the form of a capacity to be able to actually do something. This process was not always smooth or coherent and depended largely on the economic and political context. It was not sufficiently elaborated, which eventually led to teachers' and schools' disorientation and, as a result, distress.

At the same time, transformation of school education remains one of the top priorities of the Russian educational policy. In 2016, president Putin signed an instruction "to develop a set of measures aimed at a systematic modernisation of the contents of secondary education, taking into account monitoring surveys' results and most recent achievements in science and technologies, as well as changing demands of learners and society." It is not always the case, however, that political decisions are adequately implemented. Quite the contrary: a number of actual policy measures undertaken in 2014–2018 sought to entrench the archaic approaches (limiting the diversity of textbooks, rigid national control of academic performance every year, and administrative cohesion to introduce new subjects, such as astronomy and chess).

11.3 The Framework of Key Competences and Literacies in the State Federal Education Standards and School Curricula

The federal standards specify that metadisciplinary learning outcomes include "universal learning skills" and interdisciplinary concepts. Yet, the standards provide an interpretation only for the former and single out three kinds of universal learning skills: cognitive, communicative, and regulatory. It is in the exemplary program that learning outcomes are related to specific elements of universal learning skills.

The concept of universal learning skills became the developers' attempt to integrate the idea of domain-general skills used in many disciplinary areas. It is not clear, however, why the expression has the word "learning"—as it is evident that such skills eventually should be used in any context, not only in the learning environment.

The metadisciplinary learning outcomes mentioned in the federal standard include the ability to set goals, the ability to plan, regulatory skills, semantic reading, ICT-skills, etc. The full list is given in Appendix A to this chapter. It should be stressed once again that there is no clear list of metadisciplinary learning outcomes (i.e., competences, in fact) which would be coherent across all the stages of education (preschool, primary, secondary)—each key stage offers its own list, there is almost no continuity between the levels (although it is normally not too hard to identify the

similarities). These lists, in their turn, differ significantly from similar lists in higher and vocational education.

The metadisciplinary educational outcomes mentioned in the federal standard embrace heterogenous entities:

- cognitive skills or even abilities (for example, "ability to deliberately use speech strategies and tools");
- various kinds of literacy (for example, "reading comprehension");
- competences (for example, "ICT-competence").

A critical shortcoming of the Standard is the absence of a coherent model or methodology of definition and selection of key competences. The resulting list is arbitrary and often inconsistent. There are no clear connections between metadisciplinary learning outcomes within a level of education and between the levels; there are no guidelines as to how to monitor the progress of the development of key competences—neither the individual progress in formative assessment, nor in formal summative assessment used in transition to the next level of education. As a result, all the professionals whose area of responsibility implies attention to competences—learning designers, methodologists, teachers, and assessment developers—experience difficulties, as they do not quite understand how they are supposed to assess the formation of metadisciplinary competences.

The exemplary educational programs specify metadisciplinary learning outcomes mentioned in the federal standards, breaking them down into smaller elements. Unfortunately, however, they do not make them any clearer and do not offer any guidelines as to their assessment. An excerpt to illustrate the idea is provided in the table below.

Federal standards	Exemplary educational programs
Ability to set learning goals on her own, to identify and formulate new tasks in learning and cognitive activities, to foster motivation and pursue interests in her learning activity	– Ability to analyze existing learning outcomes and to plan future learning outcomes; – Ability to identify one's own difficulties and determine the main problem
Ability to assess whether a learning problem was solved correctly, ability to assess one's own approaches to solving a problem	– Ability to determine the criteria for the correctness of a learning task; – Ability to analyze and justify the application of certain tools for a learning task

11.4 Key Competences and New Skills in the Russian School: Reality and Practice

11.4.1 Most Schools: Declaring Competence, Practicing Rote Learning

The inertia of the "knowledge-based" paradigm in Russian education persists and largely determines school practice. A competence-based approach, despite its declaration in the FSES and EBEP, remains unusual for schools and teachers.

In most schools, the category of competences turns out to be a "ritualistic" element of school life. Declaratively, competences and metadisciplinarity appear in the main educational program (local school program) and teachers' lesson plans and course outlines. However, in practice, the main thing for them is so-called "working with educational material": memorizing the facts, dates, and names, instead of the ability to apply them to a real-life situation, not to mention general cognitive or communicative skills.

One of the reasons for this is that the current versions of standards and exemplary programs offer rather vague wording and fail to provide a clear connection between competences and subject knowledge. Teachers do not understand how to foster competences or skills and how to evaluate them during the course of subject study; they do not understand what needs to be changed in their lessons to achieve this goal.

According to our survey of Russian teachers conducted in 2018 [12],[6] teachers associate the task of developing key competences with the family; they do not mostly see it as their own responsibility (Fig. 11.1). More than one-third of teachers believe that creativity is not malleable—interestingly enough, this share is lower among teachers of arts and primary school teachers (Fig. 11.2).

There are significant and somewhat unexpected differences in attitudes and teaching practices between generations of teachers (Fig. 11.3). Teachers over fifty are much more focused on modern pedagogy and tend to emphasize active learning rather than teaching. This difference is very noticeable in their perception of good work: achieving sustainable knowledge is important for 38% of young teachers and only 19% of teachers of the older generation, while fostering critical thinking skills and independent learning skills is important for 72% of teachers of the older generation and only half of young teachers.

To a lesser extent, the imitation of the competence-based approach affected primary schools. This is probably due to the fact that in Russia, primary school teachers have always had more methodological freedom compared to secondary school teachers. In primary school, all learning outcomes for all subjects are controlled by one teacher, which creates a better natural environment for monitoring

[6] The survey was conducted by the Institute of Education NRU "Higher School of Economics" in Winter and Spring 2018, in partnership with the Russian Textbook Corporation and the Moscow City University. More than 4500 teachers from 85 regions of Russia took part in the survey.

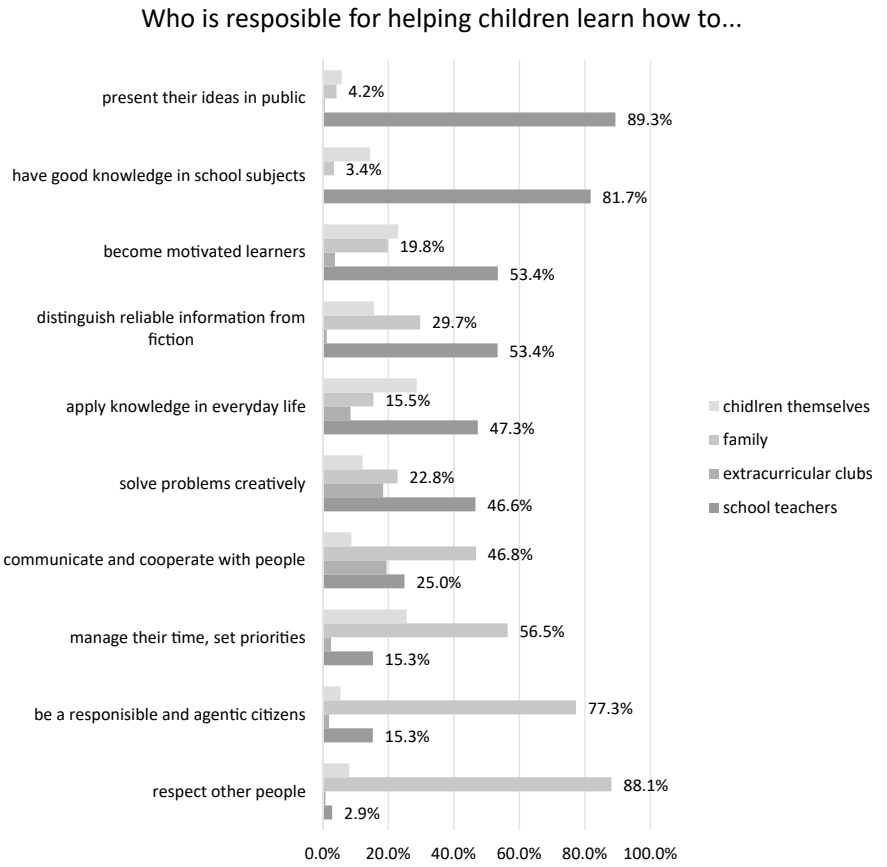

Fig. 11.1 Teachers' beliefs about the distribution of responsibility for the development of twenty-first century skills, %

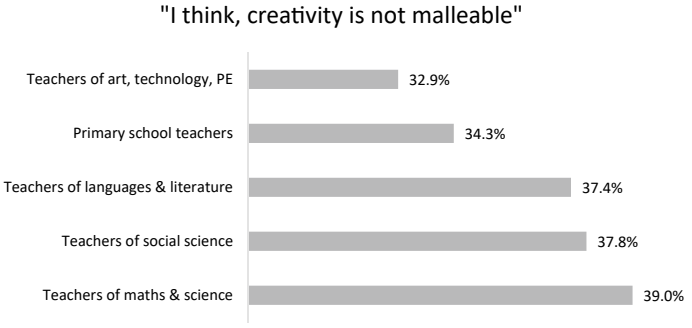

Fig. 11.2 Share of teachers who believe that creativity is not malleable, by subjects, %

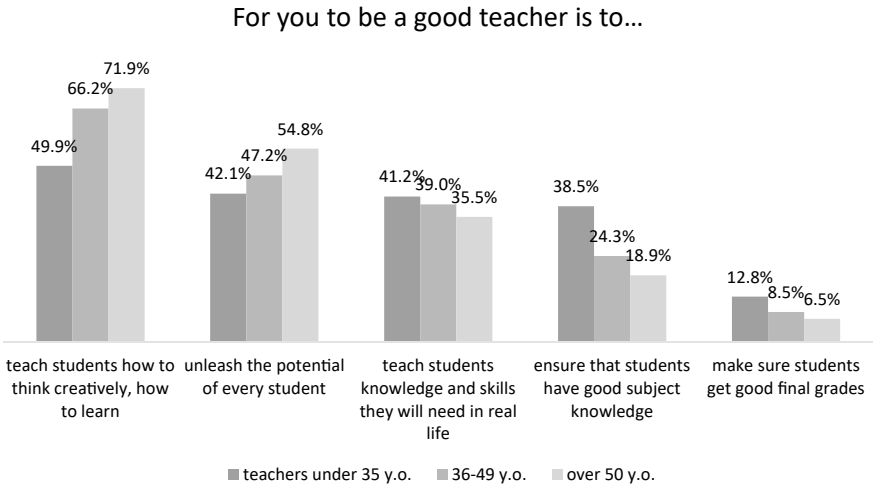

Fig. 11.3 Professional attitudes in different generations of teachers, %

students' progress in terms of their key competences. Perhaps, this is why primary schools in Russia have been better equipped for a competence-based curriculum than middle and secondary schools. Primary school teachers more often report they should help children develop social skills, communication skills, and conflict resolution skills: according to our survey, about 40% of primary school teachers and only 23% of science teachers consider this as their important task (Figs. 11.4 and 11.5). Our results are supported by other studies (e.g., on the prevailing formal approach and the dominant position of the Russian teacher, see [34], on the values of Russian teachers, see [29]).

11.4.2 Best Practices

Among the state (municipal) schools, a group of leaders attempting to rethink the usual practice can be singled out.

(a) *Experiments with educational spaces and project activities*

In School No. 548 "Tsaritsyno" (Moscow), a subject-spatial environment that promotes teamwork skills and the independence of pupils is being created. School No. 1788 (Moscow) conducts "project days," when the groups of children have lessons on "mixed subjects" (drawing and English, physical education, and history) in order to promote creativity.

The schools of the RUSNANO Corporation ("RUSNANO School League") use a three-step model of project activities: young school children are asked to perform a sample project, pupils of middle school age—a transformation project, and elder

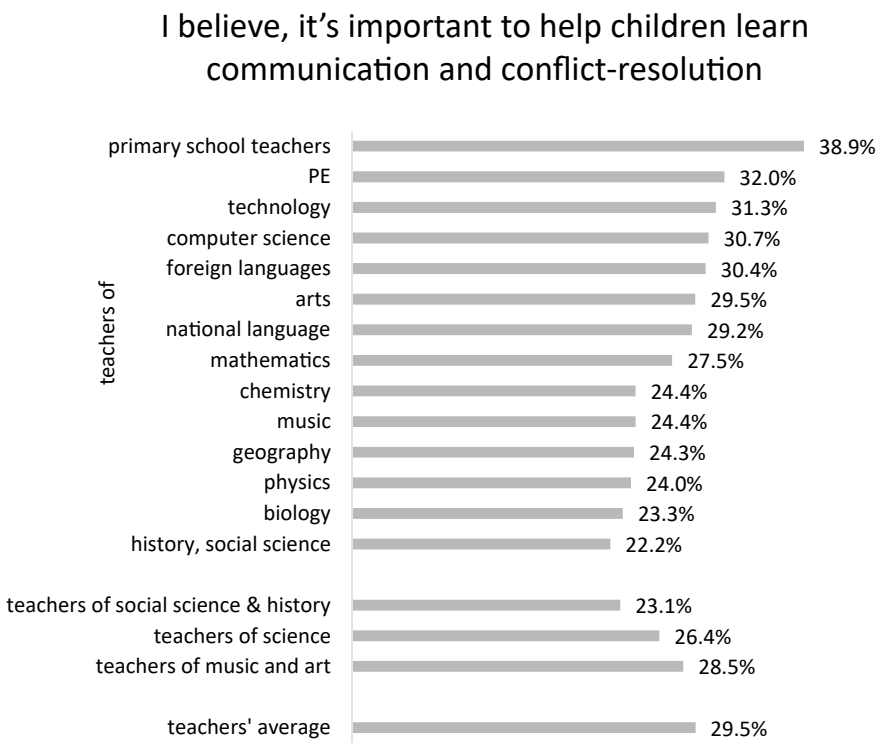

Fig. 11.4 Share of teachers who believe it is important to help children develop communication skills, by subjects, %

pupils—an invention project. All three project stages consistently develop the project competencies of the children, including the ability to work in a team, plan their activities, and reflect, developing critical and creative thinking.

(b) *"Experimental schools"*

As mentioned above (see Sect. 1 in this chapter), "experimental schools" started to appear in the post-Soviet period. Their founders were looking for alternative models of school education. Two striking examples of such schools have emerged.

A. N. Tubelsky self-regulated school No. 734 focuses on the formation of democratic values and the culture of self-determination. The school has its own constitution and laws, as well as its own court of honour. Children actively participate in school-wide events.

"School 200" (structural unit of the Moscow educational complex "School No. 1212") works in accordance with the concept of humane pedagogy (author—Shalva Amonashvili). The main focus is not on learning the teaching material, but on values and attitudes. Teachers focus on the development of children's self-understanding and positive attitude to life. However, these practices of humane pedagogy are better implemented at the elementary school level.

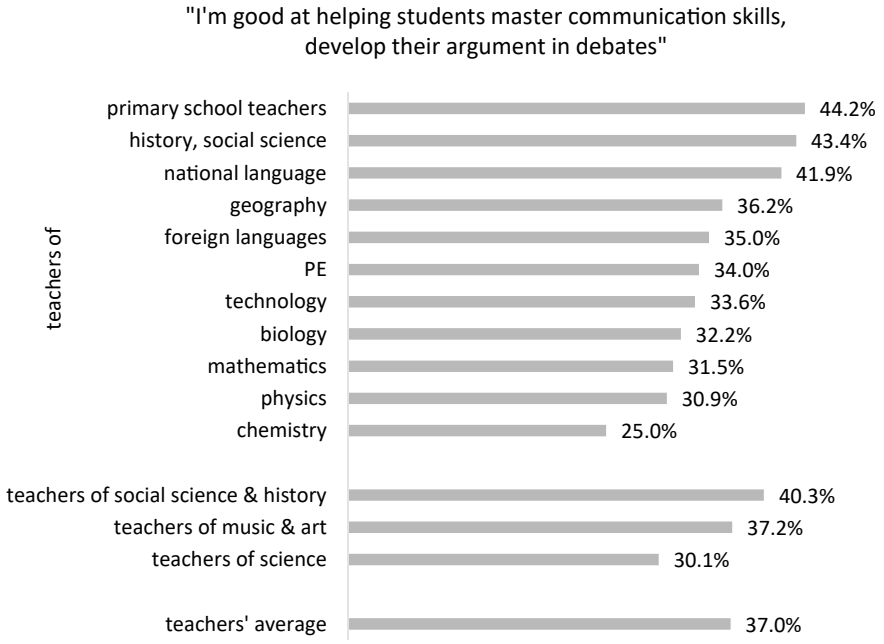

Fig. 11.5 Share of teachers who rate their ability to help students develop communication skills positively, by subjects, %

(c) *International baccalaureate schools*

Schools offering the international baccalaureate (IB) appeared in Russia more than 20 years ago and can be found today in many regions—in Moscow, St. Petersburg, Samara, Perm, etc. Such schools undergo an authorization procedure (certification of IB school status) and feature an educational program that differs from the programs of most other schools. The IB school model does not abolish FSES requirements, but supplements them so that school graduates can enroll in universities all over the world. IB schools have a more cross-subject approach. For example, in secondary school, the pupils learn some of the subjects in English and can choose the subjects to be learned in a foreign language. Also, the curriculum includes metadisciplinary elements, such as "Theory of cognition" and CAS-projects (CAS: creativity, activity, service). CAS projects aim to develop children's independence and creativity; the pupils learn to set goals, plan their activities, and reflect on their results and weaknesses.

(d) *Private schools*

The share of private schools in Russia is small—not more than 4 or 5% of the total number of schools. Thus, many of them continue to work in the usual (i.e., "knowledge-based") paradigm, while offering more comfortable learning conditions—both in terms of the number of pupils in a classroom and with regard to equipment and facilities.

However, in the past few years, private schools of a new type have emerged and become noticeable. They are trying to find their own new education model for the twenty-first century. The projects "Smart School," "New School," "Letovo," and "Khoroshkola" relate to this new type of school.

Some of the more striking examples of experiments by such schools include a competence model developed by "Smart School" in the Irkutsk region. The school was established in 2013 and was meant to grow into a whole ecosystem embracing a kindergarten, a school, and sports facilities. It is expected that such an ecosystem would not be narrowly focused on disciplinary learning but would also provide a well-rounded development for a child. The school's curriculum is constructed against five main axes: artistic modeling of the world, psychology of learning, an active practice of foreign languages, labor practice, and sport activities.

The "Smart School" has developed its own framework of competences which integrates three spheres of culture that the children are to master: the culture of self-development, the culture of creativity, and the culture of collaboration. For each culture, a set of skills or abilities is specified. For example, the culture of self-development includes the ability to make choices and the ability to turn experience into a resource; the culture of creativity includes reflexive thinking and skills of self-organization.

The team of *Khoroshkola school* (Moscow) is developing a model of personalized learning on the basis of its own digital platform. The model implies a comprehensive framework of competences and a system of learning outcomes.

The *Letovo school* (Moscow) highlights specific elements of key competences as learning outcomes in every subject and assesses their development at least two times a year.

Almost all the examples of the "best practices" mentioned here are united by a common task: to shift the emphasis in learning from memorizing information to developing competencies related to their individual and collective application in various situations. This raises the question of the balance of educational material (as a set of facts) and competencies. The assessment system is one of the decisive factors.

The Program of Personal Development (implemented by the Sberbank Charitable Foundation "Investment to the Future") should also be mentioned in this section about good practices. The program provides methodological support to school teams guiding them in their efforts to help children develop key competences. Program participants become able to change their learning environment and introduce new forms of working with children. It is expected that for 2018–2023 the program will cover 30 regions of Russia (more than 1800 schools and 24 thousand teachers).

11.5 Assessment system—The Main Focus is on Assessment of Knowledge

In Russia, the assessment system has several key stages and formats:

- the State Final Examination (SFE) upon completion of general basic education (9th grade) and a similar examination after completing general secondary education (11th grade, also known as the Unified State Exam);
- intermediate monitoring work: first of all, the all-Russian verification works, as well as monitoring conducted within the scope of Russia's participation in international comparative studies on education quality assessment;
- various regional or municipal monitoring surveys;
- individual summative assessment at the end of a learning period (a semester, a school year);
- marks given by a teacher during a lesson (a five-grade scale).

Although the modern version of educational standards formally declares a competence-based approach, it is poorly reflected in the assessment system. The international TALIS teachers survey reveals that assessment attitudes and practices of Russian teachers differ significantly from the international practice [20]. The main focus in the Russian assessment system is the verification of subject knowledge—the facts learned, while the competences remain out of focus.[7]

According to our survey [12], Russian teachers' assessment attitudes would currently belong to the "student accountability" and "school accountability" areas, if we refer to the continuum of teachers' conceptions of the purposes of assessment [23]. The idea of advancing a child's own learning is mostly understood in the paradigm of carrots and sticks ("without marks a child would be neglecting her studies").

Against this background, the final state examination at the end of the 9th grade is illustrative. These are the exams with "high stakes," since according to their results, pupils who do not plan to study at school up to the 11th grade get the right to continue their studies in vocational educational establishments. If pupils continue their education to the 11th grade, they take another state exam (Unified State Exam—USE). As a rule, control and measurement materials (tests) are created based on various

[7] The exception are some regional education quality monitoring surveys.

lists of topics and so-called "didactic units" (fractional elements of the educational material). During assessment, the pupils are required to demonstrate their formal knowledge of these "units".

Currently, new tests for the final state examination are being developed; however, they are to appear only in 2020 and 2022, for the 9th and 11th grades, respectively, due to the gradual mode of transition to the new federal education standard. As a result, most of the current measurement materials are still aimed at checking how well knowledge has been memorized.

However, despite the prevailing knowledge-based format of tasks, there are trends toward change. *First,* the essay returns as an initial examination halfway through the 11th grade; the essay format is also used in various school competitions. Five years ago, universities were granted the right to award additional points to the winners of creative writing competitions during their admission and student selection processes.

Second, participation in international research, especially PISA, has been considered as an incentive to change the focus in the assessment system, and more and more competence-based tasks in the natural sciences are being introduced into the national assessment process after the 9th grade.

Third, relatively localized initiatives are emerging, which are not mandatory but demonstrate alternative approaches to assessment. The experience of Moscow is a good example. The Moscow Centre for Quality of Education launched the "My Achievements" electronic service (www.myskills.ru), in which traditional tasks were supplemented with metadisciplinary tasks. The service can be used by any pupil of the city for free. The diagnostics tools focus on two areas:

- diagnostics of interdisciplinary concepts intended to identify the level and consistency of interdisciplinary concepts development;
- metadisciplinary diagnostics aimed at assessing the level of cognitive and communicative skills of a student.

Fourth, a new emphasis—the assessment of functional literacy—is making its way into the Russian system of assessment. This trend logically continues the aspiration to synchronize domestic and international assessment systems (like PISA) and is primarily manifested in efforts to improve the system of assessing reading literacy. Some regions (for example, Moscow and the Krasnoyarsk region) are developing their own materials for these procedures. Other regions use materials developed by the Centre for Education Quality Assessment of the Russian Academy of Education: the Centre designs tasks that require students to apply knowledge from different school subjects—pupils are presented with a range of real-life situations which necessitate the use literacy, numeracy, scientific literacy, financial literacy, global competence, or creative thinking skills).

Institute of Education at the National Research University Higher School of Economics also develops instruments to assess key competences (critical thinking, creativity, communication, and cooperation) in primary and middle schools. The instruments demonstrate an innovative approach to educational assessment: a modern digital form, interesting scenario-type tasks (children perceive them as a game), an

automatic feedback right after the assessment, providing both information about the level of competence development, and recommendations for teachers and parents as to how to further support and foster their development. A pool of tasks has been developed to integrate the task of developing these competences in disciplinary lessons [32].

Pilot studies conducted in schools of Moscow, Kaluga region, and Yaroslavl region have proved a great interest of school children and teachers in such instruments. The continuity between the frameworks of the instruments for primary and middle school allows using them to track individual learning trajectories—analysis of learning progression takes into account individual differences between students, their strengths and weaknesses, as well as their needs, motivation, and current level of knowledge.

A special tool was developed by the Institute to assess digital literacy. It is in demand in the regions of the Russian Federation; it is also localized and piloted in Armenia, Belarus, and Finland. The tool is constructed in the format of scenario-type test tasks: the student is asked to solve problems as close to real life as possible, be it a biology lesson, a trip to a museum, or organizing a party with friends. On the basis of the testing, students' abilities to use digital technologies to gain new knowledge, to communicate, and to perform an inquiry are assessed.

11.6 Training and Professional Development of Teachers: On the Way to a Real Shift

In Russia, most teachers are trained at pedagogical universities or at teacher-training programs at classical universities. At the same time, graduates of other universities, without a pedagogical background, also can teach in schools (although in practice such cases are very rare). The market for in-service training courses for teachers is also very broad and includes both universities and independent players—primarily, so-called regional institutes of teacher professional development.

Teacher training in Russia follows the Federal State Educational Standard (FSES) of higher education, which is uniform across all fields of study, akin to the standard applied in schools.

A competence-based approach was incorporated into the standards of higher education prior to its inclusion in the text of the FSES for general education. This is a consequence of many years of evolution in higher education standards. As early as the mid-1990s, the categories of "knowledge" and "proficiency" were used to describe educational objectives and requirements for graduates. Since 2000, the standard of higher education has distinctly identified "common cultural" and "general professional" competences. The full list of competences can be found in Appendix B.

Despite the declaration of a competence-based approach both in initial and in-service training of teachers, in practice the situation is often different. Many in-service training courses still only "deliver hours." Most of them adhere to traditional

lecture formats. In such courses, teachers find themselves again in an environment that emphasizes rote memorisation, not competences. That is why such concepts as "competence," "metadisciplinary," and "activity-based approach" remain but words. The issue was particularly pronounced during the transition to new educational standards in the early 2010s when the urgency to provide training for a substantial number of teachers outweighed the focus on the quality of the training itself. The outcome of such teacher training programs resulted in a widespread "mimicry" (*on fait semblant*): teachers mastered the rhetoric and learnt how to adapt to new forms of regulation, while in actual classroom practice, they continued to teach in the ways they were accustomed to.

For a certain period, the situation in initial teacher training. Bachelor's programs were of an applied professional or "craft"-like nature. Over four years of intensive, specialized courses (in subject, teaching methods, etc.), there was little room for the future teacher's self-definition and development of competences.

However, in recent years, two trends have emerged that might gradually change the situation. *Firstly*, some universities have begun to fragmentarily introduce the Liberal Arts model and integrate it with in-service training programs. This model aims to redirect graduates toward mastering competences, such as critical thinking and communicative skills.

Secondly, in the assessment of pedagogical training quality, the emphasis is shifting from the assessment of a teacher's subject-specific knowledge to the assessment of skills. One example of this trend is the participation of teacher education in the WorldSkills movement. Over the last three years, students of pedagogical colleges (non-university professional education) have been actively involved in the Russian version of the World Skills movement. This is a national competition for future nursery and primary school teachers. In the competition, students demonstrate their skills in communicating with children's parents and in organizing various lessons.

The program "Teach for Russia" (launched in 2015 with support from Sberbank) may have a significant long-term effect. The program invites graduates from top Russian universities, with specializations in any field, to undergo intensive training and then spend two years teaching at rural and remote regional schools. The goal of the program is to ensure equal educational opportunities for children in different regions and to enhance the prestige of the teaching profession. As of 2020, the program is operating in 78 schools across 6 regions, with the program's teachers instructing over 34 thousand children.

Such new formats for the assessment and certification of teachers are steadily gaining popularity in the professional community. They help gradually form teachers' new learning experience, which, in its turn, influences their teaching practice.

11.7 Major Challenges for the Agenda of the Development of Key Competences and New Literacies

Counter-reforms in recent years have led to an exacerbation of many problem areas in post-Soviet education. The main challenge is **the absence of a clear framework of competences** which could make the core of the national curriculum. Under such circumstances, both the state and society rely on a knowledge-based approach—as the more easily understood and has been "tested" throughout the years of the Soviet education system.

Modernization of disciplinary contents is associated with this challenge. Over the past few years, several orders from the Russian president on this topic have been issued. Updating the content requires a new generation of experts, methodologists, and developers.

Since the beginning of the 2010s, the competence-based approach has become more consolidated in Russia. However, this trend came to a halt in 2016–2018. The recent changes tend to support the "knowledge" model. Voices are getting louder, arguing that "first, one needs to acquire basic knowledge, and only then can one proceed to certain competences." Some social groups continue to believe that the curriculum turn toward twenty-first century skills was a mistake and that the main mission of the modern school still lies only with solid knowledge. Others believe that we should not deviate from the chosen path—that knowledge should be supplemented by the ability to apply it and by domain-general key competences.

The second challenge is associated with **digital transformation**. Russia launched a national program called "Digital Economy"; some of its action items address education. Along with vast opportunities, digital technologies are raising numerous questions. The key concerns are the competences that a pupil needs, the capabilities of a teacher, and the organization of a school in a world where most information is accessible with a single click.

As part of the digital transformation of the economy, the plan is to support the development of digital literacy (unlike the European digital competence framework,[8] Russia has not yet developed a clear strategic document on the topic). The development of digital educational environments has become another critical task. For example, the Moscow Electronic School is a specialized platform for teachers helping them design their lessons. Technical features of the platform can track users' "digital footprints"—how a teacher and students work with educational material; which tasks and resources are more popular than others; how learning outcomes are changing. Such digital footprints can subsequently form the basis for big data analysis.

Of course, digital literacy and digital footprints are not the only consequences of digital transformation. Digital environment offers greater opportunities for the

[8] DigComp 2.0: The Digital Competence Framework for Citizens. Update Phase 1: The Conceptual Reference Model https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/digcomp-20-digital-competence-framework-citizens-update-phase-1-conceptual-reference-model.

development of self-regulation and cooperation skills. However, these opportunities have not been deliberately used so far.

The third challenge is **expanding the usual "educational space**." From the USSR, Russia inherited both a unique system of extracurricular education, and families' interest in children's informal—out of school—education. Economic and technological development, especially in larger cities, means that school does not have a monopoly on education anymore. More and more children receive education outside the usual schools, including homeschooling, all sorts of clubs, and museums. There is a growing number of educational programs aimed at the development of key competences and new literacies. The recent *Quantorium initiative* (a network of technoparks for children) aims at developing project competences. Currently, Quantoriums have become part of the national project "Education," and several dozen such centres will be created throughout Russia.

Despite the temporary setback during the educational reforms in recent years, the processes that began in the 1990s are pushing Russia toward global trends. In 2018, national development goals up to 2024 were presented. One of these goals is to become a Top-10 country by the quality of education. It is indeed possible to achieve this goal if all the three major challenges mentioned above find their solution.

Appendix A

The list of targets and requirements for metadisciplinary learning outcomes by levels of the general education.[9]

Target references at the stage of completing the preschool education (Order of the Ministry of Education and Science of the RF dated October 17, 2013, No. 1155 "On approval of the federal state educational standard of preschool education"):

- the child masters the main cultural activities, shows initiative and independence in various activities—playing, communicating, cognitive and research activities, designing, etc., and is able to choose the activity and participants in joint activities;
- the child has a positive attitude toward the world, different kinds of work, other people, and self, has dignity, actively interacts with peers and adults, and participates in joint games. The child is able to negotiate, take into account the interests and feelings of others, empathize with misfortunes and rejoice in the successes of others, show own feelings in a proper way including the feeling of self-confidence, and try to resolve conflicts;
- the child has developed their imagination which is implemented in various activities and, first of all, in games; the child knows different forms and kinds of games, distinguishes between conditional and real situations, and can obey different rules and social norms;

[9] Without requirements for children with special health needs.

- the child is fluent in spoken language, can express own thoughts and desires, can use speech to express own thoughts, feelings, and desires, builds speech statements in communicative situations, and can single out the sounds in words; the child has the prerequisites for literacy;
- the child has developed gross and fine motor skills; the child is active, enduring, knows the main movements, and can control and manage own movements;
- the child is capable of conation, can follow social norms of behavior and rules in various activities, in relations with adults and peers, and can follow the rules of safe behavior and personal hygiene;
- the child is curious, asks questions to adults and peers, shows interest in cause-effect relations, tries to invent explanations for natural phenomena and actions of people, and tends to observe and experiment. The child has basic knowledge of himself/herself, of the natural and social world surrounding the child knows the works of children's literature, and has basic knowledge in the fields of wildlife, natural science, mathematics, history, etc.; the child is capable of making own decisions based on own knowledge and skills in various activities.

Requirements to metadisciplinary results for elementary general education (Order of the Ministry of Education and Science of the RF dated October 6, 2009, No. 373 "On approval and implementation of the federal state educational standard of elementary general education"):

- mastering the ability to accept and maintain the goals and objectives of educational activities, and finding the means for their implementation;
- learning the ways to solve creative and exploratory issues;
- formation of the ability to plan, monitor, and evaluate learning activities in accordance with tasks and conditions for their implementation, and determine the most efficient ways to achieve the results;
- formation of the ability to understand the reasons for success/failure in learning activities and the ability to act efficiently even in conditions of failure;
- mastering the initial forms of cognitive and personal reflection;
- the use of sign and symbolic means of presenting the information for the creation of models of objects and processes under study, schemes for solving the learning, and practical problems;
- active use of speech tools and means of information and communication technologies (hereinafter referred to as ICT) for solving communicative and cognitive tasks;
- the use of various techniques for searching (in reference sources and open educational information space of the Internet), collecting, processing, analyzing, organizing, transmitting, and interpreting the information in accordance with the communication and cognitive tasks and technologies of the subject, including the ability to enter the text using the keyboard, register (record) the measured values numerically and analyze the images, sounds, prepare own speech and speak with audio, video, and graphical accompanying support, and observe the rules of information selectivity, ethics, and etiquette;

- mastering the skills for semantic reading of texts of various styles and genres in accordance with goals and objectives, and forming speech statements consciously and in accordance with communication objectives, ability to compose texts in oral and written forms;
- mastering the logical actions of comparing, analyzing, synthesizing, generalizing, classifying by generic characteristics, finding analogies and cause-effect relations, constructing the reasoning, and referring to known concepts;
- readiness to listen to the interlocutor and hold a dialogue; readiness to recognize the existence of different points of view and the right of everyone to have own point of view; ability to state own opinion and reason own point of view and attitude to certain events;
- determination of a common goal and ways to achieve it; ability to negotiate on the distribution of functions and roles in joint activities; exercise mutual control in joint activities, assess own behavior and behavior of others properly;
- willingness to resolve conflicts efficiently by taking into account the interests of the parties and cooperating;
- mastering the basic information about the nature and characteristics of objects, processes, and phenomena of reality (natural, social, cultural, technical, etc.) in accordance with the content of a specific subject;
- mastering the basic subject and cross-subject concepts reflecting the essential connections and relations between the objects and processes;
- the ability to work in the material and information environment of elementary general education (including with educational models) in accordance with the content of a specific subject; formation of the basic standards of using the dictionaries in a system of universal educational actions.

Requirements to metadisciplinary results for basic general education (Order of the Ministry of Education and Science of the RF dated December 17, 2010, No. 1897 "On approval of the federal state educational standard of basic general education"):

- ability to independently determine the objectives of study, set and formulate new objectives in learning and cognitive activity, and develop the motives and interests of own cognitive activity;
- ability to independently plan the ways to achieve goals, including alternative ones, to consciously choose the most efficient ways to solve educational and cognitive tasks;
- ability to correlate own actions with the planned results, to monitor own activities in the process of achieving the results, to determine the ways of actions within the scope of proposed conditions and requirements, to correct own actions in accordance with the changing situation;
- ability to assess the correctness of a learning task, own capabilities of solving it;
- knowledge of the basics of self-control, self-assessment, decision-making, and taking conscious decisions in educational and cognitive activities;
- ability to determine the concepts, create generalizations, establish analogies, classify, independently choose the grounds and criteria for classification, establish

cause-effect relations, build logical reasoning, deduction (inductive, deductive, and by analogy), and draw conclusions;
- ability to create, apply, and transform the signs and symbols, models, and schemes for solving educational and cognitive tasks;
- semantic reading;
- ability to organize educational cooperation and joint activities with a teacher and peers; work individually and in a team: to find a common solution and resolve conflicts by coordination of positions and taking into account the interests; formulate, reason, and defend own opinion;
- ability to consciously use speech means in accordance with the task of communication to express own feelings, thoughts, and needs; planning and regulation of own activities; handling of spoken and written language, monologue contextual language;
- formation and development of competence in the use of information and communication technologies (hereinafter—ICT competence); development of motivation to master the culture of active use of dictionaries and other search engines;
- formation and development of the environmental way of thinking, and ability to apply it in cognitive, communication, social practice, and vocational field.

Requirements to metadisciplinary results for secondary general education (Order of the Ministry of Education and Science of the RF dated May 17, 2012, No. 413 "On approval of the federal state educational standard of secondary general education"):

- ability to independently determine the goals of activities and draw up the plans for activities; to independently carry out, monitor, and correct the activities; to use all possible resources to achieve the goals and implement the plan of actions; to choose successful strategies in different situations;
- ability to communicate and interact efficiently in the process of joint activities, take into account stances of other activity participants, and resolve conflicts efficiently;
- skills in cognitive, educational, research, and project activities, problem-solving skills; ability and readiness to search for methods for solving practical issues and using various methods of cognition independently;
- readiness and ability for independent information and cognitive activities, skills in obtaining the required information from different kinds of dictionaries, ability to navigate various sources of information, and evaluate and interpret information obtained from various sources critically;
- ability to use the means of information and communication technologies (hereinafter—ICT) in solving cognitive, communication, and organizational tasks according to requirements of ergonomics, safety, hygiene, resource-saving, legal and ethical standards, and information security standards;
- ability to determine the purpose and functions of various social institutions;
- ability to independently assess and make decisions determining the strategy of behavior, taking into account civic and moral values;
- proficiency in language means—the ability to clearly, logically, and accurately express own point of view, and to use proper language tools;

– proficiency in skills of cognitive reflection as awareness of the actions performed and the mental processes, their results and bases, the limits of own knowledge and ignorance, new cognitive tasks, and the means to achieve them.

Appendix B

The list of competencies a graduate teacher with a degree in "Education and Pedagogy," the level of higher education, should have (Order of the Ministry of Education and Science of the RF dated December 4, 2015, No. 1426 "On approval of the federal state educational standard of higher education in degree 44.03.01 Pedagogical education (bachelor degree)").

Common cultural competences

– ability to use the basics of philosophical, social, and humanitarian knowledge for the formation of a scientific world outlook (OK-1);
– ability to analyze the main stages and patterns of historical development for the formation of patriotism and civic stand (OK-2);
– ability to use natural science and mathematical knowledge for orientation in the modern information space (OK-3);
– ability to communicate in oral and written forms in Russian and foreign languages for solving the problems of interpersonal and cross-cultural interaction (OK-4);
– ability to work in a team and accept social, cultural, and personal differences in a non-judgmental manner (OK-5);
– ability to self-organize and self-educate (OK-6);
– ability to use basic legal knowledge in various areas of activities (OK-7);
– readiness to maintain the level of physical training ensuring fully fledged normal activities (OK-8);
– ability to use first-aid techniques, and methods of preservation in emergency situations (OK-9).

General professional competencies:

– readiness to recognize the social significance of own future profession, to be motivated to carry out professional activities (OPK-1);
– ability to carry out teaching, education, and development taking into account social, age, and psychophysical and individual features including special educational needs of the pupils (OPK-2);
– readiness for psychological and pedagogical support of the educational process (OPK-3);
– readiness for professional activity in accordance with legal regulations in the field of education (OPK-4);
– knowledge of the basics of professional ethics and speech culture (OPK-5);
– readiness to ensure the pupils' life and health preservation (OPK-6).

Appendix C

The list of skills[10] detailing the work functions in accordance with the requirements of the Professional Standard "Teacher (pedagogical activity in the field of preschool, elementary general, basic general, secondary general education) (educator, teacher)" (Order of the Ministry of Labour and Social Protection of the RF dated October 18, 2013, No. 544n).

Work duties: General pedagogical duties. Teaching.
Required skills:

- To know forms and techniques of teaching including those that go beyond the scope of lessons: project activities, laboratory experiments, field practice, etc.
- To objectively assess pupils' knowledge, based on testing and other control methods in accordance with the actual educational capabilities of children.
- To develop (master) and apply modern psychological and pedagogical technologies based on the principles of personality development and behavior in a real and virtual environment.
- To use and test special approaches to learning in order to involve all pupils in the educational process including pupils with special educational needs: pupils showing outstanding abilities; pupils for whom Russian is not a native language; pupils with special needs.
- To have ICT competences: general user ICT competence; general pedagogical ICT competence; subject-pedagogical ICT competence (reflecting the professional ICT competence of the relevant field of human activity).
- To arrange various kinds of out-of-school activities: play, learning and research, artistic and productive, cultural and leisure activities taking into account the possibilities of educational organization, place of residence, and historical and cultural identity of the region.

Work duties: Educational activities.
Required skills:

- To build educational activities taking into account the cultural differences of children, age and gender, and individual features.
- To communicate with children, recognize their dignity, and understand and accept them.
- To create communities of different ages consisting of children and adults, i.e., pupils and their parents (legal representatives) and teachers in learning groups (class, circle, hobby group, etc.).
- To manage study groups to involve pupils in the process of learning and education by promoting their learning and cognitive activities.
- To analyze the real state of affairs in the learning circle; to maintain a practical and friendly atmosphere among the children.

[10] Without work duties associated with subject-matter teaching.

- To protect the dignity and interests of pupils, to help children in conflict situations and/or adverse conditions.
- To find the value aspect of academic knowledge and information and to ensure its understanding and perception by pupils.
- To have skills in organizing excursions, tours, expeditions, etc.
- To cooperate with other pedagogical workers and other experts in solving educational tasks.

Work duties: Developmental activities.
Required skills:

- To have a professional set of skills to assist any child, regardless of their real educational capabilities, behavioral features, and mental and physical health.
- To use psychological approaches in the work practice: cultural, historical, and developmental approaches.
- To carry out (together with a psychologist and other specialists) psychological and pedagogical support of the main educational curricula.
- To understand the documentation of specialists (psychologists, speech pathologists, speech therapists, etc.).
- To draw up (together with a psychologist and other specialists) a psychological and pedagogical description (portrait) of the pupil's personality.
- To develop and implement individual educational routes, individual development programs, and individual-oriented educational programs taking into account personal and age characteristics of pupils.
- To know standardized techniques for psycho-diagnostics of personal and age characteristics of pupils.
- To evaluate educational results: subject and cross-subject competences formed in the subject taught, as well as to monitor (together with a psychologist) personal characteristics.
- To form communities consisting of children and adults.

Work duties: Pedagogical activities for implementation of preschool general education programs.
Required skills:

- To organize the activities carried out in early and preschool years: subject, cognitive research, game (role-playing, directing, game with a rule), productive; designing, creating ample opportunities for the development of free play of children including ensuring time and space for the game.
- To apply methods of physical, cognitive, and personal development of children of early and preschool age in accordance with the educational program of the organization.
- To use techniques and tools for psychological and pedagogical monitoring analysis allowing to assess the results of mastering the educational programs by children, the degree of their qualities required for further education and development at later education levels.

- To master all kinds of preschool developmental activities (play, productive, educational, and research).
- To build partnership interaction with parents (legal representatives) of children of early and preschool age for solving educational problems; to use the methods and means for their psychological and pedagogical education.
- To have the ICT competencies required and sufficient for planning, implementing, and assessing the educational work with children of early and preschool age.

Work duties: Pedagogical activities for implementation of elementary education programs.

Required skills:

- To respond to direct forms of the appeal of a pupil to a teacher and to recognize serious personal problems behind them.
- To set different types of educational tasks (educational and cognitive, educational and practical, educational and playing) and organize the solving of them (in individual or team form) in accordance with the level of cognitive and personal development of young children while maintaining the balance of disciplinary and metadisciplinary components component of their content.
- In cooperation with parents (legal representatives), other pedagogical workers, and psychologists, to develop and correct the individual educational path of a pupil in accordance with the objectives of achieving all kinds of educational results (disciplinary, metadisciplinary, and personal ones) beyond the scope of elementary general education.

Work duties: Pedagogical activities for implementation of basic and secondary general education programs.

Required skills:

- To apply modern educational technologies including information and digital educational resources.
- To conduct lessons based on achievements in the field of pedagogical and psychological sciences, age physiology, and school hygiene, as well as state-of-the-art information technologies and teaching techniques.
- To plan and carry out the educational process in accordance with the basic education curriculum.
- To develop a work program for the subject or the course on the basis of exemplary basic general education curricula and to ensure its implementation.
- To organize the independent activities of pupils, including research activities.
- To develop and implement problem-based training, to correlate the learning of subject (course, program) with practice, and to discuss the relevant events with pupils.
- To carry out monitoring and evaluating activities in the educational process and to use modern techniques of assessment in terms of information and communication technologies (maintaining electronic forms of documentation including electronic journals and pupils' school record books).

- To use various forms, techniques, methods, and means of education including those intended for individual curricula, accelerated courses within the scope of federal state educational standards of basic general education and secondary general education.
- To know the basics of working with text editors, electronic spreadsheets, e-mail and browsers, and multimedia devices.
- To master the techniques of persuasion and reasoning of a teacher's stance.
- To establish contacts with pupils of different ages and their parents (legal representatives), pedagogical employees, and employees from other fields.
- To master technologies for detecting the causes of conflict, its prevention, and solving.

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Chapter 12
Pedagogical and School Practices to Foster Key Competences and Domain-General Literacy

Maria Dobryakova and Norbert Seel

Abstract In this chapter, we first review the main principles of pedagogical practices which encourage the development of key competences and literacies, and then we discuss more specific methods which support their particular components. The emphasis is on students and their learning (and on students owning their learning), and not on teachers' instructional activity to introduce new content. A supportive learning environment is required involving a positive emotional background and ambitious goals for each student. Best learning outcomes can be achieved, if the task of fostering key competences and literacies is embedded into disciplinary learning. Concept-based learning would be a useful approach to structure and explore disciplinary contents, while inquiry-based learning and project-based learning approaches would help design learning situations. Learning tasks should be meaningful and relevant for the students and allow them to link their learning with real-life experiences. Assessment should support learning efforts of students, serve as a feedback mechanism highlighting students' strengths and weaknesses, their short-term and longer-term personal learning objectives.

Keywords Pedagogical strategies · Shift from teaching to learning · Discovery learning · Inquiry-based learning · Metacognition · Learning to learn · Scaffolding · Fostering key competences · Instructional activities · Fostering literacy skills · Text complexity

Highlights

- The emphasis is on students and their learning (and on students owning their learning), and not on teachers' instructional activity to introduce new content.

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- A supportive learning environment is required involving a positive emotional background and ambitious goals for each student.
- Best learning outcomes can be achieved, if the task of fostering key competences and literacies is embedded into disciplinary learning. Concept-based learning would be a useful approach to structure and explore disciplinary contents, while inquiry-based learning and project-based learning approaches would help design learning situations.
- Learning tasks should be meaningful and relevant for the students and allow them to link their learning with real-life experiences.
- Assessment should support learning efforts of students, serve as a feedback mechanism highlighting students' strengths and weaknesses, their short-term and longer-term personal learning objectives.

In this chapter, we first review the main principles of pedagogical practices which encourage the development of key competences and literacies, and then we discuss more specific methods which support their particular components.

12.1 The Framework: Consequences for Pedagogical Practices and Assessment

The framework we present in this report (see Chap. 3), and this is true of any competence-based framework in education, cannot be implemented in schools if it is not aligned with the (1) curriculum and not supported by (2) teaching + instruction, and (3) assessment. It also implies (4) professional development of teachers, and the design and development of powerful (5) learning environments.

(1) To align the curriculum with the framework of competences, it is necessary:

- to identify *disciplinary outcomes* that learning seeks to achieve;
- to define *how elements of key competences are to be embedded into disciplinary outcomes* and to formulate such integrated outcomes for the whole range of school subjects;
- to identify *instructional methods* that are considered most effective for learning these contents.
- to analyze everyday *life situations* that can be designed in learning environments on the basis of Steps 1–3.

(2) Generally, advanced curricula emphasize instructional methods focused on open tasks that integrate inquiry- and problem-based approaches, higher-order thinking skills, and the ability to cooperate and communicate.

(3) Availability of valid assessment instruments is essential for a systematic development of competences. Psychologists and educational scientists have at their disposal a wide and varied pool of methods to assess knowledge, skills, and attitudes [1]. A competence can be observable through its constituent knowledge,

skills, and attitudes. It is the task-dependent performance of an individual that makes an underlying competence visible [2].

(4) "Learning twenty-first century skills requires 21st teaching" ([3, 4], p. 8). Accordingly, the fourth support system of our framework refers to teachers' professional development [5, 6]. It aims at cultivating teachers' abilities to identify students' particular learning styles, aptitudes, and talents as well as relevant personal and motivational traits, which impact the students' strengths and weaknesses of learning. This corresponds with Hattie's (2009, [7]) approach of *visible learning*.

(5) As an alternative to traditional classroom teaching, the concept of learning environments has become very influential in recent years in educational psychology. This concept originated with Wertheimer's [8] suggestion of designing environments in which information is provided in such a way that learners are enabled to deal effectively with new problems. Learning environments are defined as "comprehensive, integrative systems that promote engagement through student-centered activities, including guided presentations, manipulations, and explorations among interrelated learning themes" [9], p. 51. This might include the use of digital tools (e.g., [10]) but does not necessarily do so. Well-designed learning environments are tricky to develop and sustain (cf. [11]), and the role of teachers is crucial [12].

12.1.1 The Major Shift: From Teaching to Learning

The overarching logic in the evolution of today's school practices has been associated with the shift from the "teaching and instruction paradigm" to the "learning paradigm," with the former being embedded mainly in behaviourist theories and the latter—in constructionist theories. A concise comparison of the two paradigms was suggested in the 1990s ([13], p. 16–17), see Table 12.1. The instruction paradigm in fact impedes the development of key competences, whereas the learning paradigm advances them.

Originally, it was discussed in order to describe a desirable change in undergraduate education. However, we find it fully applicable to schools today, and see it as a very clear framework to reflect on school practices. The highly influential model of educational change developed by Michael Fullan further supports this shift with regard to pedagogical effectiveness (see Fig. 12.1). The same conceptual approach underlines the OECD principles of modern education (see Table 12.2).

Table 12.1 Comparing educational paradigms

The instruction paradigm	The learning paradigm
Mission and purposes	
Transfer knowledge from faculty to students	→ Elicit student discovery and construction of knowledge
Offer courses and programmes	→ Create powerful learning environments
Improve the quality of instruction	→ Improve the quality of learning
Criteria for success	
Inputs, resources	→ Learning and student-success outcomes
Quality of entering students	→ Quality of exiting students
Curriculum development, expansion	→ Learning technologies development, expansion
Quantity and quality of resources	→ Quantity and quality of outcomes
Quality of faculty, instruction	→ Quality of students, learning
Teaching/Learning structures	
Atomistic; parts prior to whole	→ Holistic; whole prior to parts
Time held constant, learning varies	→ Learning held constant, time varies
One teacher, one classroom	→ Whatever learning experience works
Independent disciplines, departments	→ Cross discipline/department collaboration
Covering material	→ Specified learning results
End-of-course assessment	→ Pre/during/post assessment
Learning theory	
Knowledge exists "out there"	→ Knowledge exists in each person's mind and is shaped by individual experience
Knowledge comes in "chunks" and "bits" delivered by instructors	→ Knowledge is constructed, created, and "gotten"
Learning is cumulative and linear	→ Learning is a nesting and interacting of frameworks
Fits the storehouse of knowledge metaphor	→ Fits learning how to ride a bicycle metaphor
Learning is teacher centred and controlled	→ Learning is student centred and controlled
The classroom and learning are competitive and individualistic	→ Learning environments and learning are cooperative, collaborative, and supportive
Talent and ability are rare	→ Talent and ability are abundant
Nature of roles	
Faculty are primarily lecturers	→ Faculty are primarily designers of learning methods and environments
Faculty and students act independently and in isolation	→ Faculty and students work in teams with each other and other staff
Teachers classify and sort students	→ Teachers develop every student's competences and talents

(continued)

Table 12.1 (continued)

The instruction paradigm	The learning paradigm
Staff serve/support faculty and the process of instruction	→ All staff are educators who produce student learning and success
Any expert can teach	→ Empowering learning is challenging and complex
Line governance; independent actors	→ Shared governance; teamwork

Source Abridged from Barr and Tagg [14], pp. 16–17

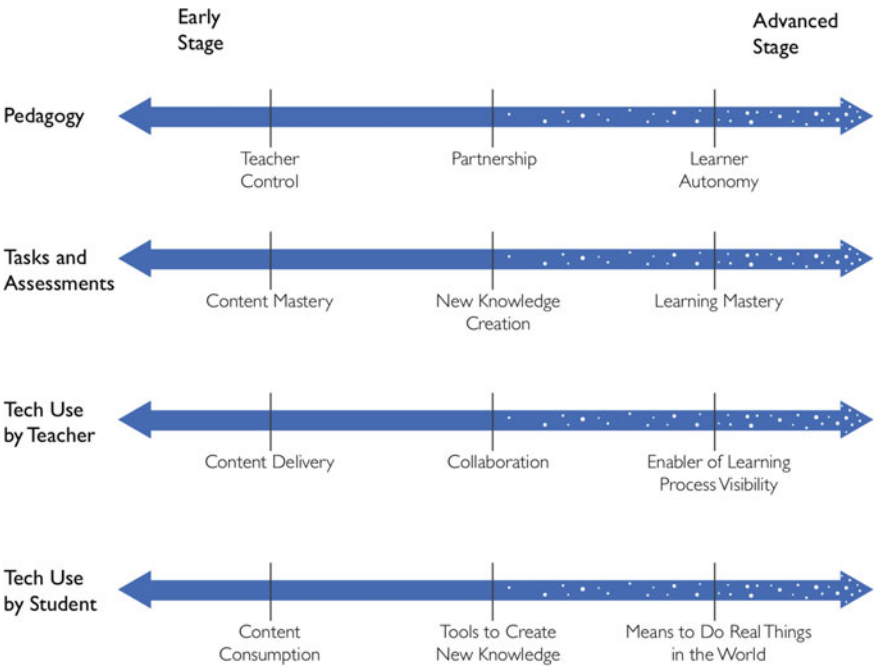

Fig. 12.1 Continuum of new pedagogies effectiveness.
Source Fullan and Langworthy [15], p. 44

12.2 Selection of Pedagogical Strategies: Universal Quality-Teaching Elements for Twenty-First-Century Skills

In the past decades, quite a number of strategies (approaches) have been promoted to support the development of twenty-first-century skills. Supporting the learner-centered paradigm, we have to stress that no teaching strategy is better than others for *all* intents and purposes. For example, inquiry-based learning can be quite challenging for a student [16], especially for low achievers, because of their lack of prior

Table 12.2 Features of learner and teacher practice consistent with the OECD principles

Principles	Learners	Teaching
1. Learner centredness	Active learner engagement skilled at self-regulation	Learning at the centre Educators are knowledgeable and collaborative Clarity of vision quality assurance
2. Social nature of learning	Cooperative learning	Social rich pedagogy Collegial activity Flexible learning settings
3. Responsiveness to motivations and emotions	Positive challenge for every learner, low disengagement bonds of attachment and trust education of the emotions	Understanding emotions Approaches that motivate
4. Sensitivity to individual differences	Individualized approaches, louder learner voice	Rich pedagogical mix Collaborative leadership
5. Graded challenges	Formative assessment, wide and deep learning matrices, inclusive challenge	High expectations Personalized evidence Growth mind-sets
6. Assessment for learning	Shared expectations, deep learning	Clarity of expectations Detailed feedback
7. Horizontal connectedness	Connectedness to the community	Connecting across subjects and topics

Source Paniagua and Istance [12]

knowledge, skills, and self-discipline. Choosing among teaching strategies should be guided by several leading questions [17]:

- How do people come to develop the knowledge, skills, values, and attitudes that should be taught? How can "natural ways" of learning be incorporated into lessons?
- Do the learners have the necessary prior knowledge, skills, and attitudes to use the teaching strategy being considered?
- How much time, space, and other resources are available, and how do they constrain the choice of a teaching strategy?
- How can students be engaged in real-life experiences as they learn?
- What can be done to make learning easy for students?
- What motivational strategies can be used to foster self-confidence in learners?

Although different frameworks emphasize different competences, skills, and attitudes, most of them are quite consistent as far as the teaching and instruction strategies that support students' learning are concerned. It is well established that, to become successful strategic learners, students need:

- step-by-step strategy instruction;
- a variety of instructional approaches and learning materials;

- appropriate support that includes modeling, guided practice, and independent practice;
- opportunities to transfer skills and ideas from one situation to another;
- meaningful connections between skills and ideas, and real-life situations;
- opportunities to be independent and show what they know;
- encouragement to self-monitor and self-correct;
- tools for reflecting on and assessing own learning [18].

Questioning, discovery learning, scaffolding, feedback, metacognition, and small-group work are central elements of quality teaching aiming at enhancing higher-order thinking and communication skills that make up the core of most twenty-first-century skills frameworks. We consider them below in more detail.

Questioning is a universal mode of instruction [19] that is used by teachers as a central part of their teaching for many reasons. Questions stimulate the recall of prior knowledge, develop interest, and motivate students to become actively involved in lessons, promote comprehension, initiate discussion, stimulate students to pursue knowledge on their own, and build critical thinking skills (cf. [20]).

Teachers' classroom questioning as a means of developing students' critical thinking skills and inquiring attitudes has a long and venerable history as an instructional strategy (cf. [21–23]), and often is referred to the *Socratic method* of using questions and answers to challenge assumptions, expose contradictions, and lead to new knowledge and wisdom (cf. [24, 25]). The Socratic method as well as the use of questioning in the realm of reciprocal teaching (e.g., Rosenshine and Meister [26] demonstrate that teachers might ask thought-provoking questions that require higher-order thinking to answer (cf. [3, 27]).

Teachers can continually ask probing questions to motivate students, guide the inquiry process, and stimulate curiosity and thought—but critical thinkers should also be enabled to ask themselves questions: "To become an effective problem solver, students must ask questions to deepen understanding and gain information about the problem" ([28], p. 22). The shift from teachers' classroom questioning to teaching students to ask questions is a key feature of the framework for twenty-first-century learning. By asking questions, students can identify their knowledge gaps and think critically about what they are learning, assess information from peers and other sources of information. Many types of questions qualify as good questions, especially if they lead to hypothetical thinking, reflection, hunches, or inquiries that help students plan investigations (cf. [29]). Learning to generate different types of questions for different purposes helps students learn to ask questions that lead to knowledge and understanding. (See also the section on "Fostering communication skills" below for more techniques of questioning.)

The educational approach of *discovery learning* fosters the development of critical thinking skills and creativity, collaborative and autonomous work, problem solving, etc. It is guided by attempts to invoke students' interests, ideas, and intellectual curiosity, to apply their intuition and imagination to discover solutions to complex problems. Discovery learning as an instructional strategy has a long tradition in education (e.g., Dewey, 1916/[30–32]). Based on Dewey and Piaget, it was primarily

Bruner (in the 1960s) who propelled the educational approach of guided-discovery learning [33]. From Bruner's perspective, discovery was not restricted to "the act of finding out something that before was unknown to mankind, but rather [included] all forms of obtaining knowledge for oneself by the use of one's own mind" ([34], p. 22). He further states that there are "powerful effects that come from permitting the student to put things together for himself, to be his own discoverer" (p. 22).

The teacher's main task consists of guiding and motivating learners to seek solutions to problems by extending what they already know and inventing something new. Teachers should assist the learners in combining prior knowledge with new information, and encourage them to connect their knowledge to the real world. According to Bruner, learning also occurs through failure. Thus, discovery learning does not focus on finding the right end result, but rather the new things to be discovered in the process of problem solving. The teacher's main responsibility is to design instructional conditions and facilitation to guide the learning process: learners can work on their own or with others, and they learn at their own pace.

Papert [35] argued that the role of the teacher is to create the conditions for discovery learning and invention in the classroom rather than provide ready-made knowledge. Accordingly, discovery-oriented instruction provides students with learning environments focusing on a complex problem and opportunities for inventing creative solutions to the problem (see also [36]).

Several instructional strategies make discovery learning more effective (e.g., [37–41]):

(1) The learning activities should be related to a challenge defined in terms of a complex task or problem.
(2) Scaffolding is needed to support the learner in the process of discovery. Scaffolding fades gradually so that the learner may develop a feeling of self-responsibility as problem solver.
(3) The learners are allowed and encouraged to test possible solutions of problems against different views in different contexts.

Scaffolding is a key concept in constructivist approaches to learning. Through scaffolding, teachers guide students in their discovery of new learning by providing support in the form of questions, demonstrations, or through the generation of hypotheses for explanations [42]. Scaffolding involves giving students support at the beginning of a lesson and then gradually turning over responsibility to the students to operate on their own (cf. [43, 44]). Without this limited temporary support, students are unlikely to develop higher-order thinking skills, too much scaffolding, however, can be as detrimental as not enough.

Feedback is the third quality-teaching element [45]. In Hattie's list of visible learning factors [46], feedback belongs to the most influential factors for improving students' learning. In teaching twenty-first-century skills, feedback allows target learning, not grading. The main purpose of feedback "is to reduce discrepancies between current understandings and performance and a goal" ([47], p. 86). Feedback works at four levels: task level (i.e., how well a learning task is understood/performed), process level (i.e., the main process needed to understand/perform

tasks), self-regulation level (i.e., self-monitoring, directing, and regulating of actions), and personal level (i.e., evaluations and affect unrelated to the specifics of the task) (Ibid.).

Metacognitition (learning to learn). A central goal of twenty-first-century teaching consists of enabling students to act and learn autonomously [48], which implies advanced skills in metacognition. Metacognition refers to higher-order thinking which involves active control over the cognitive processes engaged in learning [49]. Metacognition is important both for critical thinking (e.g., [50–52]) and creativity (e.g., [53–55]). Activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress toward the completion of a task are metacognitive in nature (cf. [56]).

Providing students with opportunities to practice self-monitoring and thinking about the thinking strategies they are using in problem solving is an important quality-teaching element which also contributes to the creation of scientific communities inside the classroom because metacognition encourages students to learn about the nature and practices of scientific investigation [57]. Creating scientific communities in classrooms is a highly challenging yet important educational goal and presupposes collaboration and group work (cf. [58]).

Small-group work is a highly valued quality-teaching element for fostering critical thinking, creativity, and metacognition in the classroom [59–61]. Putting students in group learning situations is the best way to foster critical thinking: "In properly structured cooperative learning environments, students perform more of the active, critical thinking with continuous support and feedback from other students and the teacher" ([62], p. 8). Similarly, small-group work is also considered as a quality element for teaching creativity (e.g., [63, 64]). Furthermore, small-group work is a necessary condition for fostering communication and collaboration.

Let us now turn to pedagogical practices addressing specific domain-general competences and literacies.

12.3 Pedagogical Strategies to Foster Specific Kinds of Key Competences and Literacies

12.3.1 Competence of Thinking

Competence of thinking results from deliberate training of higher-order thinking skills (supported by knowledge and attitudes, as described in Chap. 3). Higher-order thinking skills, including critical, logical, reflective, metacognitive, and creative thinking are activated when individuals encounter unfamiliar problems, uncertainties, questions, or dilemmas.[1] Thus, the goal of teaching is to equip students with the ability to identify and solve problems in their academic work and in life. What instructional

[1] See e.g. [65] http://www.cala.fsu.edu/files/higher_order_thinking_skills.pdf.

strategies are available to promote higher-order thinking? Educational research and practice has dealt with this question for quite a while (e.g., [66, 67]) but it is still a challenge to build the competences into K-12 education.

Many educators believe that higher-order thinking skills need to be taught explicitly [68], through *deliberate teaching* [69], which includes:

(1) teaching skills through real-world contexts,
(2) varying the context in which students use a newly taught skill,
(3) emphasizing the building blocks of higher-order thinking (e.g., building background knowledge, classifying things into categories, making hypotheses, drawing inferences, solving problems),
(4) encouraging students to think about the thinking strategies they are using.

There is quite a variety of adjectives describing different aspects of thinking (critical, creative, logical, systemic, reflexive, metacognitive, etc.). However, it is not that an entirely new kind of thinking (autonomous from its other kinds) is implied in each case—rather it is about its focus on specific reasoning procedures and situations. In a simplistic distinction relevant in terms of pedagogical practices, two reasoning procedures can be identified: (a) those that structure a situation, limit a task, and filter the information available; (b) those placing a task into a broader context, making new connections. The first kind of reasoning is usually associated with critical thinking, and the second kind—with creative thinking. Below we offer a selection of pedagogical practices to foster each of those.

Fostering critical thinking

It is widely believed that critical thinking can be infused in lessons throughout all disciplines by utilizing in-depth questioning and evaluation of both data and sources for finding and utilizing credible information (cf. [70]). Indeed, the development of critical thinking skills is not only applicable to core subjects such as reading, mathematics, language arts, science, and social studies, but also to fine arts and music education (e.g., [71]).

Critical thinking includes cognitive processes such as looking at evidence and seeking justification, selecting pertinent information, distinguishing relevant from irrelevant facts, analyzing the credibility of an information source, determining the strength of an argument, identifying relationships and alternatives, discerning examples and counter-examples, recognizing assumptions, biases, and logical fallacies, defending ideas and hypotheses, and drawing appropriate conclusions and inferences [37]. Much has been written about critical thinking and its psychological foundations but much less about teaching critical thinking, probably because it is presumed to be hard to do [72]. The pioneering work by Diana Halpern is of special importance [73–76]: she paid attention to the structural aspects of a learning task or situation, which allowed a transcontextual transfer of critical thinking skills.

Some decades ago, training programs were designed to make students better thinkers (e.g., [77–79])—with lots of time and effort but only modest benefit. However, positive results were produced by the *Higher Order Thinking Skills (HOTS) programme* of Pogrow [80], based on four kinds of thinking skills: (1) metacognition,

or the ability to think about thinking, (2) making inferences, (3) transfer, or generalizing ideas across contexts; and (4) synthesizing information. This programme is a pure thinking skills approach to assist educationally disadvantaged students in grades 4–8. Such a programme is based on the idea that there is a set of critical thinking skills that can be applied and practiced across content domains, and that every student should master such skills.

Despite the reported positive results of Pogrow's programme, the general experience with training programs to enhance critical thinking leads to two conclusions: (a) thinking critically should be taught in the context of subject matter, and (b) critical thinking strategies should be taught explicitly and practiced [72]. Correspondingly, the *Critical Thinking Consortium* (www.tc2.ca) advocates a four-pronged approach to embedding critical thinking into teaching and learning:

- create an atmosphere for thinking by nurturing thoughtful communities that support student thinking,
- create opportunities for thinking by framing critical challenges that invite students to think critically about the subject matter,
- build capacity for thinking by developing the intellectual tools that enable students to competently think through the task at hand, and
- provide guidance about student efforts that includes assessing thinking and performance—what students have achieved and their use of the intellectual tools to support their thinking.

A similar approach is offered in *Philosophy for Children* programmes[2] [81]. In fact, it is thinking skills that they foster.

"If teachers purposely and persistently practice higher order thinking strategies for example, dealing in class with real-world problems, encouraging open-ended class discussions, and fostering inquiry-oriented experiments, there is a good chance for a consequent development of critical thinking capabilities" ([82], p. 353). Using dialogues, questions, and discussion to develop critical thinking skills is what most authors advocate as instructional strategy (e.g., [83–85]).

Box 12.1. Instructional Activities to Prompt and Support Critical Thinking:

- Provide a less-structured learning environment that prompts students to explore what they think is important.
- Provide social-learning environments such as those inherent in peer-group works and small-group activities to allow students to see other points of view.
- Provide emotionally supportive environments in the classroom encouraging re-evaluation of conclusions.

[2] E.g. http://www.philosophy-foundation.org

- Provide enough wait-time for students to reflect when responding to inquiries.
- Provide authentic tasks involving ill-structured data to encourage reflective thinking during learning activities.
- Prompt reviews of the learning situation, what is known, what is not yet known, and what has been learned.
- Prompt students' reflection by asking questions that seek reasons and evidence.
- Provide some explanations to guide students' thought processes during explorations.
- Provide reflective journal to write down students' positions, give reasons to support what they think, show awareness of opposing positions and the weaknesses of their own positions.

Practice manuals to enhance critical thinking skills:

Burkhalter, N. (2016). *Critical thinking now. Practical teaching methods for classrooms around the world*. Lanham, MD: Rowman & Littlefield.

Caroselli, M. (2009). *50 activities for developing critical thinking skills*. Amherst, MA: HRD Press.

Halonen, J.D., & Gray, C. (2015). *The critical thinking companion* (3rd ed.). London: Macmillan.

Rozakis, L. (1998). *81 fresh & fun critical thinking activities*. New York: Scholastic Professional Books.

Worley, P. (2015) *40 Lessons to get children thinking: Philosophical thought adventures across the curriculum*. London: Bloomsbury Education.

Fostering creative thinking

Historically, creativity and creative thinking can be traced back to ancient times [86], but usually Wallas [87] is acknowledged as having designed one of the first psychological models of the creative process. In the 1950s, Guilford [88] pioneered creativity as a scientific approach in psychology and education. Guilford's most important contribution to conceptualizing creativity consists in the distinction between convergent and divergent thinking [89]. Actually, divergent thinking is sometimes used as a synonym for creativity in psychology literature.

When people speak or think of creativity, often they mistakenly think of it as having only to do with artistry. Moreover, this concept entails some myths (cf. [90]): that creative inventions are a burst of spontaneous inspiration from a lone genius, that a person working alone is always more creative than a group; or that social conventions always interfere with invention and innovation. However, all "the myths quickly fall apart when we examine the lived reality of creativity" ([91], p. 259). Psychological research on creative thinking shows that usually there is not a spontaneous insight into a solution of a problem but rather creative invention is "hard work" [91] and mostly results from collaborative work.

Accordingly, the UK *National Advisory Committee on Creative and Cultural Education* (1999) suggests that the first task in teaching creativity is "to encourage young people to believe in their creative potential, to engage their sense of possibility and to give them the confidence to try" (p. 90). Students need to be repeatedly reminded and shown how to be creative, to integrate material across subject areas, to question their own assumptions, and to imagine other viewpoints and possibilities (cf. [39, 92]). This can be supported by creativity training programmes and learning environments.

Creativity training programmes have been developed since the 1960s. They differ with respect to domain specificity, use of substantive models, and theoretical assumptions about the nature of creative thinking [93, 94], but most programmes share the common foundation of divergent thinking [95]. A meta-analysis of 70 studies demonstrated that well-designed creativity training programmes prove to be successful also in enhancing critical thinking [92]. Creativity training appeared beneficial for a variety of people, not just younger or unusually gifted children. "These observations lead to a relatively unambiguous conclusion. Creativity training works" [92], p. 382). It should be emphasized that unassisted discovery does not benefit learners [96], whereas feedback, worked examples, scaffolding, and elicited explanations do (cf. [97]).

Box 12.2. How Creativity Training Works: Results of a Meta-Analysis of 70 Studies [92]

- Among various theoretical models, only the use of a cognitive approach consistently contributed to significant effect sizes.
- Cognitive processes linked to the generation of new ideas (problem finding, conceptual combination, and idea generation) proved to be the most powerful factors on the effectiveness of training (see also [98]).
- In most cases, the success of creativity training could be attributed to *providing guidance* concerning the application of requisite cognitive processes. Specifically, techniques such as critical thinking, convergent thinking, constraint identification, and use of analogies were positively related to the success of training. In contrast, less guidance such as use of open exploratory techniques (e.g., expressive activities, illumination, and imagery) was negatively related to obtained effects.
- Simple demonstration of heuristics or strategies may be sufficient to stimulate divergent thinking, because these strategies and heuristics are readily grasped.

Learning environments play an important role in fostering creativity. Based on 58 studies, Davies et al. [99] summarized several environmental factors which enhance creative skills development in children and adolescents: (1) the flexible use of space and time within a classroom, (2) the availability of appropriate materials

and resources for making artifacts, (3) the flexible use of games providing learner autonomy, and (4) supportive relationships between teachers and students with an emphasis on constructive dialogue and collaborative work with others, (5) teachers' awareness of students' needs and non-prescriptive instructional planning.

We, thus, argue that students' creativity can be extended through *explicit support for enhancing curiosity, exploration, and discovery*. An extensive list of ways to develop creativity in the classroom, with references both to instructional strategies and learning environments is summarized in Sternberg and Willams ([100], p. 20).

It should be stressed that fostering creativity cannot be limited to direct instruction. It needs teaching aimed at mentoring, encouraging, and inspiring students to think creatively. In other words, one cannot expect creative students if those who teach them are not capable of inspiring and encouraging them in this endeavor. Thus, teaching creativity presupposes creative teaching and creative teachers (cf. [101]). Teaching is in itself a creative undertaking that requires teachers' commitment and expertise that, however, can be enhanced by using proved and tested practice manuals or even ready-to-use creativity training programs (cf. [102, 103]).

Practice manuals to enhance creative thinking skills:

Bowkett, S. (2005). *100 ideas for teaching creatively*. London: Continuum.

Caroselli, M. (2009). *50 activities for developing critical thinking skills*. Amherst, MA: HRD Press.

VanGundy, A.B. (2005). *101 ways for teaching creativity and problem solving*. San Francisco, CA: Wiley.

Worley, P. (2015) *40 Lessons to get children thinking: Philosophical thought adventures across the curriculum*. London: Bloomsbury Education.

12.3.2 Interpersonal Competence and Intrapersonal Competence: Fostering Social and Emotional Skills

To communicate effectively, one has to be able to understand other people and to understand oneself, to be able to predict reactions. Analytically, we can distinguish between the competence of interaction with other people (comprising all sorts of communication and cooperation) and the competence of "interaction with self" (self-regulation, self-organization, etc.). This is an important distinction which helps to structure diverse elements from multiple frameworks of competences. However, in the practical dimension, social and especially emotional skills that make the core of these competences are impossible without each other and must develop together: to be empathetic toward a sad person, one has to be familiar with the feeling of sadness; a person first learns to identify one's own emotions and only then to interact with people taking into account their emotions. This logic is reflected below in the section.

First, we explore social and emotional skills (working together, they make the foundation for emotional regulation in the interpersonal and intrapersonal competences). Then we discuss a specific element of intrapersonal competence dealing with learning to learn. In doing so, we describe both independent programmes that address the development of social and emotional skills, and also pedagogical methods integrated into disciplinary learning which are used to foster communication and collaboration skills.

Educational programs to foster social and emotional learning

In terms of educational interventions and curriculum planning, interpersonal competence and intrapersonal competence tend to go hand in hand as mutually reinforcing. The process is generally referred to as *social and emotional learning (SEL)* and aims at developing one's ability to recognize and manage emotions, set and achieve positive goals, appreciate the perspectives of others, establish and maintain positive relationships, make responsible decisions, and handle interpersonal situations constructively ([104]; CASEL[3]).

Several in-depth reviews (e.g., [105–107], Corcoran et al. 2018) and a comprehensive meta-analysis of over 300 studies [108] show that training programmes designed to enhance social and emotional learning may significantly improve students' interpersonal and intrapersonal competences as well as their academic performance. Such programs aim at assisting students in the development of skills that help them better manage their emotions and interactions with other people in educational settings to maximize their learning experiences. Intervention programs can be incorporated easily into routine classroom practices and do not require additional staff for effective delivery. Generally, it appears that classroom-based SEL programs are successful across all educational levels and grades.

Short-term objectives of SEL programs include fostering students' self-awareness, self-management, social awareness, and responsible decision-making skills, as well as improving their attitudes and beliefs about self, others, and school (CASEL; [108]). From an intervention standpoint, attempts to foster discrete emotional skills without fostering skills of social interactions would be short-sighted. In SEL programmes, emotional abilities typically are related to social functioning in order to support coordinated social, emotional, and academic learning in the classroom (cf. [109]).

SEL programs vary in their pedagogical approaches, with some focusing on *individual-level skill development* and others emphasizing *contextual changes* designed to improve interpersonal dynamics and climate at the classroom or school level (e.g., [110]). Two strategies can be distinguished to enhance school performance and youth development by addressing the cognitive, emotional, and social dimensions of learning.

- The first strategy is aimed at *educational intervention* or prevention and involves carefully designed instruction in processing, integrating, and applying social and emotional skills in the realm of particular training programs. Through

[3] https://casel.org/what-is-sel/

explicit instruction and *deliberate practice*, social and emotional skills are taught, modeled, practiced, and applied to diverse situations so that students become enabled to use them eventually as part of their daily repertoire of behaviors [106, 111].

- The second strategy involves the design of comprehensive learning environments, which provide a supportive school and classroom *climate* for learning and teaching as well as a broad range of opportunities for acquiring and applying social and emotional skills in the daily routines in and out of school. This holistic approach presupposes improved classroom management and teaching practices as well as whole-school community-building activities (cf. [110, 112–114].

At the same time, after-school SEL programs turn out to be very successful. A meta-analysis of 69 after-school programmes revealed important results [115, 116]: young people who participate in after-school programmes improve significantly in three major areas—feelings and attitudes, behavioral adjustment, and school performance. After-school programmes succeeded in improving feelings of self-confidence and self-esteem, school bonding (positive attitudes toward school), positive social behaviors, and achievement test scores. They also reduced problem behaviors (e.g., aggression, noncompliance, and conduct problems). Thus, after-school SEL programmes produced multiple benefits that pertain to adolescents' personal, social and academic life. Especially, programmes that used evidence-based skill training approaches were consistently successful in producing multiple benefits for participants.[4] Linking school and afterschool through SEL has become top of the educational agenda (cf. [121]).

Learning environments to support fostering social and emotional skills

Educational programmes to support SEL enable students of different ages to manage their emotions and social interactions in the realm of educational settings [122], but it is no less important that SEL programmes also help teachers to develop their own social and emotional skills and to incorporate SEL techniques in a school-wide approach. Thus, the effectiveness of classroom-based SEL programmes depends, to a large extent, on improved strategies of instruction and classroom management aiming at learning environments that provide a supportive and engaging climate for students and teachers.

In our framework, learning environments are conceived as *communities of social practice* that provide opportunities for shared social and emotional learning. A community of social practice is different from both a team and a social network because it is defined by knowledge, skills, and attitudes. A community of social practice produces shared practice as members engage in collective processes of social and emotional learning because participation has value to the members. A community of practice defines itself along three dimensions: (a) the joint enterprise as comprehended and continuously negotiated by its members (the "what about"), (b) the relationships of mutual engagement and participation ("how it functions"), and (c) the shared repertoire of resources and capacities that member develops over

[4] For more detail see, among others: [117–120].

time ("what is produced") [123]. With communities of social practice, the "what is produced" refers to shared social knowledge, attitudes, and skills. It can be argued that communities of social practice correspond with Vygotsky's (1978) idea of the *zone of proximal development* defined as an area of learning in which a learner is assisted by a teacher or peer with a skill set higher than that of the learner.

Communities of social practice support informal and incidental SEL, and thus are a necessary but not sufficient condition for enhancing SEL in the classroom. It is most efficient when combined with deliberate training in intentional SEL programmes.

Molding an SEL programme

From a psychological perspective, enhancement of social and emotional skills is one of the most extensively investigated areas of educational intervention and prevention. Therefore, it makes sense to rely on the large-scale experience, namely: (1) to adopt and adapt the concept of CASEL as the leading paradigm for organizing a comprehensive program of SEL in and out of school, and (2) to adopt and adapt successful SEL programmes, such as the *Prepare Curriculum* or the *Supporting Positive Behaviour*. The *Prepare Curriculum* [124] includes skill-streaming for adolescents and covers 50 social and emotional skills focusing on the reduction of aggression, stress, and prejudice. *Supporting Positive Behaviour* [125] aims at teaching 59 specific skills for five major skill groups: skills for classroom learning, skills for making friends, skills for dealing with feelings, alternatives to aggression, and skills for dealing with stress. A very useful review of SEL programmes is offered by a Harvard team [126], this is a "live" document, and the authors continue to update it (http://easel.gse.harvard.edu). In Russia, development of SEL programs is supported by the Sberbank charitable foundation as part of the Personal Development Programme.

There are over a hundred of important social and emotional skills for students to learn, but they can be grouped into skill areas to make it easier to identify and determine appropriate interventions. Our operational framework focus on four groups of emotional skills [127] and five groups of social skills [128]:

Emotional skills:

- identifying emotions,
- using emotions to facilitate thinking,
- understanding emotions,
- managing emotions.

Social skills:

- the ability to express oneself in social interactions,
- the ability to "read" and understand different social situations,
- knowledge of social roles, norms, and scripts,
- interpersonal problem-solving skills,
- social role-playing skills.

Such grouping is supported by the availability of reliable and valid instruments (like, correspondingly, the MSCEIT[5] or the SSI[6]), to measure these emotional and social skills across childhood and adolescence.

Instructional practices to foster social and emotional skills

We consider that SEL programmes are a starting point of competence development to be combined with mastery learning in order to achieve a level of "skilled performance" (see Chap. 3), which constitutes the fundamental basis of a substantial transfer of social and emotional skills into various situations of everyday life. Specific instructional practices can be applied to support skilled performance of social and emotional skills. Normally, they would focus on two explicit areas: communication and collaboration to solve problems, both domain-general and domain-specific.

A. **Fostering communication skills**

In the classroom, communication is mainly oral and organized as discussion, conversation, and questioning between students or between students and teachers. These forms aim both at communication skills as such, but also make the reflection and thinking process more explicit.

Discussion is generally valued as a powerful tool in helping students to exchange ideas, understand new concepts, and reach a decision in ambiguous situations. Discussions in the classroom may differ in the level of their inclusiveness and structuredness. For example, we can distinguish between *brainstorming* as a process for generating creative ideas and solutions through intensive and freewheeling group discussion [130], *tutorial discussion* with students work in groups on problems that are designed to build a conceptual understanding of a topic (cf. [131]), *task-directed discussion* aimed at eliciting dialogues that may be useful for vicarious learning (cf. [132]), and *inquiry-centered discussion* as an engaging and insightful conversation.

D**iscussion often** is used as a synonym of **conversation**, and the distinction between discussion from debate and dialogue is also quite fuzzy. See Box 12.3 for a clarification of these theoretical terms.

Box 12.3. Discussion, Conversation, Debate, and Dialogue: A Differentiation in the Classroom

Discussion is generally defined as the action or process of talking about something in order to reach a decision or to exchange ideas or opinions. In a *discussion* people are involved in an exchange of knowledge or information and respond to each other from different positions with the focus on a particular topic that is at the center of the communication.

In a **conversation,** participants exchange knowledge, sentiments, observations, opinions, or ideas from different positions but there is no particular topic

[5] Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT).

[6] The Social Skills Inventory (SSI), also known as the Self-Description Inventory, was developed by R. E. Riggio and assesses 6 basic social skills that underlie social competence [129].

on which the exchange is concentrated. While discussion is focused on a particular topic, conversation is permitted to move into all possible directions. For instance, a conversation can be a talk between two or more people in which thoughts, feelings, and ideas are expressed, questions are asked and answered, or news is exchanged.

In a **debate,** the participants pursue the intention to express a particular position and articulate it in its difference from over even in contrast to position of other participants. Debaters are not primarily motivated to learn from each other but to defend and articulate their own positions.

Participants involved in a **dialogue** are explicitly concerned about learning from each other and revising and developing their original positions. *Dialogue* differs from discussion, conversation, and debate in some features: There is an exchange between different positions in such a way that the original positions of the participants are changed and developed on the basis of the preceding phases of the interchange. Thus, dialogue has innovative potential. More than discussion, conversation, and debate, dialogue creates a common space and leads to shared experiences and insights. Thus, dialogue is a kind of *reflective discourse* [133]. The *Socratic dialogue* is generally considered as the best example of reflective discourse.

Source: Chesters [134].

These forms of classroom communication share one salient property: students have to play an important role in constructing new knowledge and in acquiring new understandings about the world. The teacher thus plays the role of facilitator rather than of "transmitter" of contents. Accordingly, rather than providing step-by-step instruction designed to produce right answers or correct performance, teachers encourage students to display their ideas and thinking processes and guide them to increasingly sophisticated levels of comprehension. Five practices to promote classroom discussion have been distinguished [135], see also [136]:

(1) *anticipating* the students' likely answers to cognitively demanding learning tasks,
(2) *monitoring* the students' responses to the tasks during the exploratory phase,
(3) *selecting* some students to present their responses during the discussion phase,
(4) *intentionally sequencing* the students' responses, and
(5) *helping* the class to make connections between the students' different responses.

Effective discussion in the classroom goes beyond question-and-answer recitations and aims at providing opportunities for *reflective communication*, including discussion, conversation, and dialogue. The major goal of reflective communication is to challenge students' critical thinking and to extend personal responses by considering the views of others, and to share personal thoughts, feelings, and experiences. Usually, the teacher initiates the discussion by asking a question that requires the students to reflect upon and interpret learning experiences. In addition to this

instructive communication, reflective communication also occurs when students try to explain or refute conjectures offered by their peers [137]. Probably the best example of reflective communication is the *Socratic dialogue* with its particular "rules of the game" [24].

In reflective classroom communication, the teacher focuses and moderates the discussion, but the setting is underpinned by broad and active student participation. In an atmosphere of open and reflective communication, students should feel free to express their ideas and ask questions for themselves. However, most frequently it is the teacher who initiates and organizes reflective communication by asking questions which help students to make sense of their activities, to speculate, argue about and resolve problems, and to link ideas and applications. This instructional approach is referred to as *accountable talk* [138] and aims at fostering the meaningful conversation, respectful debate, and academic discourse needed to build the collective knowledge of its participants.

Competent and well-planned *questioning* is critical for classroom communication, and each discussion, conversation, and dialogue should include a mixture of factual and thought-provoking questions in order to enhance critical and reflective thinking (cf. [76, 139]), However, conventional classroom teaching often is characterized by a plethora of teacher questions which are not systematically planned and executed. A wide range of studies has documented the fact that the typical pattern of classroom discourse is one-sided, following a pattern of teacher question, student response, and teacher evaluation of the response [76, 140]. Certainly, teacher questions which require recall of information are necessary to support academic learning but also questions are needed that require students to think independently and critically. Carefully planned and executed questioning provides the path to critical and productive thinking (cf. [141–145])—because "a mind with no questions is a mind that is not intellectually alive" ([146], p. 3).

Questions come in many different forms and can be asked at varied cognitive levels (cf. [147]), However, the issue of effective classroom communication raises one simple question: What strategies of questioning stimulate higher-order thinking? Besides questioning according to the Socratic dialogue rules (e.g., [142, 148–150]), *divergent, evaluative,* and *reflective questions* are usually credited for their capacity to "develop higher-order thinking—to elicit motives, make inferences, speculate on causes, consider impact, and contemplate outcomes" ([130], p. 221).

A classification of questions by their fundamental essence is presented in Table 12.3.[7]

Teachers can develop questioning skills and strategies through a combination of knowledge and deliberate practice but pre-service and in-service teachers' questioning skills can also be trained effectively (e.g., [152–154]), in particular through microteaching (e.g., [155–157]). As mentioned above, a key feature of the twenty-first-century classroom consists of a shift from teachers' classroom questioning to

[7] See also taxonomies of questions in classroom teaching, which refer to Bloom's taxonomy of educational objectives and classify questions according to their cognitive level or complexity: [69], [151].

Table 12.3 Taxonomy of questions in classroom teaching

Question Type	Description
Convergent	Closed, not offering many options; converges on a single or narrow list of "best" answers; encourages focused, succinct response
Divergent	Open, having many responses; permits the exploration of diverse perspectives; encourages dialogue
Focal	Student must choose or justify a position
Brainstorm	Questions that generate a list of ideas or viewpoints
"Shotgun"	Questions containing several content areas with no particular link
"Funnel"	Multiple questions starting broadly and gradually leading to more focused inquiry

Source Tofade et al. [20], p. 2

teaching students to ask questions (e.g., [158, 159]) aiming at a "classroom culture that supports the common core" [160], including teaching students the techniques of questioning and conversation to improve cognitive and social learning.

Practice manuals to foster communication:

Garber, P.R. (2008). *50 communications activities, icebreakers, and exercises.* Amherst, MA: HRD Press.

Kerwood, R. (2005). *Essential questions and questioning strategies.* Columbia, MO: eMINTS National Center.

Koechlin, C., & Zwaan, S. (2006). *Q tasks. How to empower students to ask questions and care about answers.* Markham, Ontario: Pembroke Publ.

Fostering collaboration

A key feature of the current discussion about twenty-first-century skills teaching is the universal emphasis on learning and problem solving in *small groups*. Different terms are used to denote small-group activities. Some authors (e.g., [62, 161]) use the term *cooperation*, others (e.g., [61, 162, 163]) prefer the term *collaboration*, and yet others speak about *teamwork* (e.g., [164]). Collaborative/cooperative learning is a process by which students interact in dyads or small groups with intent to solicit and respect the abilities and contributions of individual members. Collaborative/cooperative learning changes the dynamics of the classroom by requiring discussion among learners. Five essential features characterize effective cooperation and collaboration: positive interdependence, individual and group accountability, beneficial interactions, appropriate use of social and emotional skills, and group dynamics [165].

Formal learning groups, informal learning groups, and study teams are the most common formats for collaborative/cooperative learning (cf. [166–168]).

- Formal learning groups consist of students learning and working together, from one class period to several weeks, to achieve shared learning goals and

complete jointly specific tasks and assignments. There is sustained collaboration to accomplish the academic assignment.
- Informal learning groups are temporary groupings of students who work together to achieve a joint learning goal in spontaneously formed ad-hoc groups that last from a few minutes to a class period.

The ultimate goal of forming learning groups is to create a *community of learners* who share values and beliefs and who actively engage in learning from one another. A community of learners creates an environment in which students and teachers are actively and intentionally constructing knowledge together and solving problems. Learning communities are connected, cooperative, and supportive. Participants are interdependent in that they have joint responsibility for learning and share resources and points of view, while sustaining a mutually respectful and cohesive climate of learning [11, 169]. Communities of learners as well as collaborative learning in general have been related to discovery learning, critical thinking, and creativity (e.g., [61, 170–172]).

Research across several decades demonstrates that group work can be an effective method to motivate students, encourage active learning, and develop skills of critical thinking, communication, and decision making. When students learn in these kinds of supportive, relational groups, they not only learn better, but they also develop sociability and social skills that strengthen their interpersonal relationships. But without careful planning and facilitation, group work can frustrate the participants who then develop an averseness to collaboration and cooperation. This phenomenon is called "group-hate." Group-hate has been referred to as the dread and repulsion that many people feel about working in groups or teams [173, 174]. However, these feelings diminish among group members who have received proper instruction about working in groups.

One way to overcome group-hate is to form realistic expectations of group work and talk to students about their past experiences with group work (cf. [175]). Placing students in the same room, assembling them together, and assuring them they are a group, does not mean they will cooperate or collaborate effectively. Group work must be carefully planned and organized.

Based on research and practice of collaborative group work, the Centre for Teaching Excellence of the University of Waterloo provides useful suggestions to implement group work successfully in the classroom.

Designing Group Activities and Communities of Learners

I. *Preparing for group work*

- Think carefully about how students will be physically arranged in groups.
- Insist on professional, civil conduct between and among students.
- Talk to students about their past experiences with group work (this will help to overcome "group-hate."

II. *Designing the group activity*

- Identify the instructional objectives. For group learning to be effective, students need a clear sense that group work is "serving the stated learning goals and disciplinary thinking goals" of the course ([176], p. 280).
- Make the task challenging but not too difficult.
- Assign group tasks that encourage involvement, interdependence, and a fair division of work. Specifically, allocate essential resources so that group members are required to share information (e.g., the jigsaw method) …or assign different roles to group members.
- Decide on group size.
- Decide how you will divide students into groups. To vary group composition and increase diversity within groups, randomly assign students to groups.
- Allow sufficient time for group work.
- Try to predict students' responses.
- Design collaborative work in multiple forms: pairs, small groups, large groups, online synchronously, online asynchronously, etc.

III. *Introducing the group activity*

- Share your rationale for using group work. Students must understand the benefits of collaborative learning.
- Have students form groups before you give them instructions.
- Facilitate some form of group cohesion.
- Explain the task clearly.
- Set ground rules for group interaction.
- Encourage students ask questions.

IV. *Monitoring the group task*

- Monitor the groups but do not hover.
- Expect a lot of your students.
- Be slow to share what you know.
- Clarify your role as facilitator.

V. *Ending the group task*

- Provide closure to the group activities.
- Model how you want students to participate.
- Connect the ideas raised to course content and objectives.
- Don't provide too much closure.
- Ask students to reflect on the group work process.

Source: https://uwaterloo.ca/centre-for-teaching-excellence/teaching-resources/teaching-tips/

Following these suggestions increases the chances that collaborative learning will facilitate thinking and makes it explicit in a non-stressful environment, while also enhancing the skills of working together in a productive and respectful way.

Practice manuals to foster collaboration:

Kane, K.O., & Harms, J. (eds). *Getting started: A guide to collaboration in the classroom.* http://www.cte.hawaii.edu/publications/Collab_web.pdf

Race, P. (2000). *500 tips on Group Learning.* London: Kogan Page.

Stewart, G. (2014). *Promoting and managing effective collaborative group work*. Belfast: Education and Library Board.

Hughes, M., & Ph.D. Shapiro (2004) *101 Ways to teach social and emotional skills*. London: Bureau for At-Risk Youth.

12.3.3 Intrapersonal Competence: Fostering Learning to Learn and Thinking About Thinking

The idea of *learning how to learn* is quite old and can be traced back to the Socratic method. Since the 1970s, this idea has been incorporated under the term *metacognition* [177–179] and is commonly referred to as "thinking about one's thinking" as well as self-regulated learning [180]. For more than 40 years, the term metacognition has dominated educational research. However, as a result of the discussion about twenty-first-century skills, *learning to learn* has become a fashionable term, which attracts educational policy makers more than the term metacognition.

Metacognition Versus Learning to Learn: A Clarification

Metacognition is generally defined as thinking about one's thinking, and refers to processes of planning, monitoring, and assessing one's understanding and performance. Thus, metacognition includes a critical awareness of one's thinking and learning. It involves recognizing the limit of one's knowledge or

ability and then figuring out how to expand that knowledge or extend the ability. Learning and "transfer can be improved by helping students become more aware of themselves as learners who actively monitor their learning strategies and resources and assess their readiness for particular tests and performances" ([14], p. 67).

Learning to learn has been defined as a developmental process in which people's conceptions of learning evolve and become consciously available to one's systematic analysis and review (e.g., [181]). In general, it involves the acquisition of attitudes, knowledge, and skills that allow people to become more effective, flexible, and self-organized learners in a great variety of contexts. Likewise, in a Finnish research project *learning to learn* has been defined as "the ability and willingness to adapt to novel tasks, activating one's commitment to thinking and the perspective of hope by means of maintaining one's cognitive and affective self-regulation in and of learning action" ([182], p. 39).

Most definitions of *learning to learn* that can be found in the literature (e.g., [183–185]) share an emphasis on metacognitive processes and self-regulation. For Bransford et al. [14], the pursuit of a metacognitive approach in teaching can make students take the control of their learning. Teaching students how to learn is as important as teaching them the content of a subject-matter domain.

> ...much attention is now focused on the critical role of metacognitive competence, the capacity to understand and control one's own thinking and learning processes. This competence makes people aware of how and why they acquire, process and memorise different types of knowledge. In this way, they are in a position to choose the learning method and environment that suits them best and to continue to adapt them as necessary ([186], p. 16).

The good news is that *metacognition and learning to learn can be taught* [187–189]: teaching students metacognitive skills and learning to learn will lead them to pursue their own learning throughout their education and their life [184]. Students *and* teachers need to engage in active practice of metacognition and self-regulation of learning.

Learning to learn cannot be taught in a separate course but has to be embedded in regular courses. In comparison with learning to learn which is a relatively new concept, metacognition has been an area of interest to educational researchers for more than 40 years. From this research, several features of effective learning environments for teaching metacognitive skills can be deduced (cf. [190]):

- an *engaging curriculum* [191],
- *assessment integration* by preferably using divergent questioning [192],
- *consistent practice* of metacognitive skills, such as making predictions, visualizing, and summarizing [193],
- *explicit strategy instruction*, including direct instruction (e.g., providing explanations), as well as strategy modeling and practice combined with verbalizations.

On the whole, educational research across 40 years clearly shows that aligned teaching can develop students' metacognitive capacity by encouraging them to explicitly examine how they think. For example, teachers can reinforce students' metacognition by modeling it on a regular basis as they address an example problem and then asking students to reflect on the teachers' model. According to Ellis et al., this kind of *modeling* is the most widely used approach to metacognitive training. However, it is also important for students to develop positive mental models—combined with collaborative articulation—about how they learn, the limits of their learning, and indications of failure [4, 194]. In addition to modeling, *diagrams* and concept maps have been frequently used to foster the metacognitive skills of planning, monitoring, and evaluating. Further strategies to enhance metacognition are reported, including mnemonics, use of checklist, goal attainment, and learning diaries (e.g., [195]). Quite recently, *wrappers* are recommended as quick and easy tools for monitoring and evaluating metacognitive activities. A wrapper is a scaffold designed to help students enhance their thinking skills over a lesson or their test-taking skills (e.g., [196–198]).

Example of a Metacognitive Wrapper

Metacognitive Reflection

Respond to the following prompts as you complete your research project.

1. *Planning*
    a. What do you know about this topic now?
    b. What do you want/need to know about this topic?
    c. What resources are you considering exploring?
    d. How did you decide where and how to begin?
    e. Where did you start? What did you do first? Why?
2. *Acting*
    a. How did you proceed? Describe your steps.
    b. What resources seem worthwile? Why? How did you evaluate them?
    c. List the resources you explored; mark those that were most useful with an asterisk (*).
    d. How did you decide which ones to mark?
    e. How did you know how you were going? What did you ask yourself?
    f. What problems did you run into? How did you change or adjust your process in response?
    g. How did you know when you reached your goal?
3. *Evaluating*
    a. What worked to produce a high-quality product?
    b. Describe any new strategies you used.

c. What could you do differently if you were starting over?
d. How well did you do in relation to the requirements of the assignment?

What other thoughts do you have about your research or your metacognition?

Source: adapted from [196], p. 88.

A wrapper is an activity that surrounds a pre-existing learning or assessment task and fosters students' metacognition. Wrappers work because metacognition practice is integrated with the task: students are self-monitoring in the context where it is needed, feedback on accuracy can be built in, and support can be gradually faded.

Comprehension shouldn't be silent [199], and thus, verbalization, and in particular, *Think Aloud* is a frequently used method for fostering metacognitive skills. *Think Aloud* means verbalizing the steps or procedures of a strategy as it is being deployed. It also involves posing questions, identifying resources, and reciting affirmations well [199]. The various strategies for fostering metacognition and learning to learn accord with (a) encouraging students to examine their thinking when accomplishing a learning task or problem, (b) giving them practice in identifying confusions, (c) pushing them to recognize conceptual change, and (d) providing a forum in which students monitor their own thinking [200].

Metacognitive skills are a prerequisite for self-regulation of learning, which can be paraphrased as self-created thoughts, feelings, and actions in the pursuance of learning tasks. Students who regulate their learning effectively can process learning tasks on their own initiative and with creativity, persistence, and a sense of responsibility. However, this requires high motivation to learn. Thus, models of self-regulated learning include motivational variables (e.g., goals, self-belief, and intrinsic interests) as central elements [201]. To develop positive attitudes toward learning to learn students must accommodate self-motivation for learning, willingness for personal development and changes, self-awareness and self-confidence, willingness to motivate and support others [202]. Equipped with motivation to learn, positive attitudes and metacognitive skills students may develop the potential to become *expert learners* who are characterized by their methodical approach, control, and reflection in mastering tasks, are conscious of the knowledge and skills they (do and do not) possess, and use appropriate strategies to apply or acquire them. Expert learners are capable of monitoring their own learning progress in order to make a quick decision on what to do in case a problem may arise. An expert learner is strategic, self-regulated, and reflective [203]. However, it takes time and deliberate practice to become an expert learner [204].

Practice manuals to enhance learning to learn and metacognition:

Frender, G. (2014). *Learning to learn* (rev. ed.). Chicago, Il: World Book.
James, M. et al. (2006). *Learning how to learn. Tools for schools*. London: Taylor & Francis.

These manuals provide metacognitive activities to guide students in (a) identifying what they already know, (b) articulating what they have learned, (c) communicating their knowledge, skills, and abilities, (d) setting goals and monitoring their progress, (e) evaluating and revising their work, (f) identifying and implementing effective learning strategies, and (g) transferring learning from one context to another. Basically, two types of metacognition are trained: *reflection* (i.e., thinking about thinking) and *self-regulation* (i.e., learning to learn).

12.3.4 Fostering Domain-General Information Literacy

According to our framework (see Chap. 3), literacy is the ability to use information represented by signs and symbols (sign systems), including the ability to use relevant technological tools. Such literacy is instrumental (it depends on the formats and tools for communication used in a certain society) and domain-general (not limited to any particular sphere of life). Today it means that the 3Rs (Reading, wRiting, and aRithmetic) acquire a new digital dimension. The digital dimension reveals new aspects of the familiar skills and allows for their new combinations. The main feature of the new combinations of information is "multimodality" [205–207].

In the digital world, information is often presented in multiple formats: text (also nonlinear, with hyperlinks), images, diagrams, infographics (also animated), video (combined with text). Therefore, to be literate in the modern world, one has to be learn how to use these formats and their combinations—for various tasks and audiences, as both a producer and consumer of information.

It is helpful to identify two ways of representation of information (logic of representation): the logic of time and the logic of space [208]. In the logic of time, events unfold one after another and thus are presented to the reader/spectator; in the logic of space, lots of things happen simultaneously, the reader/spectator is able to see all the elements and their connections at once. To master both logics of representation—in other words, to make meaning across multiple modes [209] is a major task in developing modern literacy [210].

This said, first of all one has to learn how to use information as expressed in words and data. We shall not discuss the task of developing reading skills—an abundant literature is available on this subject. However, we should highlight one aspect which is very important for designing a system of assessment of key competences: levels of text complexity—whether and to what extent a text is demanding for the reader [211].

Scholars usually identify quantitative and qualitative measures of text complexity. The *quantitative complexity* of a text measures its objective characteristics: the length of the text, its average sentence length, its word length and frequency, which are easily evaluated by computer software. However, without evaluating the text's qualitative complexity for a reader, the evaluation would be incomplete and may be even distorted.

The *qualitative complexity* has several dimensions: the structure of the text, the clarity of narration, demands to the cultural background of the reader, etc. The US Common Core State Standards[8] summarize them in a very clear way; moreover, these levels of complexity are applicable to the whole range of disciplines, not only language and literature (see the box). This approach takes into account the nature of interaction between the text, the reader, and the learning situations [212]. It should be stressed that complexity increases along about the same continuum as in the case of thinking and reasoning skills: "explicit – implicit," "known – unknown," "linear – nonlinear" (cf.: explicit and implicit information, needed and redundant information for a problem to be solved, etc.)

Qualitative measures of text complexity for English Language Arts and Literacy in History/Social Sciences, Science, and Technical Subjects
Levels of Meaning (literary texts) or Purpose (informational texts)

- Single level of meaning → Multiple levels of meaning
- Explicitly stated purpose → Implicit purpose, may be hidden or obscure

Structure

- Simple → Complex
- Explicit → Implicit
- Conventional → Unconventional (chiefly literary texts)
- Events related in chronological order → Events related out of chronological order (chiefly literary texts)
- Traits of a common genre or subgenre → Traits specific to a particular discipline (chiefly in information texts)
- Simple graphics → Sophisticated graphics
- Graphics unnecessary or supplementary to understanding the text → Graphics essential to understanding and may provide information not otherwise conveyed in the text

Language Conventionality and Clarity.

- Literal → Figurative or ironic
- Clear → Ambiguous or purposefully misleading
- Contemporary, familiar → Archaic or otherwise unfamiliar
- Conversational → General academic and domain-specific

Knowledge Demands:

(a) ***Life Experiences (literary texts)***

- Simple theme → Complex or sophisticated themes
- Single themes → Multiple themes

[8] http://www.corestandards.org/assets/appendix_a.pdf.

- Common, everyday experiences or clearly fantastical situations → Experiences distinctly different from one's own
- Single perspective → Multiple perspectives
- Perspective(s) like one's own → Perspective(s) unlike or in opposition to one's own

(b) ***Cultural/Literary Knowledge (chiefly literary texts)***

- Everyday knowledge and familiarity with genre conventions required → Cultural and literary knowledge useful
- Low intertextuality (few if any references/allusions to other texts) → High intertextuality (many references/allusions to other texts)

(c) ***Content/Discipline Knowledge (chiefly informational texts)***

- Everyday knowledge and familiarity with genre conventions required → Extensive, perhaps specialized discipline-specific content knowledge required
- Low intertextuality (few if any references to/citations to other texts) → High intertextuality (many references to/citations to other texts)

Source Common Core State Standards for English Language, Arts & Literacy in History / Social Studies, Science, and Technical Subjects. Appendix A, p. 6. http://www.corestandards.org/assets/Appendix_A.pdf

Learning situations and texts aimed at fostering students' literacy skills should be designed keeping in mind such a scale of the levels of complexity. It does not mean that, in primary school, only texts from the "simple pole" would be appropriate. This is not so: all the levels of complexity are applicable for all ages, but a qualitatively complex text should be relevant to the age and experience of a particular student. Therefore, primary school texts should not be limited to linear unambiguous plots. Nonlinear narration, irony, and other elements of qualitatively complex texts are possible both for primary and secondary school children.

Such a scale of the levels of complexity is applicable not only to traditional texts but virtually to any fragments of information, including multimodal ones. To develop modern literacy, all the learning environment should be multimodal and offer opportunities for multimodal communication (both as a producer and consumer of information) [213]. Pedagogical strategies here would be similar to those used to develop key competences:

– direct instruction as to how to create a text in various semiotic formats;
– learning situations which require to create multimodal texts;
– students' co-working and co-creating such texts;
– inclusion of multimodal literacy skills in assessment practices [214]

A Summary

In conclusion, let us highlight what kind of tasks and learning situations would be especially advantageous for development of key competences and literacy:

- tasks that present a "challenge" (demanding though not discouraging: in the zone of proximate development);
- open tasks that have more than one solution or no unambiguous solution;
- tasks that are connected to real life and are meaningful for the student stimulating their curiosity;
- tasks that demand a combination of diverse informational modes (multimodality) and diverse modes of communication and collaboration in different roles.

Such learning situations can and should be designed within the main disciplinary learning, making its integral part.

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Chapter 13
A Modern Aspect of Instrumental Literacy: Coding

Suhas Parandekar, Eugeny Patarakin, and Gulcan Yayla

Abstract This chapter discusses a new dimension of domain-general literacy pertaining to working with information—coding. The authors make it clear why everyone today needs to have some level of coding skill, and how the latter can be developed. Coding is a dimension of instrumental literacy (mediated by specific tools): It is about one's ability to use sign systems and communication tools in "human–to–machine" interaction. Such interaction is not limited to any specific area of life but instead it is applicable everywhere, being thus ubiquitous. It is important to highlight the connection between coding and computational thinking—just like traditional 3Rs literacy (reading, writing, arithmetic), it is inextricably linked with thinking skills.

Keywords New literacies · Domain-general literacy · Coding · Computational thinking · Motivation for learning · Coding in national school curricula · Coding in extra-curricular activities · Teacher training for coding education

13.1 Why Coding Became a Part of New Literacy

13.1.1 Turning into Literacy

Educators and opinion makers have defined several reasons to teach coding to children. One of the main reasons is to improve computational thinking skills, which are essential for any individual to solve problems in daily and professional life [23].

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Apart from improving computational thinking skills, coding can be a perfect tool for creative thinking [4] and teaching children "how to learn" [2, 14, 29].

Understanding the history of literacy can help us figure out how other kinds of skill sets, such as computer programming, can function in society and whether they can be considered as new literacies now or in the future. Text literacy emerged from central government initiatives that expanded to other large institutions and businesses and finally prevailed in the everyday life of citizens. Two historical phases are usually singled out [31]:

- *Phase 1. Texts becoming a part of the infrastructure*

Texts became central to people's lives because they aided developing institutions (government bureaucracy, written contract law, and the enterprise of publishing) to scale up and accommodate population and information growth. The first large-scale adoption of text at the government level started in eleventh-century England, due to the information need of Norman invaders. Based on the order of King William I, a detailed census, known as the Domesday Book, was produced. The Domesday Book is the earliest public record and the foundation document of the national archives. After the Census initiative of the central government, local provinces started to adopt writing in thirteenth-century England. The text was used as a means to create laws and policies. Especially land laws started to take the form of written texts instead of personal witnesses, requiring individuals to sign their names.

- *Phase 2. Text becoming an inseparable part of everyday life*

Starting from the nineteenth century, mass literacy campaigns helped writing and reading become a common skill in society. People needed to have literacy skills to be able to benefit from the information presented in newspapers that cataloged both local and global events and almanacs that provided advice to farmers. Accounts that kept track of debts. Institutions such as the postal service, written tax bills, public signage, and mass education were built on the assumption that a majority of citizens could read and write. As a result, as more people learned how to read and write, more people were expected to be literate. This expectancy is so valid today that managing our daily lives became inseparable from text literacy.

The historical dynamics behind the adaptation of computers in daily life is quite similar to the history of text literacy. Parallel to the historic description of text literacy, we now have computational literacy in two phases:

- *Phase 1. Computers becoming a part of the infrastructure*

The first phase of the history of computational literacy resembles that of text literacy: The first widespread use of computers may have begun with government efforts to capture census data. Afterward, as texts were adopted from the central government to the local province level, computers were adopted from the central government to large-scale industries and institutions in the US and other countries. Universities,

airlines, and the banking industry started using computers starting from the 1950s and continued through the 1970s.

It was around the 1980s that computers became affordable enough for ordinary people to become familiar with them. Knowledge about computers started to spread into ordinary people's lives. From healthcare systems to managing data at the governmental level to managing education systems, computers became part of the infrastructure, though the writing of instructions for computers mostly remained in the hands of specialists. People became "users" of computers. The "scribes" of historic times who wrote letters for the illiterate masses became the "developers" of computer programs or "coders."

- *Phase 2. Computers becoming an inseparable part of everyday life*

In the past few decades, the ability to write code has started to become a necessary skill not only for computer science, but also for other fields. Today, every profession benefits from the capabilities of coding, and computational literacy is becoming a required expectation from almost every professional from scientists to journalists. Computer enthusiasts introduced the concept of "literacy" to emphasize the importance and power of writing for and with computers. As a result, coding knowledge has been spreading into all fields rather than becoming a specialization of a group of computer scientists. As understanding and writing code becomes more and more expected from individuals, considering programming not as a specialized skill but as a "literacy" is a natural outcome. If coding is indeed a literacy, then the corollary is that we may need to start from an early age.

13.1.2 Definitions of Coding and Computational Thinking

Computational thinking can be defined as a set of skills that help set up a problem in such a way that a computer can help us solve it [1]. It is derived from computer science but applicable in any domain [32]. Computational thinking has four main pillars as summarized in Fig. 13.1.

Coding, computer programming, and programming are terms that can be used interchangeably (Fig. 13.2).

Coding is a tool to improve CT; while CT involves a wider range of abilities such as problem analysis and algorithmic thinking. In this respect, coding is a constituent of CT, making CT concepts concrete and can thus become a tool for learning. CT actually entails much more than coding. For example, the processes of problem analysis and problem decomposition precede coding. Coding is only one of many ways to learn CT; however, it can be considered as the most powerful one [5, 14]. (Editors' note: Coding with its formal representation of problems as symbols and commands means an ability to use a special sign system to manage modern communication tools and informational problem-solving and, thus, is essentially an instrumental tool-mediated literacy for computational thinking.)

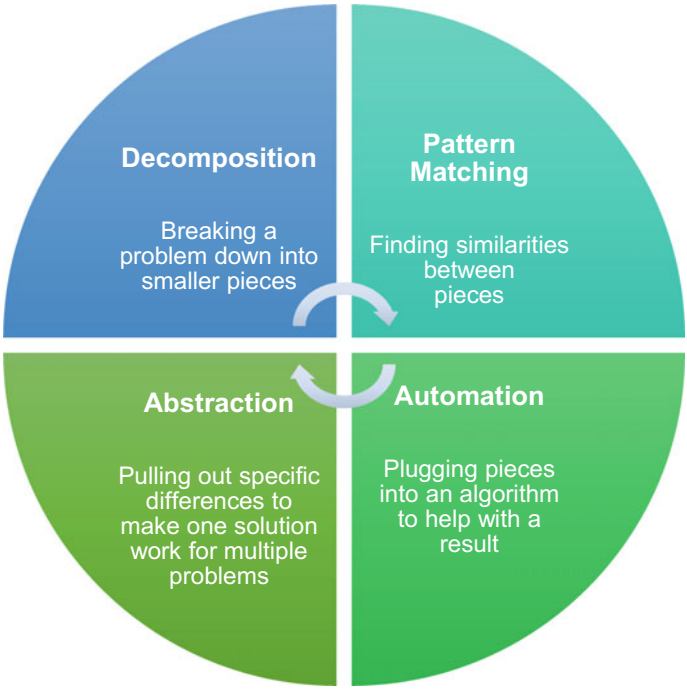

Fig. 13.1 Four main pillars of computational thinking [15]

13.1.3 Why Should Children Learn to Code?

If we want to understand the connection between coding and learning, we need to start with the work of Seymour Papert, today known as the "patron saint of the maker movement" [20]. Papert viewed children as active constructors rather than passive recipients of knowledge. Building on the constructivist theories of Jean Piaget, Papert held that children construct knowledge most effectively when they are actively constructing things—which led to the idea of *constructionism* [18].

> Constructionism shares constructivism's connotation of learning as "building knowledge structures" irrespective of the circumstances of the learning. It then adds that this happens especially felicitously in a context where the learner is consciously engaged in constructing a public entity, whether it's a sandcastle or a theory of the universe...
>
> Seymour Papert [18].

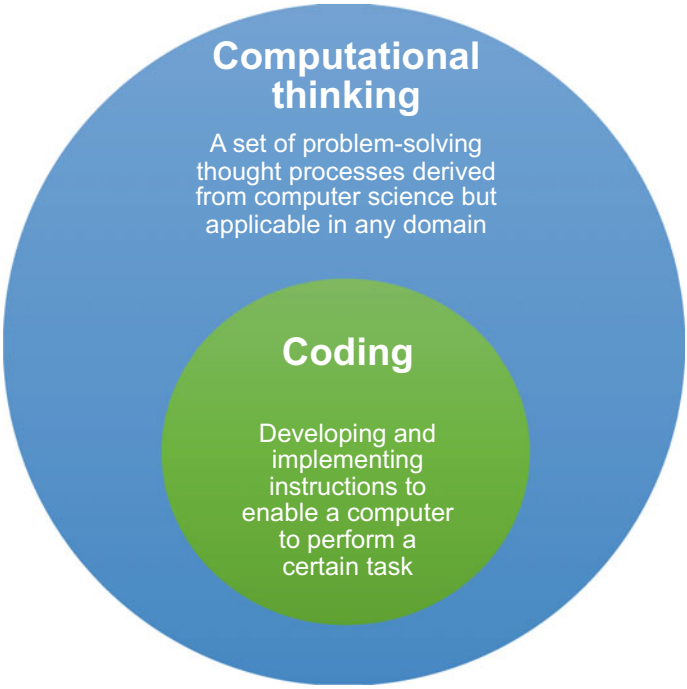

Fig. 13.2 Relationship between coding and computational thinking

Constructionism brings together two types of construction: Children constructing things in the world and constructing new ideas in their heads. These two types of construction create a never-ending virtuous cycle of learning, because as the child has new ideas, s/he constructs new things in the world. Coding for children brings these ideas to life. It started with the Logo programming language co-designed in 1967 by Papert, which is the first computer programming language for children, where children used coding primarily to control the motions of a robotic "turtle."

Since Logo, many new programming environments have been designed to help children construct things in the real world and in their minds. Today, one of the most well-known coding environments is Scratch. Expression and excitement of a 12-year-old user of Scratch exemplifies what Seymour meant by constructionism:

> With Scratch, I am always coming up with my own ideas for project–and working on problems that I am interested in. It's exciting to find solutions to problems, but it's even more exciting to find solutions to problems that I've come up with myself. That's a lot more motivational ([20], p. 58).

Computational thinking is an example of a Papert invented phrase—"powerful idea"—because it helps children to learn many skills: problem-solving skills, creative thinking, learning to learn, and teamwork.

Coding supports problem-solving skills

Coding and computational thinking help children in two main respects: understanding our increasingly networked in twenty-first century and at the same time benefiting from being able to use the four main components of CT when tackling complex tasks [9]. In this respect, the goal of teaching coding to children should not be to train future programmers, but rather to develop computational thinkers who can confidently cope with increasing complexity and with open-ended problems in the twenty-first century and transfer computational perspectives across all contexts and disciplines. When a child internalizes the decomposition of a large problem into smaller parts, recognition of patterns between different pieces, identification and elimination of unimportant details, and plugging pieces into an algorithm to reach a result, then this child can deal with a variety of problems in all disciplines [4].

Coding encourages creative thinking

Mitchel Resnick, co-creator of Scratch at MIT Media Lab, argues that creativity can indeed be nurtured, encouraged, and supported [20]. Young users spend a significant amount of time consuming information on the Internet, interacting with computers, and playing games. For the majority of children, there is only a limited amount of time allocated to creating their own artifacts, games, or art. Proliferating programming tools for children, such as Scratch, Alice, or Kodu have started to change this state of affairs in one country after another. Using these tools, children create a diverse selection of games, animations, stories, and art. These are effective ways to nurture and cultivate the creativity of children by providing stimulation and inspiration for children to express their ideas and personalities.

Coding develops learning to learn skills

In learning to write code, children can learn to adjust their own thinking when programs do not run as expected. Learning to program, learning to understand new ideas, and learning to learn are all connected. Compared to other learning activities, coding is a more forgiving process, which makes children comfortable with making mistakes and learning from them. When coding, a child can easily undo what s/he did and recover from mistakes, make adjustments, and try something new. The mistakes in coding are generally called "bugs" rather than "failures." An important process in coding is to learn "debugging," that is identifying a problem and trying several methods to solve it. Seymour Papert and Sherry Turkle defined this notion as learners constructing their own learning by arranging and rearranging a set of materials rather than simply receiving content provided by a teacher [29].

The following reflection from a mother illustrates how children can become comfortable with making mistakes in coding:

> It has afforded her a bravery to try new things. Even if the first result is failure, that failure is only a clue to an alternate path that should be taken instead of an end to the quest, and there are multiple paths that could lead to the same destination, not always a 'right' and 'wrong' way" ([20], p. 148).

Although improving the computational thinking skills of children is a key contribution of coding, narrowing down the potential of coding only to improving problem-solving skills would not provide a full picture to us. On the contrary, coding is a unique tool that allows students to unleash their creative potential, to express themselves, and to participate in a community that they can both contribute into and learn from. In this respect, coding addresses a pain point of the traditional education system: How to tap a child's own motivation for learning.

Computational participation

If programming is promoted solely to improve cognitive skills that are used to solve problems, we would fail to realize what it can afford us in a networked age. Learning to code ultimately manifests its worth when it allows a child to express herself or himself through an artifact that can be shared with others and increases a child's capacity to participate in today's digital publics. This thinking leads to a new term, which is computational participation.

> Computational participation is solving problems with others, designing intuitive systems for and with others, and learning about the cultural and social nature of human behavior through the concepts, practices, and perspectives of computer science [14].

Having kids work in groups and use their peers' codes to remix is just the beginning to encourage computational participation. By making programming a community effort, educators can turn schools into collaborative environments. According to these authors, when children code games, stories, or art, these should not be considered only as objects-to-think-with, but as objects-to-share-with that connect children with each other.

Coding to tap motivation for learning

In a traditional classroom environment, teachers assign the problems and students need to solve them. There is not much time and resources allocated for the self-expression of children. While this might work well for children who are intrinsically motivated, it does not work for all children. Computational participation offers a solution to the lack of opportunities for self-expression in the classroom through two mechanisms:

– **Personalization**

Coding can allow children to personalize the projects by adding "putting themselves into the project." For instance, it is possible in Scratch to add personal photos and even voice records into the projects. In this way, Scratch can provide a personalized

experience and allow children to actively participate in the development process, which makes learning more exciting and motivating for children.

– **Building on intrinsic motivation and interests**

Coding in itself is well-suited to allow children to draw upon their intrinsic motivation to learn rather than providing them extrinsic rewards. This is the approach adopted by Scratch: It encourages children to make interactive stories and animations that they find interesting and satisfying. Instead of providing explicit rewards, points, and badges, Scratch selects certain projects to feature on the home page, which makes children very excited when their projects are chosen. But the goal of featuring is not to reward particular community members but to motivate other users for possible project ideas. In a specific user's profile, there is no mention about the number of times the user's projects are mentioned. Instead, it shows the projects that the child worked on.

13.2 Pathways of Provision

Many countries around the world started to take steps toward integrating coding education into school curriculum starting from early grades. In this part, we presented the trends in countries from Israel to Europe to Australia and USA. This includes the level of integration in the curriculum and strategies to meet the needs of coding education, including different types of investments in teacher training and education materials.

13.2.1 Countries that Have Integrated Coding into the School Curriculum

Considering the increasing need for computational thinking skills in the economy and social life and the alarming shortage of talent in the information and communications technology sector, policymakers in many countries are developing national coding education efforts in various ways. Many countries are in the process of integrating coding into the curriculum, mostly on the secondary level of education. However, increasingly, coding and computational thinking have been introduced to the primary education curriculum (Fig. 13.3).

Israel: Israel was an early adopter of computer science education in its curriculum [27]. The intention of the Computer Science course at the high school level is not to train students to become programmers but rather to introduce learners to logical and algorithmic thinking and to expose them to different development environments

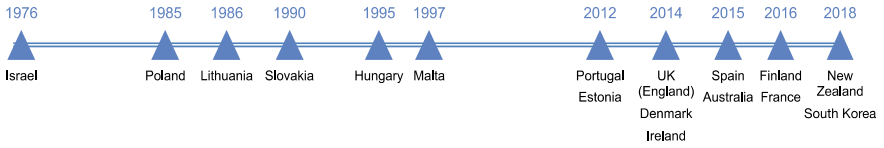

Fig. 13.3 Timeline of integration of coding into the school curriculum in different countries

at an early stage. Israel offers a range of mandatory and elective modules, allowing students to acquire the foundations of computer science while providing more time and content for those who have a higher interest in computer science [5].

In Europe, as part of the *New Skills Agenda*, in 2016 the European Commission invited EU member states to "invest more in digital skills formation, including coding / computer science, across the whole spectrum of education and training." As of 2016, 16 European countries have integrated coding into their curricula at national, regional, or local levels. Eight of these European countries already integrated or developed plans to integrate coding into the curriculum at the primary school level, and 12 European countries already integrated or developed plans to integrate coding into the curriculum at the secondary school level (country descriptions below are based on [5]) (Fig. 13.4).

Poland: Poland has a long history of integrating coding into the curriculum, starting from 1985. A stand-alone "Informatics" subject has been taught in classes

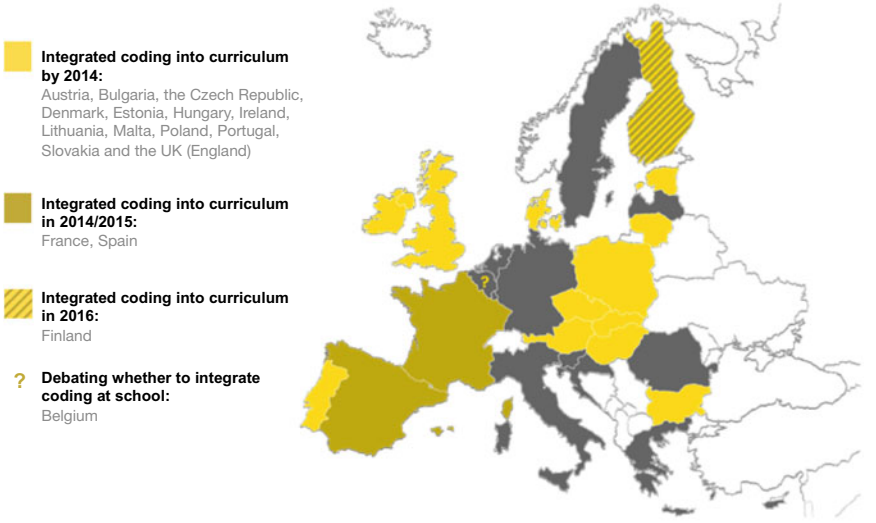

Fig. 13.4 16 European countries that integrated coding into the curriculum by 2016 *Source* https://www.euractiv.com/section/digital/infographic/infographic-coding-at-school-how-do-eu-countries-compare/

starting from grade 1, and recently Poland has developed a new curriculum with the aim to help students apply computational thinking skills in other school subjects.

Lithuania: Lithuania's Information Technology (IT) subject not only introduces students to digital competencies, but also to ethics and legal principles of coding. The subject is included at both lower and upper secondary school levels, and the upper secondary school also includes an advanced IT course.

Slovakia: Slovakia is one of the early adaptors in Europe: Coding curriculum is mandatory from primary school to upper secondary school in the country.

Hungary: Hungary has a long history of introducing coding in the high school curriculum; however, in recent years, it has been working on strategies to integrate coding into all school levels starting from primary school.

Malta: Malta integrated coding into the upper secondary school curriculum; however, the Department of eLearning and the Department Curriculum's strategy explicitly supports the introduction of computational thinking skills from Kindergarten to grade 11.

Portugal: Computational thinking is among the learning outcomes for students in grades 7 and 8. In 2015–2016, the Ministry of Education launched a pilot project for primary schools, entitled "Introduction to Programming," involving 27,000 students in grades 3 and 4 and about 670 teachers. The pilot focused on two main themes: Computational Thinking and Programming languages. The initiative has been extended to the 2016–2017 school year expecting to involve about 56,000 students and about 1,600 teachers.

Estonia: Estonia is one of the world leaders in technology, with high-tech industries accounting for 15% of the GDP in the country [26]. However, Estonia is short of programmers for this thriving industry, its schools have started teaching coding to pupils as young as six since 2012. Estonia is one of the two countries in Europe that integrated coding into the education system at all levels—from primary to upper secondary school [30].

United Kingdom: In response to a documented decline in interest and participation in computing activities by young children, a major reform was instituted in 2012, with a new curriculum that emphasized computer science and pupil-friendly programming environments such as Scratch and Lego Mindstorms. Computing became mandatory for English schools for children aged 5 to 16. A scientific review of the reform carried out in 2017 found that some of the targets of the reform had been met, but inadequate teacher preparation remained a hurdle [22].

Denmark: The Denmark curriculum is tailored for the need of technology companies in the country. It puts more emphasis on topics such as the design of user interfaces, which interests its big firms, and the impact of digital technology on society [27].

Finland: Finland is one of the first countries to integrate coding in a cross-curricular approach, which requires that all subjects strengthen the ICT competence of students starting from grade 1. In addition, coding is integrated into two subjects; Math classes starting from grade 1 and Craft classes starting from grade 3 [5].

New Zealand: In New Zealand, the Education Minister of New Zealand announced that digital technologies will be fully integrated into the curriculum from

Grades 1 to 13 in 2018 [5]. The goal of the Ministry of Education is to make all students "digitally capable"—able to use and create digital technologies to solve problems and take advantage of opportunities—by Grade 10. By Grade 13, the students will be guided toward specialization, and the government has announced its intention to provide resources dedicated for the training of teachers toward a digitally oriented education system [11, 12].

Australia: In Australia, a new curriculum named "Digital Technologies" was launched in 2015, making coding education compulsory from the first year in school to grade 10. In this new curriculum, there is a strong focus on the creative use of technology through its three learning components: Digital Systems, Data and Information, and Creating Digital Solutions [3].

South Korea: South Korea has made Software Education course mandatory at both primary and secondary levels starting from 2018. The objective is for primary school children to develop computational thinking abilities, using a visual programming language such as Scratch. The curriculum stresses real-world problem-solving abilities: "Students should apply computational thinking skills in authentic problem situations while collaborating with their peers" [3].

USA: USA does not have a nationwide curriculum integrating coding; different states have adapted coding at different levels. Several organizations have been supported by the government to support coding education in classrooms. One of the most prominent of these organizations is Code.org, highly supported by the tech industry in the USA [19]. The goal of Code.org is to make every public school in the USA teach computer science. The advocacy efforts of Code.org and Microsoft have helped to persuade many States to allow computer science to count toward math or science credits required for high school graduation [25]. Some states, including Arkansas, Virginia, and Indiana, integrate computational thinking and digital literacy into the primary school curriculum.

13.2.2 Countries that Are Planning to Introduce Coding into the School Curriculum

Although some countries have not yet implemented programs to integrate coding into the curriculum, these countries are currently undertaking studies to introduce coding into the school curriculum.

China: Coding education has not been yet integrated into the curriculum for pre-university education. The interesting story from China is the CS0 "College Computers" course that is required for all university students, regardless of major. The mandatory course is taken by about six million students each year since it was introduced in 1997. In recent years, the emphasis of this course is shifting toward computational thinking. The mandatory nature of CS0 makes for some unexpected positive outcomes, for instance, the preparation of a course on computational thinking for deaf students [25].

Germany: Integration of coding into curricula varies across the sixteen States that constitute the Federal Republic. In five States, Computer Science (CS) is mandatory for all students in High School; five other States do not offer CS courses at all. In the State of Schleswig–Holstein, schools may themselves decide whether to offer CS as mandatory or elective. The State of Baden-Württemberg introduced a new State curriculum where CS is part of an interdisciplinary approach, with coding activities included under the objective of media literacy [8].

Netherlands: In the Netherlands, computer science subject is an elective course in secondary education and the national institute for curriculum development is working on developing a curriculum.

Norway: In Norway, a special expert group has submitted a report to the Norwegian Directorate in September 2016 recommending the integration of technology and programming into compulsory subjects. Accordingly, Norway has started to pilot the introduction to programming in 143 lower secondary schools; however, there is not yet a finalized plan about compulsory coding education.

In ***Greece***, a 2016 report prepared by the Committee of Continuous Educational Affairs of the Greek Parliament suggests including computational thinking in the curriculum as a short-term priority.

In ***Sweden***, the Swedish National Agency for Education has been working on how to strengthen the digital competence and programming skills of children within national curricula.

In ***Japan***, the Education, Culture, Sports, Science, and Technology Ministry announced that computer programming will be a compulsory subject in primary schools in 2020, followed by lower secondary schools in 2021 and higher secondary schools by 2022.

13.3 Teacher Training for Coding Education

In order to implement a new curriculum in which coding is an integral part, supporting teachers in terms of skills and knowledge regarding coding education is critical. However, the lack of teachers who can teach coding is a serious problem facing many countries today. The problem is connected to the job preferences of mathematics and computer science graduates, who generally prefer more lucrative professions than teaching. On the other hand, humanities and social science graduates that represent the majority of teachers need considerable training to deliver coding education to children.

13.3.1 In-Service or Pre-Service Training

According to European Schoolnet, Twelve European countries (Austria, Bulgaria, France, Estonia, Hungary, Ireland, Malta, Poland, Portugal, Slovakia, Spain, and UK)

where coding is integrated into curriculum provide in-service or pre-service training to teachers to support them in teaching coding at the classroom. The main provider of these trainings are universities rather than Ministries of Education; however, for-profit-companies and non-profit organizations are also often involved in these trainings [1].

13.3.2 Bottom-Up Initiatives

In some countries, teachers are trained by bottom-up initiatives as they need training. For instance, in Denmark, the Ministry of Education does not provide coding training for teachers. Instead, a movement of teachers, entrepreneurs, and programmers called "Coding Pirates" provides training to teachers. Another example is Code.org's teacher training workshops in the US. It has trained 30,000 teachers in the USA from 2014 to 2017 through professional workshops and conferences.

13.3.3 Online Resources

Online resources are useful for teachers in a wide range of subjects, but online resources are especially important for the teaching and learning of coding. These online resources may take the form of online portals (e.g., Estonia) and specific coding websites and community platforms (e.g., Bulgaria, France, Finland) [1]. Some governments have introduced other innovative methods to support teachers. For instance, "tutor-teacher system" of Finland provides a tutor-teacher for each school who is responsible for supporting other teachers in the implementation of the new coding curriculum. When a MOOC was introduced to teach the teachers to use Scratch and other tools, the teachers themselves produced the course material including videos. The teachers learnt how to use Eliademy, a learning management system based on the open-source Moodle platform, and used other platforms such as Google forms for feedback and Padlet for sharing course materials [28].

13.3.4 Lesson Plans and Activities

Lesson Plans and Activities in template-form help educators to use specific coding/computational thinking tools when teaching children in the classroom. Some platforms have resources that are divided on the basis of experience level and needs of teachers. For instance, *ScratchED*, the educator platform of *Scratch*, categorizes a vast variety of educator resources based on grade level, content type, curricular area, and language. Some platforms offer a very practical teacher "kit" that involves

step-by-step guides for teachers to use in each class. For instance, *Stencyl*[1] provides a free educator's kit that contains two weeks of lessons, student activities, a final project, and a setup guide [16].

13.3.5 Certification Programs for Educators

Although not common, some platforms that can be used for advanced programming provide courses and then a certification program for teachers. For instance, *Stencyl* provides three different kinds of certification exams for educators and schools who want to develop structured game design and programming classes. The four available certifications are Stencyl Game Design Specialist, Stencyl Game Programming Specialist, Stencyl Game Design Expert, and finally Stencyl Game Programming Expert. Another example is the "Blue Ribbon Educator" program of *Tynker*. The program selects a certain number of educators each year to provide exclusive training to help them become coding experts and then awards a Professional Development Certificate to the selected teachers.[2]

13.3.6 Support for Parents

Along with teacher support, a recent trend is to involve parents as well. For instance, *Tynker* provides a "Parent Dashboard," where parents can view their children's progress, the projects they have created, and the concepts they have learned. *Tynker's* Parent Dashboard even allows parents to share their children's projects with friends and family.

13.4 Learning Coding as an Extra-Curricular Activity

"In general, formal settings can provide structure for systematic thinking and approaches, while informal settings can help children build up motivation and identify their interests. An ideal setting should have both of those" (Resnick in [5], p 45). For the past hundred years, the school has been assumed to be the primary site of learning. However, the proliferation of new technologies in twenty-first century is disrupting the boundaries between formal and non-formal education. Computational culture moves beyond needing to "funnel all educational programs through the teacher" to "providing the learner with new links to the world." Learning, no matter

[1] Http://community.stencyl.com.

[2] Http://www.tynker.com/school/training.

where it happens, should situate the learner at the center of the process, reinforcing the agency of the learners [9].

The structure of the classrooms versus the agency of learners causes a tension between schools and non-formal learning in twent-first century [6]. *Structure* in this context means rules, roles, and resources, both explicit and assumed, in learning environments. *Agency* of the child refers to the child's ability to define and pursue learning goals, which enables him / her to play a part in their self-development, adaptation, and self-renewal with the changing times.

It is already known that imposing too much structure can constrain learner agency; however, we should also remember that a lack of structure does not equal agency. At this point, we should begin to think about agency and structure not as separate, but as mutually reinforcing concepts. According to Brennan, in this way, we can find out ways that in-school and non-formal activities can support each other. For instance, in Finland, non-formal teaching and learning of CT and coding often take place on school premises outside school hours. Non-formal coding clubs are understood as a way of complementing formal education and aim to be compatible with the national curriculum.

In order to measure the difference between structured teaching and high-agency extra-curricular environments, [14] constructed two learning environments for writing digital stories in Scratch for ten consecutive weeks with the same instructor. The two environments and results are summarized in Table 13.1.

Although these results are not conclusive, they suggest that afterschool club engaged children more than the structured classroom. Although the percentage of students who completed a project was less in the club, the students completed many

Table 13.1 Two learning environments

	A structured classroom	An afterschool club
Characteristics of the environments	– A standard academic curriculum – The students were expected to submit a storyboard on Scratch – The projects were graded – Attendance was mandatory	– A standard academic curriculum – The students were expected to submit a storyboard on Scratch – The projects were graded – Attendance was mandatory
Results	– 90% of students completed a story – Average length of stories was 2–3 min – Stories were based on real-life experiences or icons from movies, books, etc – 10% of projects were remixed – Students twice accused their classmates of cheating by remixing others' work	– 71% of students completed a digital story – Students completed twice as many projects as those in the class – Storied included more types of coding concepts: Included interactive art pieces and video games – 26% of projects were remixed

Source [14]

more projects than their classroom peers, used more creative coding skills, and collaborated twice more with their peers. Yet, a higher completion rate in the classroom indicates that integrating coding into the classroom would increase the number of students who at least start engaging in coding.

In order to find the middle ground between class and club, Mitchel Resnick [20] suggests that good teachers should move fluidly among the following four roles to find the balance between structure and agency:

- *Catalyst*. Teachers should provide the sparks that accelerate the learning process. The best way is generally to ask the right questions that catalyze exploration and reflection: "How did you come up with that idea? What would happen if you changed this code?"
- *Consultant*. Teachers should be a "guide on the side," not a "sage on the stage." The role is not to deliver instruction but to figure out the best way to support students.
- *Connector*. Teachers should connect children with each other to work with, learn with, and learn from. The goal should be to create a community of shared learning, where a child works with another child on a challenge.
- *Collaborator*. Teachers should not only provide support but also should invite youth to join their own projects. For instance, by inviting their students to join in a project they are working on.

13.4.1 Learners Improving Themselves by "Making"

The unique characteristic of most extra-curricular activities is that they generally bring learners together in order to "make" their own projects, either physical or digital. The maker movement around the world has been gaining momentum recently because constructing *things* provides learners motivation to learn, and the opportunity to use their knowledge to create something while realizing what else they need to learn [21].

It is also possible to build schools around the maker philosophy. For instance, *Brightworks*, a school for 5- to 15-year-old children in San Francisco founded in 2011, aims to use a project-based maker approach to educate children. Students learn through projects, such as building a *Kid City* at the school, calculating the size of the area they want to allocate to each student, and deciding on how much space they want to have for their community gatherings.

There are also many volunteer-based, grassroots activities taking place around the world. Some of the most prevalent ones of these activities are CoderDojo, Code Club, and the Clubhouse Network.

CoderDojo [13]. A free afterschool club, led by volunteers, for children aged 7–17. Active in 65 countries. There are more than 1,100 active volunteers reaching 45,000 kids.

Code Club. A worldwide network of free, volunteer-led coding clubs for children aged 9–13. Active in 140 countries. Over 10,000 Code Clubs have reached 150,000 children around the world.

Club House Network. An international community of free out-of-school learning environments for underserved youth. 100 Clubhouses located in 19 countries. 100 Clubhouses works with 25,000 youth per year. The Clubhouse Network aims to make a shift from "think-it-yourself" to "make-it-together."

13.4.2 Coding Events

Coding events provide materials for participants to carry out guided coding activities within their communities. A teacher, parent, or a child can organize a coding event easily by organizing children in the community and downloading guidelines from the event's website. Three of the most prevalent and successful international coding events are organized by Code.org's Hour of Code, Codeweek EU, and Bebras Challenge.

Hour of Code refers to a one-hour coding challenge tutorial designed for all ages in over 45 languages. Hour of Code activities are held in 180 countries. 263 million people have tried the Hour of Code worldwide.

CodeWeek is a two-week coding event for children organized by volunteers around the world. Launched by EU Commissioner Neelie Kroes in 2013, CodeWeek is active in 50 countries. In 2016, nearly a million people took part in EU Code Week.

Bebras challenge is held every year around 38 countries usually in November. Participants are 8 to 19 years old, and each participant has 45 min to solve 18 tasks that focus on solving problems from a broad range of informatics topics, without requiring any programming skills. Activities can be held at schools with supervision from teachers and winners are rewarded with certificates and honors.

Scratch Day is a global network of events that celebrate Scratch. Scratch Day is a special day where Scratchers gather at different events around the world to celebrate Scratch's release and accomplishments. Most Scratch Days are celebrated in May, but events are held year-round.

13.4.3 Technoparks

Technoparks are educational sites for school children, equipped with high-tech equipment with an aim to motivate the next generation of highly skilled ICT and engineering sector employees. For instance, a network of children's technopark model, "Quantorium" in the Russian Federation is scaling up. Currently, there are 24 of these technoparks in 19 regions of the country. One of the activities of the technopark in

Moscow includes providing a 94-hour course over 9 months about Aircraft Construction and helping students design aircraft products using a specialized engineering software—Autodesk Inventor.

13.5 Creative Computing in the Russian Federation

In Russia, KuMir, PictoMir, Robotland systems, and many other learning environments with visual performers were developed in the 1980s and 90s. The Logo international community gained informational support through printed periodicals (LogoExchange, LogoUpdate) and remote face-to-face conferences (EuroLogo, Constructionism). A network of Russian teachers using the Logo language and its variants such as LogoWriter, Splash LogoWriter, LogoExpress, and MSWindows Logo began to form in the early 90s and was associated with summer computer schools and the information-and-educational network established in 1992 by the Institute of Program Systems of the Russian Academy of Sciences.

The project was aimed at studying educational opportunities of telecommunications in the Logo environment and building a telecommunication association of Russian Logo users. In July 1993, project participants from different Russian cities (Moscow, St. Petersburg, Cherepovets, Yaroslavl, Nizhny Novgorod, Saransk, Omsk, and Norilsk) took part in a two-week workshop of the International Computer School in Pereslavl-Zalessky. The School had telecommunication access to the Internet and could distribute its materials via the TV-INFORM educational network.

13.5.1 Scratch in the Russian Federation

As the international Scratch community developed, the Scratch environment and contents of the website hosting Scratch projects were translated into Russian in 2006. In addition, this environment was enriched with objects familiar to Russian schoolchildren, which help them to create games and stories with characters representing Russia's nature, history, and literature. It means they can not only see and read, but also play with objects and use them for their own project. And here children can crack digital collections of Russian universities, which is extremely useful. For example, collections of Novgorod Pedagogical University's Astronomy Museum were used to create sprites and scenes (Fig. 13.5).

A lot of plants and animals found their way into Russian Scratch libraries from identification guides and digital Red Books created by environmental experts from Nizhny Novgorod. Once embedded into open Scratch galleries, collection objects can be used by students and schoolchildren to create new presentations, multimedia stories, and games (Fig. 13.6).

Scratch teaches users how to build a project using bricks and to share results with others. These skills are essential not only in special programming environments,

Fig. 13.5 Sprites from the Novgorod Pedagogical Uni Museum's collection

but also in modern online communities. The network of Scratch programmers, or scratchers, was featured in Russia by a close wiki-Scratch connection. Letopisi.org, the Russian wiki-project with the international participation, has supported Russian scratchers from the very beginning. The Letopisi.org wiki-environment was adjusted so that members could store there their projects and specific sprites. Images of plants and animals were included in wiki-articles and at the same time were used as part of Scratch project sprites.

13.5.2 Intel Corporation and Google Competitions and Remix Projects

In 2008, Russia welcomed the first competition of individual projects created by students in the Scratch environment. The competition started on January 20, 2008. The jury members reviewed two types of works: games and videos. More than 500 people took part in the initial (distance) round. The initial round was followed by onsite semifinals. They were arranged in Nizhny Novgorod, Moscow, Novosibirsk, and St. Petersburg. More than 80 children took part in the onsite semifinals. The winners of regional semifinals from Novosibirsk, Angarsk, Nizhny Novgorod, Sarov, Magnitogorsk, Moscow, the Yaroslavl region, and Yakutia participated in the next,

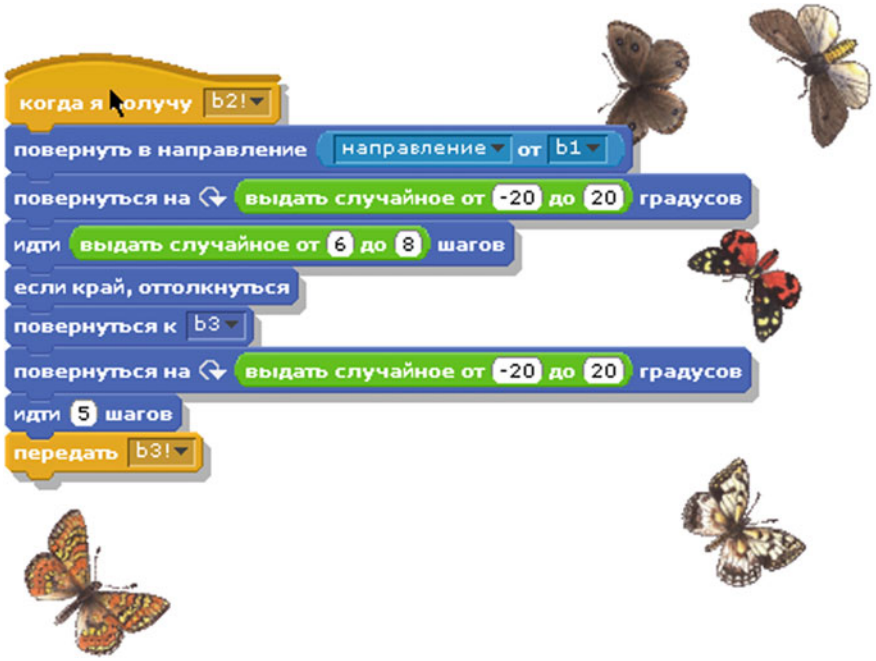

Fig. 13.6 Insect sprites

final round held on June 20, 2008 in St. Petersburg. Young programmers competed for four hours to see who can create the best computer games in the Scratch environment. The teenagers were given various scripts and a special library of objects and backgrounds.[3]

In 2010, Intel's Teach to the Future program arranged a competition of animated stories called Once Upon a Time for school teams of teachers and students from various regions of Russia and the CIS. Each territory and each region has its own unique stories—legends, myths, fables, tales, and sayings. These are the stories passed on from generation to generation, unique stories of this particular area or corner of the world. The competition organizers asked the teams to tell these stories in animation. Of 195 works submitted to the competition, 29 projects were made as digital stories in the Scratch environment.[4]

The growing interest of teachers to a new learning environment prompted the opening of a Scratch distance school in the spring of 2010, which welcomed more than 100 teachers from various regions of Russia. All the school's materials were open and posted in several formats: Blog, wiki, and Google documents.[5]

[3] https://scratch.mit.edu/studios/17369.

[4] Http://letopisi.org/index.php/scratch:once_upon_a_time.

[5] Http://groups.google.com/group/scratch_en.

Russian teachers of the Galaxy educational network took part in several network projects shaping and studying the culture of remixes. The first network project was called Journey of the Little Prince and brought together 12 teachers. The project's idea was to create an interactive quest game, where the main character was moving in virtual space to find and visit a given number of cosmic planets.

13.5.3 Scratch Collab 2018

In 2018, Moscow City University and the National Society for Technology in Education joined efforts with the Rybakov Fund to develop a Russian network to deal with new learning activities shaping twenty-first-century skills. The network organizers had years of experience in arranging social and educational projects at the interface of educational policies and learning activities. The project was focused on digital literacy of all the twenty-first-century skills, and in digital literacy, the focus was on collaboration skills. The organizers decided to find and form learning activities that would shape students' ability and willingness to share the results of their activities, to work as a team, and to distribute tasks. They chose Scratch as an environment that already had tools to arrange and monitor such activities.

The project brought together Scratch hackathons and schoolchildren's Collaborative Challenge competitions. Hackathons and competitions use templates—prototypes of learning activity scripts. At the next stage of joint guiding work, the hackathon organizers discussed and finalized the initial scripts of training activities. Joint efforts were made to amend the scripts. Some building blocks used to construct learning activities were modified or replaced by entirely new building blocks. All remix entries, including code snippets and links to Scratch projects, were combined in one entry—a collection of learning activity guiding materials. This collection is available online both as wiki and PDF: http://letopisi.org/index.php/Scratch/HowTo/Hackathon/Manual.

Moscow and other Russian cities welcomed hackathons, where students mastered new learning activities meant to develop network collaboration skills. Hackathons were chosen as the most appropriate format to find innovative solutions. Totally, there were more than 90 hackathons with more than 4,000 schoolchildren as participants. The hackathons were focused on collaboration skills and tools. During testing, the teachers revealed weaknesses and uncertainties in a proposed learning activity and amended the pattern. This work was conducted mostly onsite—in schools and centers of additional education. The hackathons and workshops gave the most emphasis to the use of collaboration tools.

13.6 Take-Aways and Conclusions

Coding as a key to unlock twenty-first-century possibilities for children: Coding provides all children with an opportunity to strengthen their cognitive skills as well as their non-cognitive skills. Coding and computational thinking are required for children not because it will help them get software programming jobs, but because computational thinking is increasingly required in all types of jobs. Coding reinforces problem-solving abilities as well as creativity. Perhaps the most important thing about coding is how the immediate feedback helps motivation and grit and affords learning as a sequence of "aha moments" of discovery and self-driven challenge, rather than doing something because you are told to do it.

Coding in school and coding in extra-curricular activities: Countries around the world are taking steps to incorporate coding into the curriculum, starting as early as pre-school and extending to high school and university-level courses regardless of majors. Coding as part of school activities is definitely fun for children, but requires massive shifts in the mindsets and abilities of teachers and school administrators. Extra-curricular opportunities face lower barriers to the changes that are required.

Teacher preparation: Teachers teaching traditional subjects can learn to code and enjoy learning and teaching code, but serious efforts and resources are usually required to help provide teachers with the coding knowledge and skills. Upgrading the technical know-how of teachers is a challenge, but an even bigger challenge is a change in the mindset, the realization that it is okay if the teacher does not have all the answers, but can help students to learn how to find out answers, how to learn from mistakes, and how to persevere.

Changing roles of government and market: One of the forces that underlies the teaching of coding is the difference from tradition roles regarding the supply and purchase of software and the use of platforms. Scratch is an open-source platform of worldwide popularity, including in the Russian Federation. A substantive portion of development and learning is based on the sharing of projects and the contributions of volunteers. Extra-curricular provision relies a lot on products and services from entrepreneurs that are often not strictly regulated. An emerging role for the government is to support universities and research institutions to carry out research and educate parents and teachers about the products in the market.

Reform of assessment: Coding as a learning activity, whether conducted in school or as part of extra-curricular activities, provides an opportunity for a breakthrough for a new kind of assessment. Traditionally, with knowledge provision as the key objective of education, students have taken question-based tests—questions whose only purpose is to determine whether students know what they are supposed to know. Coding typically is in the form of projects, and whether the code works or not is known immediately. The very purpose and meaning of assessment change. Questions now come from the student, seeking to find out what new knowledge they need to acquire to complete their project. A student is motivated to find out answers to questions to which the teacher herself may not know the answer, but can surely help the student to find out!

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Chapter 14
How to Integrate New Literacy in the Curriculum—Example of Environmental Literacy

Maria Dobryakova

Abstract In this chapter, we discuss the nature of domain-specific new literacy and ways of its integration into the core disciplinary curriculum. We have chosen environmental literacy as an example, but this logic of description can be applied to any other domain-specific literacy—financial literacy, health literacy, civic literacy, etc. Like other kinds of domain-specific literacy, environmental literacy embraces both an initial set of specific knowledge, and ultimately sustainable behavior. We also look into what schools can do to foster this kind of literacy.

Keywords New literacies · Domain-specific literacy · Environmental literacy · Key competences for environmental problem-solving · Fostering environmental literacy · Knowledge for environmentally responsible behavior · Big ideas for environmental education · Sustainability education · Environmental literacy in the curriculum

14.1 How Environmental Literacy Came to School

The United Nations Conference on the Human Environment was held in 1972, and since then the evidence that human activity and habits lead to an unprecedented malfunctioning of the planet has been increasing [48]. Caring for the planet and the environment has become an urgent problem that requires a response from the education sector. It is normally associated with the idea of "sustainable development"—such that allows to preserve the vitality and diversity of living and non-living

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nature on the planet, as well as to improve the quality of life for present and future generations [43, p. xxii].

Sustainable development implies changes in individual and organizational behavior and practices—their ways of thinking and behaving that allow them to meet their needs today should not prevent future generations of all living things to meet their needs tomorrow [43, p. xxii, New Zealand Curriculum Guides[1]].

The topic of responsibility toward nature and our environment is often linked with the discussion about twenty-first-century skills: what are the competences that a human person needs today, and which competences should be included in educational standards and curricula? The need to integrate this responsibility and education was recorded back in 1977 at the first UNESCO Intergovernmental Conference on Environmental Education [47]:

> The role of education in the face of environmental problems and opportunities is therefore a crucial one. <…>
>
> A basic aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of the biological, physical, social, economic and cultural aspects, and acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and the management of the quality of the environment.
>
> …full advantage must be taken of all private and public facilities available to society for the education of the population; the formal education system, different forms of non-formal education, and the mass-media. [47, p. 12, 25]

UNESCO experts analyzed curricula of 78 countries and found out that 73% of them mention "sustainable development," 55% mention "ecology" and 47% "environmental education" [48]. The concept of "environmental literacy" is also frequent.

In general, in curriculum texts, all these adjectives—environmental, ecological, sustainable (ecological/environmental literacy/learning/education; learning for sustainability)—are now used interchangeably as contextual synonyms, so we shall not be making a difference between them here.

14.2 "Environmental Literacy" and "Environmentally Responsible Behaviour": A Clarification of Concepts

Environmental literacy is knowledge in areas related to maintaining the desired state of the environment and preventing undesirable effects and phenomena.

Environmentally responsible behavior is the ability to act in a certain way (and achieve a certain result) to help maintain the desired state of the environment. It is

[1] https://seniorsecondary.tki.org.nz/Social-sciences/Education-for-sustainability/Key-concepts.

important to stress: actions based on one's independent decisions are meant, not on external coercion [15].

Thus, what we have here is an interplay of knowledge about a specific area of life, on the one hand, and of attitudes guiding one's actions in this area, on the other. Essentially, "environmentally responsible behaviour" is a competence: it relies on a set of knowledge, skills, and attitudes which are mobilized in a certain context to solve a certain problem or perform a certain task in a certain situation. In this case, it involves one's complex ability to recognize situations in which environmental knowledge should be applied, and ability to act in such situations in a responsible and sustainable way.

Using the distinction between declarative and procedural knowledge (see Chap. 3), it can be said that *environmental literacy is based on declarative knowledge ("know that…"), but environmentally responsible behavior requires procedural knowledge ("know how to…").* Attitudes toward nature will influence the willingness of consumers to adopt "green" habits and practices.

As we have already shown in Chap. 3, key competences and literacies can be divided into domain-general, universal by the context of their application, and domain-specific, limited to a specific sphere of life. *Environmental literacy belongs to the latter, domain-specific type; however, for it to reach the behavioral level, a number of key competences have to be mobilized.*

Environmentally responsible behavior and actions become possible, when citizens:

(1) have a motivation to change something;
(2) are able to see the problem in a systematic way, in all its complexity;
(3) are able to find a solution that does not contradict sustainable development goals;
(4) have some experience of successfully performing similar tasks [43].

So which aspects of key competences and what knowledge are needed for environmental literacy and environmentally responsible behavior to emerge?

14.3 Key Competences for Environmentally Responsible Behavior

Environmentally responsible behavior implies one's ability to anticipate how various things directly or indirectly related to the environmental condition will be developing; to understand effects of individual and collective actions in the "human–nature" dimension, also taking into account specific features of social and economic development of the region in question and the world in general; to make efficient decisions (which implied one's ability to make choice among a number of possible variants) and implement them. It means that environmentally responsible behavior involves elements of all three domain-general competences:

– competence of thinking,
– competence of interaction with people,
– competence of "interaction with self."

These competences will be unfolding in the course of the three stages of environmental problem-solving:

– assessment of the situation, collection, and analysis of information;
– performance of the task;
– evaluation of the results.

Components of Key Competences Mobilized in Environmental Problem-Solving
Stage 1a: Research and assessment of the situation, setting goals

- critical thinking: to identify a gap between existing and desirable state/knowledge and formulate it as a formal task/problem.
  This includes the following skills:
  - to formulate a task, problem, question; to identify the known and the unknown, the given and the desired;
  - to explore cause-effect relationships and sequences, with the necessary degree of detail (branching);
  - to check for the logical correctness of reasoning/argumentation;
  - to identify patterns and inconsistencies in a set of facts, data, observations.
- creative thinking: to connect the situation, the idea in question with a broader context; to take it to a new, unusual context,
  This includes the skill:
  - to make connections between phenomena from different spheres, unexpected connections.
- interaction with other people: together with other community members, to develop a common understanding of the situation; to put the situation in a normative framework adopted in the community;
- interaction "with self": to identify the gap between one's attitude to the situation and their ability to change it; to be able to identify feasible realistic actions.

Stage 1b: Gathering information and choosing a solution

- critical thinking:
  - to reveal deficiencies in information, data (formally missing elements to obtain complete sufficient information to solve the problem);
  - to find and create information, data, using adequate methodology and relying on already existing knowledge; to know how to use different types of sources (books, media, interviews, archives, and observation…), to understand the principles, features, and limitations of each source;

to recognize similar arguments (supporting the same idea, version) in different sources;
- to be able to differentiate between a fact, an opinion and a judgement; to understand cultural and social embeddedness of judgments;
- to check for the existence of alternative arguments in different sources and their validity (includes distinguishing between facts and opinions); to find similar arguments (confirming the same idea, version) in different sources, to recognize one idea in different wordings (to understand its essential meaning and multiple manifestations);
- to put forward hypotheses based on the analysis of the collected information and data;
- to compare several possible solutions, to choose the most suitable one, taking into account the features of the task, conditions for its implementation, and available resources;
- to formulate the final goal and to plan intermediate steps to achieve it, determining their sequence and criteria for success (cause and effect, necessity, and sufficiency).

- creative thinking:
  - to be able to refrain from (culturally determined, emotionally biased) generalizations and classifications until sufficient evidence has been collected to confirm any version of the solution to the problem;
  - to be able to develop more than one solution to the problem.

- interaction with others:
  - to assess what kind of communication will be needed to solve the problem (with whom, in what format, how to contact);
  - to refrain from projecting their feelings onto others (attributing the same thoughts, sensations, and perceptions to them by default);
  - to be able to generate ideas together with other people, to develop and complement each other's ideas;
  - to be able to compromise;
  - to plan one's work, one's individual role, responsibility, and the distribution of tasks among team members;
  - to be able to give up their interests if they interfere with the group task.

- interaction "with self":
  - to adequately assess their own strengths and weaknesses;
  - to choose the best way for oneself (taking into account the assessment of their strengths and weaknesses) to accomplish the task;
  - to be able to formulate short-term and long-term goals (considering individual goals and the involvement in collective tasks);

  - to be able to set and adjust one's priorities, considering the nature of the task, its context, and a clear understanding of one's own capabilities.

Stage 2: Performance/implementation of the task

- critical thinking:
  - to compare actual performance with the plan, recognize deviations from the plan.
- creative thinking:
  - to be able to adjust the selected solution to changing circumstances.
- interaction with other people:
  - to be able to work efficiently in a team;
  - to be able to take on the role of a leader.
- interaction "with self":
  - to be able to adjust the selected solution to a change in one's own capabilities.

Stage 3: Evaluation of the results and reflection on the performance

- critical thinking:
  - to compare the obtained results with the initial task (to check whether the desired solution has been achieved, what its strengths and weaknesses are);
  - to predict possible further development of events and their consequences.
- creative thinking:
  - to transfer the obtained results to new contexts, evaluate the applicability of the solution in different contexts.
- interaction with other people:
  - to compare the obtained results with the initial task, in terms of collaboration with the team, community interaction, and communication with stakeholders.
- interaction "with self":
  - to understand, to be able to describe the consequences of one's decisions and actions.

All the stages require **fluency with information**:

- to assess what kind, type, and format of information is needed to solve the task;

- to collect, register, and systematize relevant information about the object, phenomenon, process in question, to be able to use different ways of ordering information using tables, databases; to be able to use different ways of formal presentation of information;
- to be able to make "mental maps" with varying degrees of branching, identify logical connections between elements of the object, phenomenon, and process under study; to use different mind map formats;
- to evaluate events in terms of their probability, chance, and uncertainty; to see the mathematical nature of a real-life problem, to be able to formulate it in the language of mathematics; to use mathematical reasoning;
- to use quantitative estimates and assumptions, also when combining different sources of information;
- to recognize the same idea presented in different formats (e.g., as a text and as a diagram); to interpret data offered in different formats, including statistical data;
- to express ideas in different formats, to use adequately available tools of communication.

A specific feature of environmental problems is their high degree of uncertainty, a complexity of factors involved (including also the contradiction between economic rationality and sustainable economic development), as well as the deferred nature of observed results. Yet their main difficulty has to do with the need of practical actions at both individual and collective levels. Therefore, environmentally responsible behavior is very closely linked to motivational attitudes and one's ability to act (the latter is often called "action competency" or "agency," and there is a whole bulk of literature exploring factors and circumstances which limit or enhance human agency) [2, 15].

14.4 Knowledge for Environmentally Responsible Behavior ("Environmental Knowledge")

Environmentally responsible behavior emerges on the basis of key competences, on the one hand, and knowledge, ideas about the environment, principles of its existence, on the other. The spectrum of such knowledge unfolds in the "human–nature" relational dimension: how these relations developed in the past, and, especially, how they are developed in the present and will be developing in the future.

Such knowledge, conceptions, and ideas are not limited to natural sciences, rather they equally reach out to social sciences and humanities. UNESCO Intergovernmental Conference on Environmental Education pleads for an interdisciplinary approach to environmental issues: "an interdisciplinary, comprehensive approach

which will permit a proper understanding of environmental problems… UNESCO views education in the context of development in the broadest sense and approaches its problems in relationship with those of the exact and natural sciences, the social and human sciences and of culture and communication" [47].

Natural sciences help understand biological and physical processes that influence environmental condition, determine preservation, maintenance, deterioration, and development of the environment.

Social sciences and humanities offer understanding of the following issues:

- the relationship between the environment and cultural traditions and history of a region. For example, in the case of Russia it may involve activities related to the abundant natural resources of the country: forests, rivers, and lakes (and associated industries: forestry, fishery, and agriculture);
- understanding of human nature: being physically part of nature, a human being (unlike other living things) can predict the future and make rational responsible decisions that are based also on values and norms about fair distribution and exploitation of national resources [3, p. 23];
- awareness of the conflict of interests between individuals and groups of people about natural resources, understanding the conflict between economic benefits in the short term and environmental balance in the long term;
- a moral choice: what is right and what is wrong in the short and long-term perspective, taking into account objective differences in the interests of different groups of people and wildlife. Solving environmental problems goes beyond purely technical sphere [21],
- an aesthetic appreciation of the beauty of nature and biodiversity (not just a utilitarian idea of opportunities offered by natural resources).

In fact, the dimension of analysis unfolds from a two-party "human–nature" to a three-party "human–human–nature." In the economic sphere, the conflict between short-term and long-term choices is becoming especially important (Fig. 14.1).

Thus, environmental literacy and, consequently, environmentally responsible behavior requires an interplay of natural, social, and human sciences. National

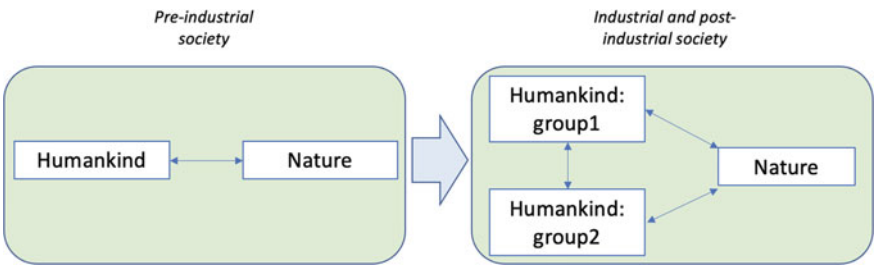

Fig. 14.1 "Participants" of environmental interaction

sciences help explain causal relations in the realm of nature, while social sciences and humanities investigate cause-and-effect relationships in human activity, as well as explore the possibility of eliminating, mitigating, and preventing problems.

14.5 Methods of Fostering Environmental Literacy and Environmentally Responsible Behavior

The declaration of the UNESCO Intergovernmental Conference on Environmental Education identifies the following possible ways to integrate environmental topics in the curriculum [47, p. 19–20][2]:

- to introduce into each subject the essential environmental dimension;
- to have curricula prepared by interdisciplinary teams;
- to study practical problems, that is the reality surrounding pupils and teachers.

> … Environmental education should not be just one more subject to add to existing programs but should be incorporated into programmes intended for all learners, whatever their age.
>
> …The central idea is to attain, by means of growing interdisciplinarity and of prior coordination of disciplines, a practical education oriented toward a solution of the problems of the environment, or at least to make pupils better equipped for their solution by teaching them to participate in decision-making.

These forty-year-old recommendations are no less relevant today. Moreover, a review of 1993–2014 publications still reveals a deficit of efficient approaches and calls for more interdisciplinary, creative, inspiring approaches that require an active involvement [39].

A path model for development of environmentally responsible behavior is depicted in Fig. 14.2. Its key difference from the model of development of key domain-general competence (see Chap. 3, Fig. 3.1) consists in the integration of specific disciplinary knowledge and mastering certain basic concepts.

It is clear that for this model to be implemented, teachers should have an opportunity to achieve a sufficient level of environmental literacy [8].

The most efficient principles to foster environmentally responsible behavior in education would be the following:

– the learning process should be based more on experiment rather than direct teaching (or any other form of passive receipt of information from the teacher (see e.g., [37]),
– active learning and associated attitudes should be emphasized;
– individual contribution and involvement of each student should be encouraged, alongside with their ability to work together with others [1],
– as the area is multidisciplinary, deep understanding of threshold and basic concepts is essential, it is important to remember not a lot a scattered facts and theories

[2] https://www.gdrc.org/uem/ee/EE-Tbilisi_1977.pdf.

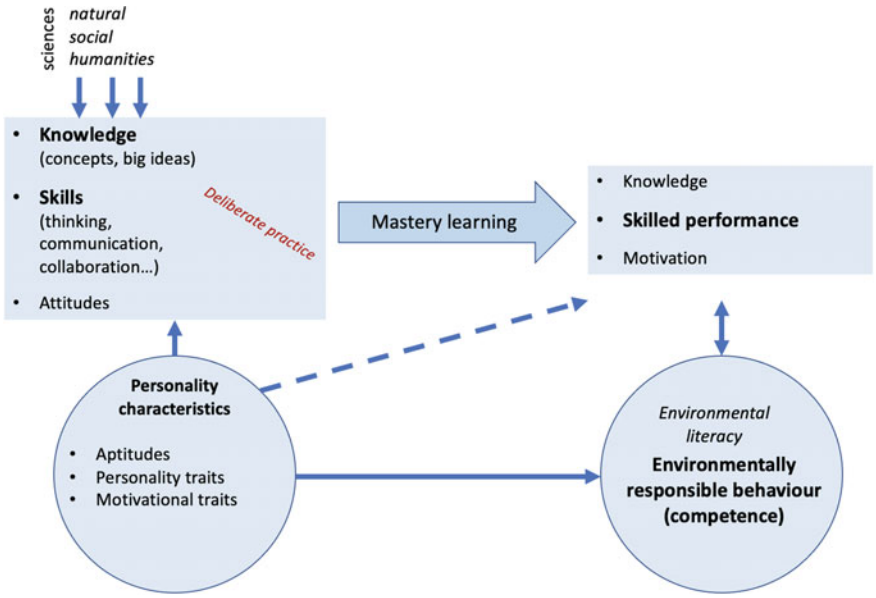

Fig. 14.2 Developing environmental literacy and environmentally responsible behavior: a path model

from different disciplines, but to combine them into holistic "big ideas" that allow to interpret various data [26].

Several pedagogical approaches are based on these principles:

(1) concept-based learning (e.g., [11, 12, 34, 44, 45, 24, 25, 27, 38, 40, 46]),
(2) inquiry-based learning (e.g., [21–20, 32, 33, 5]),
(3) project-based learning (e.g., [4, 30, 51], et al.).

It should be highlighted that all the three approaches emphasize different aspects of the learning process or the structuring of subject contents—but in no case they are alternative to each other. On the contrary, in ideal situation they are organically woven into one coherent learning model: concept-based learning is responsible for the principles of the organization of knowledge in the curriculum; inquiry-based learning describes the principles of students' engaging with learning; and project-based learning is an organizational form of learning activity.

(1) *Concept-based learning*

Concepts are abstract constructs not limited to any specific time or location. Conceptual learning, concept-based learning is focused on understanding deep underlying principles, ideas which help organize information; these principles or ideas can be used in different contexts.[3]

[3] https://evolve.elsevier.com/education/concept-based-curriculum/conceptual-learning-definition/.

For example, in the case of environmental literacy and environmentally responsible behavior the concept of "sustainable development" (or, broader, sustainability) is the big idea which determines how we see the consequences of some actions for the future (*what* is relevant for the future).[4]

A "big idea" is an interpretative framework for phenomena and processes we encounter, which is interiorized as a thinking strategy and influences our choice- and decision-making in the practical domain. One big idea can involve multiple disciplines.

- "Big ideas" help make sense of observations, phenomena, facts, which at first seem to bear no relation to each other. An idea can be considered "big," if it helps to identify connections in a confusing abundance of facts;
- "Big ideas" help focus our attention, set an analysis strategy;
- "Big ideas" are useful for us, as they suggest what is relevant in the analysis, they help us to solve problems and strengthen our capabilities when exploring and issue or interpreting a situation;
- "Big ideas" help transfer meaning and conclusions to new situations, "big ideas" describe something that is repeated in different situations;
- "Big ideas" help predict the behavior of elements, possible development of events which we have not yet studied purposefully.

Thus, the British Columbia curriculum for Grade 11 suggests the following big ideas for environmental science[5]:

- Complex roles and relationships contribute to diversity of ecosystems.
- Changing ecosystems are maintained by natural processes.
- Human practices affect the sustainability of ecosystems.
- Humans can play a role in stewardship and restoration of ecosystems.

Ideally, a big idea unfolds in a curriculum gradually and consistently, providing a continuity from year to year.

"Big ideas" most often rely on "threshold concepts" (e.g., [9, 28, 29, 16]. Such concepts are usually not limited to one area of knowledge and are

- *Transformative*—they change our perceptions of and ideas about a subject or phenomenon;
- *uneasy and troublesome*—they may be difficult to understand but once they are understood they make further learning easier;
- *irreversible*—if a person has grasped this concept once, she cannot get back to the state when she did not know and understand it;
- *integrative*—they allow to identify features of a subject which can be observable in different contexts (thus, they help to identify patterns).

[4] http://mobilizingstem.wceruw.org/documents-June/Sherman%20SustainabilityTheBigIdea.pdf.

[5] https://curriculum.gov.bc.ca/sites/curriculum.gov.bc.ca/files/curriculum/science/en_science_11_environmental-science_elab.pdf.

Examples of "threshold concepts" include

– in biology (but not only)—probability and chance; balance; scale (of time and space);
– in mathematics (but not only)—limit; function;
– in physics (but not only)—inertia.

For environmental education, the following concepts and big ideas seem especially important (see Children's Environmental Literacy Foundation[6]):

- Change over time: all organisms/places/systems are constantly changing.
- Ability to make a difference: everyone has the ability to affect change or impact a system, community, self.
- Community: all communities involve nested economic, environmental, and social systems. We need to understand the interconnections to come up with sustainable solutions.
- Cycles: every organism/system goes through different stages.
- Diversity: systems/places function because of variety.
- Equilibrium: a state of balance.
- Equity/Fairness: resources need to be shared to meet the needs of living things across places and generations.
- Interdependence: all living things are connected. Every organism/system/place depends on others.
- Long-term effects: we can project that actions will have effects beyond immediate reactions.
- Place: natural and human communities together make up one's place. Every place has its own needs and limits.
- Systems: elements that affect each other and are connected through larger patterns.
- Limits: every system has a carrying capacity.

Almost all these ideas and concepts are discussed both in natural and social sciences.

Inquiry-based learning

Inquiry-based learning is based on stimulating natural curiosity. As a rule, it is organized as a cycle or a spiral: asking a question, investigating the situation, choosing a solution, reflection, and discussion of the results [6]. This approach seeks to actively engage students.

Learning should follow a question which

- is meaningful for the students;
- is poorly structured;
- requires comparing different points of view.

Most environmental problems satisfy these criteria.

[6] http://sustainableschoolsproject.org/education/big-ideas.

Examples of questions which encourage environmental thinking and attitudes may include [42]:

- How did values of the past influence human behavior, social order, and environmental change over time?
- How do environmental values and behavior differ in different cultures and with what consequences?
- How do conflicting values affect environmental behavior of individual people?
- How does individual and collective decision-making influence environmental change?
- What do we actually mean by the words "environment," "nature," "wild life," "health," "justice"? What does this meaning tell about our personal background?
- What is environmental fairness and justice?
- What does it mean to be good toward nature?

A deep high-quality question helps:

- conduct a real inquiry/research and connect it with central disciplinary concepts of a subject (and also to see them in a new light);
- stimulate thinking, conversation and lead to a new understanding and new questions;
- encourage students to consider alternatives, look for evidence, and justify their ideas and answers;
- highlight links between available learning experience and personal experience;
- provide opportunities to transfer the new knowledge/explanation to new contexts and subjects.

Stages of inquiry learning normally include

(1) asking the question (the area under study should be limited to a manageable piece; students should be given the opportunity to follow their own interests);

Students try to answer a scientific question, to explore an event or a phenomenon. They link the phenomenon with what is already known to them. They identify the gap between what they know and what they are observing. An incentive appears for them to explain the gap. Students make guesses, test hypotheses, explain observations.

(2) looking for data and information;

(3) a practical part: an experiment, a survey, etc. (if needed for the topic of the inquiry);

(4) analysis and reflection of the results (independently or with teacher's help).

Students analyze and interpret the data obtained, synthesize ideas, expand their understanding of the issue/phenomenon, transfer their knowledge to new situations, and reflect on what they leant and how they did it.

Project-based learning

Project-based learning helps:

- understand real complex issues that do not have a single unambiguous solution (as in real life);
- learn to work together as a team.

The topic of the project is almost always linked to the curriculum and often interdisciplinary, focusing on a key issue—which is carefully thought out and does not have a single solution. The key question of the project encourages students to look for a solution, to understand the topic.

To find the key question students try to

- work together;
- plan their work together with the teacher;
- explore relevant literature;
- (if necessary) meet adult experts;
- make prototypes;
- conduct surveys and experiments;
- create a final product that answers the key question.

When choosing a topic and planning a project, it is important to bear in mind that

- a project should imply a sufficient **immersion into the subject** (not just a superficial analysis of the topic);
- the way the key question is formulated should require **a conceptual understanding and analysis** ([22, 7, 13])—and not a reproduction of a familiar algorithm or set of facts;
- a project should address **real-life issues** (students are to solve real problems, not only simplified educational ones devoid of any ambiguity).

Advantages of project-based learning for fostering skills of environmentally responsible behavior include

- development of habits associated with interaction and communication, critical thinking, self-organization, and self-regulation;
- a deeper understanding of disciplinary knowledge (especially if the topic is relevant and inspiring for the student);
- a focus on open-ended questions and, thus, learning to adapt to a greater degree of uncertainty than children usually encounter at school (and which is characteristic of the real world and environmental issues);
- constant reflection and adaptivity: clarifying the plan and adjusting the timeline (which allows to adapt to the nonlinear development of environmental processes).

Project-based learning can be offered at school and in informal education. Moreover, opportunities for such learning can be offered by municipalities. The

London Curriculum[7] makes a good example of how project-based learning can be implemented: city's environment itself servers as a learning resource.

14.6 Environmental Literacy in the Curriculum: Approaches of Different Countries

Countries, which explicitly emphasize the task of fostering environmental literacy at school, usually highlight two main components: an interdisciplinary approach and opportunities for gaining practical experience.

Australia: "sustainability" is one of the three cross-curricular themes which permeate the curriculum and connect relevant aspects of content across learning areas and subjects.[8] The topic is structured along three key concepts (systems; world views; futures) and associated ideas (e.g., "All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival"). Sustainability issues are discussed in all learning areas, such as English, Mathematics, Science, Humanities and Social Science, the Arts, Languages, Technologies, Heath and Physical Education, and Work Studies.

Scotland takes an interdisciplinary coherent whole school and community approach [50, p. 13, 23, 30]. Students, teachers, school leaders, and practitioners in the communities in which they all learn and live, all together strive to create a fairer and more equitable society based on the principles of social justice. Students get "active curricular learning experiences that develop their understanding of the inter-relationships of environment, society, economy and inequity, of the ecological limits to development and the interdependence of ecological and human well-being" (p. 30). A coherent practical experience and outdoor learning are emphasized which are both rewarding and transformative for learners. Learning for sustainability (LfS) "significantly enhances relationships, the sense of community spirit, parental engagement" (p. 4), it brings together "the curriculum, campus, community and culture of the establishment" (p. 13). LfS also makes part the framework for self-evaluation and self-improvement at school level. Training and support is available to all practitioners to allow them to develop their LfS knowledge and skills, and their confidence in teaching.

Ontario (Canada) also emphasizes the importance of learning in the outdoors [35, p. 2–3]: "Learning in the outdoors not only offers a unique context for learning but also provides experiential learning outside the classroom to foster a connection to local places and to develop a greater understanding of ecosystems. Natural and human-built environments can be used as sites for discovery, problem- solving, and active learning, as well as for first-hand experiences that put students in touch with nature" (p. 3). The curriculum highlights interconnections between social and economic

[7] https://www.london.gov.uk/what-we-do/education-and-youth/london-curriculum.

[8] https://www.australiancurriculum.edu.au/f-10-curriculum/cross-curriculum-priorities/sustainability/.

systems, on the one hand, and natural systems, on the other; it explores natural and social sciences aspects of environmental problems, positive and negative effects (both expected and unexpected) of interaction between human-created and natural systems.

Environmental issues are integrated throughout the curriculum: in business studies, Canadian and world studies, arts, modern and classical languages, literacy, computer science, health and physical culture, mathematics, natural sciences, social sciences and humanities, technological education, and career education.

Finland: in most cases the study of the principles of sustainable development is integrated in disciplinary knowledge—primarily, in sciences but economic, social, and cultural aspects are also attended to in almost in all the subjects. There are no specific recommendations as to how exactly schools should be implementing this approach; however, all schools integrate environmental issues in their learning process in some ways. They often offer approaches implying project-based and collaborative learning. The general orientation is on practical skills and everyday responsibilities [23, p. 19–21].

Island: environmental topics are not explicitly stated in the curriculum, but are integrated into the judgments and values offered in relation to nature and the environment, into the knowledge about a wise use of natural resources, about social well-being, democracy, and active participation, equality and multiculturalism, economic development, and global awareness [17].

India: textbooks for all levels of education have been revised to integrate environmental issues [49].

Mexico: environmental issues run through all subjects, but teachers complain about insufficient theoretical elaboration of concepts and approaches [36].

England: after the 2014 educational reform, there is no explicit reference to environmental education in the curriculum and it is not any longer mentioned as an "cross-curricular theme." However, environmental education aspects can be found in the curricula (e.g., [31, p. 6]).

Russia: despite the talk about the importance of environmental issues (for example, 2017 was declared the "year of ecology" in Russia), their integration into the school curriculum is at an early stage and remains declarative. Some experts favor a separate subject (possibly combined with the Life Safety), others support a seamless integration into the curriculum as a whole [14]. Currently, Russian schools do not offer any practical experience that would encourage development of environmental attitudes and thinking. The topic is paid more attention in informal, extra-curricular education. As a formal, though not too large-scale, incentive to support environmental education, the National Environmental Olympiad for Schoolchildren is held by the ministry of education since 1994, the winners of which receive the right to enrol in relevant majors in Russian universities without exams (in 2019, there were 40 such winners in the country[9]).

[9] According to the monitoring of enrolment to Russian universities: http://ege.hse.ru

A Summary

Environmental literacy and environmentally responsible behavior require a combination of specific disciplinary knowledge with values and attitudes and are based on key competences (such as thinking and reasoning, interaction with people and with self, working with information).

Necessary knowledge includes exact sciences, natural sciences, social sciences, and humanities and requires an interdisciplinary approach. The task of developing environmental literacy can be organically integrated into the core curriculum.

Useful pedagogical approaches to fostering environmentally responsible behavior include concept-based learning, inquiry-based learning, and project-based learning.

When integrating environmental topics into the curriculum, it is desirable to link them with local community issues and introduce practical learning situations in the outdoors.

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Chapter 15
How Countries Reform Their Curricula to Support the Development of Key Competences

Kirill Barannikov, Igor Remorenko, and Isak Froumin

Abstract In this chapter, we try to summarize the attempts to change school education and integrate key competences as a mandatory learning outcome. We explore the experience of the countries discussed in this volume, as well as in some recent publications. In our analysis of this diverse experience, we use several theoretical lenses: theory of educational change by Michael Fullan (which emphasizes the involvement of teachers and parents) and Michael Barber (who highlights the role of clearly set targets); institutional theory by John Meyer which demonstrates the limitations and barriers of change, as well as neo-institutional theory which draws attention to interaction between changing organizations and the role of their environment. Our analysis of competence-based curriculum reforms reveals: there is no single correct path to this goal. Coordinated efforts of various mechanisms are needed to advance the new and mitigate resistance of the old.

Keywords Curriculum modernization · Educational change · Developing key competences · Key competences in national education policy

Highlights

- key competences and new literacies have been an important strand in public debate on education, actively involving also stakeholders from NGOs and business;

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- key competences are increasingly becoming a conceptual reference point for educational reforms, entering the core of national curricula; the emphasis on key competences does not deny the value of subject knowledge, as learning outcomes are to embrace both;
- in most cases, the conceptual framework of key competences does not rely on a theoretical foundation and draws mainly from politically obvious slogans and patchy, uncoordinated economic demands; key competences are often confused with "new literacies" and personality traits;
- in some countries, active political support of the competence-based shift in education faces a serious resistance, which may result in a renunciation of plans and a turnback toward "well-established" approaches;
- learning outcomes are increasingly formulated in terms of "capability"—as actions which students, using their subject knowledge, will be able to perform in different situations (and not in terms of sheer knowledge of facts, dates, and formulae);
- in countries with centralized curriculum regulation, it is difficult to foster key competences in "traditional" school subjects. Even when schools enjoy a strong political support, they have to resort to outflank variations—through non-mandatory activities and non-academic subjects;
- in countries with a strong tradition of school autonomy, integration of key competences into all aspects of school education (disciplinary learning, extra-curricular activities) gradually brings about and disseminates effective practices;
- revised teaching and learning practices (supported also by digital technologies) become a driver for key competences' formation. Yet, there is few, if any, evidence-based research that would reveal valid methods to develop key competences;
- there is no system of key competences assessment that would be widely recognized by public or professional stakeholders, which makes it quite difficult to evaluate the effectiveness of the reforms conducted. At the same time, it is national systems of assessment or international assessment programs that often inspire the debate on the development of key competences;
- key competences repeatedly remain evasive as a mandatory learning outcome, because it is still unclear how to combine them with the pure disciplinary learning outcomes;

In this chapter, we have tried to summarize the attempts to change school education and integrate key competences as a mandatory learning outcome. We explore the experience of the countries participating in this report, as well as discussed in some recent publications, such as countries of the European Union [1, 2], Singapore, Mexico, India, Chile [3].

In our analysis of this diverse experience, we use various theoretical lenses: theory of educational change by Michael Fullan (which emphasizes the involvement of teachers and parents) [4] and Michael Barber (which highlights the role of clearly set targets) [5], institutional theory by John Meyer [6] which demonstrates the limitations and barriers of change, as well as neo-institutional theory [7] which draws attention to interaction between changing organizations and the role of their environment.

15.1 How Objectives of Modernization Are Set?

Almost all the countries discussed in this chapter lead an intense public debate about the goals of mass education in the changing twenty-first century world facing a new technological revolution. A more recent feature of these discussions in the last decades has been an active involvement of industry and business representatives expressing their concerns about the growing gap between skills mastered at school, on the one hand, and demands of the changing labor market, on the other. One might even discern a certain state of public nervousness about this issue. As a result, the growing foresight industry begins to explore, among other things, skills and personality traits that are most likely to be in demand.

National debates on education reform are further fuelled by global forums—international organizations and development agencies like UNESCO, OECD, World Bank, World Economic Forum [8–11]. Rankings make another driver, and a much stronger one, with PISA playing the leading role.[1]

It is hard to overestimate the role that the new understanding of scientific, mathematical and reading literacy has had for the discussions on learning outcomes. The challenging PISA experiments of the recent decade to assess global competence and collaborative problem-solving have become milestones prompting the next step to take for many national education systems.

In these debates, three new aspects of statutory learning outcomes are put to the forth: soft skills (twenty-first century skills, transversal skills, etc.), new knowledge of the world, and skills of using new technologies (first of all, digital). Associated with the efforts to advance these new demands, public movements sprout up and charity initiatives are launched.

Answering both this social pressure and objective evidence from the labor market, governments in different countries launch curriculum reform to integrate these new learning outcomes. No country can now oversee digital (technological) skills as an essential outcome of education. Most countries revise their national curriculum standards for sciences, social sciences, technology, mixing in new knowledge and skills. Strictly speaking, such a revision is not at all surprising—in the history of mass education, school curriculum and even the list of subjects have never been carved in stone and have been modified following civilizational, cultural, and technological change. However, it is maybe for the first time in the history of universal general education that statutory learning outcomes are being extended to include cognitive and social skills which had earlier been seen as abilities that are either innate or fostered at home, and school could enjoy them in its pupils but could not make them a compulsory outcome it would be held accountable for.

Although most countries follow this track, there are examples of reverse movement (England, Poland, Russia): the state calls for going back to basics—toward "hard" knowledge and skills in traditional academic subjects (in these approaches, subject knowledge and key competences are seen as two alternatives: as if an increase in one inevitably would bring about a decline in the other). In such cases, not only

[1] See Chap. 2 for more detail on the global discussions.

traditional learning outcomes are emphasized, but any additional learning goals may be discarded.

There is a small group of countries that do not include development of key competences in their national education policy. The USA would be a good example of this approach. Yet, the greatly decentralized nature of K-12 education cannot be accounted for this—it did not significantly impede the launch of nation-wide initiatives like *No Child Left Behind* and *Race to the Top* which have a more traditionally academic focus.

In what follows, we shall analyze how the task of developing key competences is treated in these varied contexts.

Hardly any education reform we are aware of—either supported by a coherent government policy or not—rests upon a rigorously developed framework of competences, a clear taxonomy of learning outcomes, or experimental evidence to prove the adequacy of very task of putting key competencies to the forth.

In the 1960s, when the development of thinking skills was for the first time announced an important objective of mass education, educational psychology was exploring age-related properties of this competence. In the twenty-first century, however, most reforms rely simply on some analysis of international experience and it is very seldom that they scrutinize results of theoretical and experimental research (although such research does exist in psychology and neuropsychology, in sociology, linguistics, and education studies). Perhaps, it is only Canada and Finland (among the countries we have studied) that sought to integrate results of this research into their education endeavors; however, even this was not enough to provide for an operational solution to the goals set.

As a result, there has been a lot of debate, both global and national—substantiated no more than mass media talk and appealing mostly to common sense—which produced lists of skills as a tradeoff between diverse stakeholders, yet often sadly lacking coherence and logic. Mostly these lists were meant just to embrace "everything good." Such conceptual ambiguity has been a significant handicap impeding systematic support of key competences in schools: it does not allow to formulate clear learning objectives or identify appropriate indicators for success criteria. Indeed, in the absence of all these ingredients, a strategy cannot be really successful and efficient.

15.2 How National Education Systems Pursue New Learning Outcomes: The Role of Context and Regulatory Mechanisms

Economic, social and cultural context play an enormous role in setting and achieving new goals of education.

First, in most countries that have announced the development of twenty-first century skills as their priority, high-tech and service industries are growing fast.

Yet, these countries differ significantly by their share of high-tech industries in GDP and by entrepreneurial activity of their population in these industries.

Second, in most countries seeking new learning outcomes, the social and cultural context is changing, gross enrolment in tertiary education is growing. It means that educational expectations among youth and families with children are also changing. However, different countries have different ideas of good quality education and its appropriate amount. Narrow professional focus typical of socialist countries, emphasizes "hard" knowledge and skills overlooking social skills and higher order thinking skills. Similarly, according to a number of scholars, the "Confucian orientation" intrinsic to South-Eastern countries also sets quite a peculiar context, in which creativity, initiative, and critical thinking are valued less than knowledge of facts, and compliance with traditions and strict discipline (e.g., [12–14]). Such demands to school education (especially to its mandatory components) may contradict the new priorities associated with skills necessary for the knowledge economy.

In terms of what kind of learning outcomes are valued, we can roughly identify two groups of countries:

– countries that emphasize traditional academic knowledge as a general education ideal; their criticism of superiors and academic gurus is usually very low. In these countries, compulsory subjects usually make a large share of the curriculum;
– countries that emphasize independence and self-organization skills; they value practical knowledge and are critical toward opinion leaders and authorities. In these countries, the share of elective subjects in the curriculum is significant.

In the first group of countries, a considerable part of parents and teachers would resist any attempt to revise the established balance between knowledge and social skills; whereas in the second group, new teaching and learning practices (like, say, project-based learning) may enjoy a fairly supportive reception, even though their implementation might reduce the amount of pure academic knowledge to be learnt.

This context of contradictory expectations and cultural traditions is further complicated by curriculum regulation practices, as well as by practices of academic autonomy, at the level both of teachers and schools, associated with them.

Trying to analyze the differences in curriculum regulation at the national level, one should pay attention to what exactly does the state intends to control and what kind of methods (mechanisms of dissemination and implementation of national education strategies in regions and schools) it is using.

As a rule, in its curriculum regulation efforts, the state addresses the following aspects of education as learning outcomes:

(1) disciplinary content (topics to be taught in every subject included in the curriculum);
(2) disciplinary skills (may also be called disciplinary competences);
(3) key competences and particular (practical) competences (like healthy life-style skills);
(4) personality traits (including values, motivation, and interests).

It can be argued that in the twentieth century, the first item of traditional disciplinary content was supplemented by the other three. Thus, by the end of the twentieth century it became clear that absolutely each pupil graduating from secondary school should not just know facts, dates, rules, and formulae, but be able to apply them in various situations—and this requirement is no longer skewed to only the very best pupils. This type of learning outcomes is usually described in terms of actions that the pupil is able to perform. However, this emphasis on performance does not in any away deny the value of disciplinary knowledge. Quite the opposite: learning outcomes formulated in the mode of "…is able to do…" simply integrate disciplinary knowledge (they are not based on it or refer to it—they integrate it!).

The place and the role of these four components of curriculum vary from country to country. The number of countries integrating quite persistently the second type of learning outcomes (disciplinary skills) is growing. They do not consider a list of topics as an expected outcome (Ron Brandt, William Spady[2]). They focus not on knowledge as such but on knowledge embedded in the process of action, application. This approach is pursued, for example, in Ontario (Canada) or Finland. Disciplinary skills and competences here may integrate disciplinary knowledge. Thus, for Analytic Geometry in mathematics the following expectations are mentioned: "identify, through investigation with technology, the geometric significance of m and b in the equation $y = mx + b$."[3] The content is not to be atomized into crumbs distributed according to lesson hours. Rather, these "crumbs" are aggregated into larger units which in Canada are called "big ideas." According to Ontario curriculum, "big ideas are the broad, important understandings that students should retain long after they have forgotten many of the details of something that they have studied."[4] The new British Columbia curriculum provides similar examples: "big ideas" embrace key messages gradually elaborated and interconnected throughout the studies (see Table 15.1). These ideas are fairly broad to be used to explain real social and natural phenomena. Such an approach to structuring disciplinary content bridges knowledge and one's ability to apply it.[5]

Yet, Finland and Ontario (Canada) each have its own approach to handling key competences in the curriculum. In Ontario, key competences and disciplinary skills develop side by side but do not overlap; in Finland, these two types of learning outcomes are combined in a matrix-like form. Thus, the Ontario curriculum mentions "use of processing skills" as part of key competences. This "achievement" is further subdivided into two smaller "achievements": (1) "carrying out a plan (e.g., collecting

[2] E.g. [15, 16].

[3] http://www.edu.gov.on.ca/eng/curriculum/secondary/math910curr.pdf, p. 34.

[4] The Ontario Curriculum, Grades 1–8: Science and Technology. P. 6. http://www.edu.gov.on.ca/eng/curriculum/elementary/scientec18currb.pdf.

[5] British Columbia New Curriculum. Science: https://curriculum.gov.bc.ca/curriculum/science.

Table 15.1 "Big ideas" in the British Columbia new curriculum

Year of schooling	Biology	Chemistry	Physics
Kindergarten	Plants and animals have observable features	Humans interact with matter everyday through familiar materials	The motion of objects depends on their properties
Grade 1	Living things have features and behaviors that help them survive in their environment	Matter is useful because of its properties	Light and sound can be produced and their properties can be changed
Grade 2	Living things have life cycles adapted to their environment	Materials can be changed through physical and chemical processes	Forces influence the motion of an object
Grade 3	Living things are diverse, can be grouped, and interact in their ecosystems	All matter is made of particles	Thermal energy can be produced and transferred

data, questioning, testing, revising, modeling, solving, inferring, forming conclusions), (2) looking back at the solution (e.g., evaluating reasonableness, making convincing arguments, reasoning, justifying, proving, reflecting)."[6]

The Finnish National Curriculum [17] is a good illustration of the other approach. It emphasizes seven transversal competences, and their interpretation is different for different grades. Transversal competences and content areas are specified for each year of schooling and each subject. Each learning objective can be linked to several transversal competences and content areas (see Table 15.2).

The first column of Table 15.2 describes learning outcomes (objectives of instruction), the second features content areas, and the third highlights transversal competences. As we can see, one outcome can foster three different competences and be embedded in several content areas. This is a complex organization of learning objectives, competences, and disciplinary content.

Let us further illustrate it with an example from mathematics curriculum for Grades 3–6: "O13 to guide the pupil in preparing and interpreting tables and diagrams and using statistical key figures as well as to offer experiences of probability." This objective is linked to only one content area: "Data processing and software, statistics, and probability" and to several transversal competences: multi-literacy, ICT-competence. For assessment, a similar matrix-like structure is provided. In the example given, the assessment criterion is formulated as follows: "the pupil is able to prepare a table based on a given set of data and to interpret tables and diagrams." Most likely, research on how pupils acquire conceptual knowledge would be helpful if one seeks to get to grips with the principles of this approach (see e.g., [18]).

[6] The Ontario Curriculum. Grades 1–8. Mathematics. 2005. https://www.edu.gov.on.ca/eng/document/curricul/elementary/math1-8e.pdf.

Table 15.2 A matrix of learning objectives for mathematics, Grades 1–2, The National Core Curriculum for Basic Education, Finland [17]

Objectives of instruction	Content areas related to the objectives	Transversal competences
Significance, values, and attitudes		
O1: to support the pupil's enthusiasm for and interest in mathematics and the development of his or her positive self-image and self-confidence	C1–C4	T1, T3, T5
Working skills		
O2: to guide the pupil to improve his or her ability to make mathematical observations and to interpret and use them in different situations	C1–C4	T4
O3: to encourage the pupil to present his or her solutions and conclusions through concrete tools, drawings, speech, and writing, also using information and communication technology	C1-C4	T2, T4, T5
O4: to guide the pupil to develop his or her reasoning and problem-solving skills	C1–C4	T1, T4, T6
Conceptual objectives and objectives specific to the field of knowledge		
O5: to guide the pupil to understand mathematical concepts and notations	C1–C4	T1, T4
O6: to support the pupil in developing an understanding of the concept of numbers and the principles of the decimal system	C2	T1, T4

The Australian National Curriculum largely shows a similar approach. Although educational outcomes are presented under the label of Year Content, i.e., the content to be studied in the corresponding year of studies, essentially they are closer to the idea of disciplinary outcomes. They are packed into a table (matrix), and each outcome is linked to key competences (in the document, they are called General Capabilities). Every general capability is broken into specific skills, which result in a corresponding educational outcome. As in the Finnish case, one educational outcome can be linked to several competences and areas of subject contents. The outcomes, competences, and contents are also laid out as a matrix.

For example, the Year 5 mathematics curriculum states the following educational outcome: "Describe and interpret different data sets in context," and links it to the following general capabilities: Literacy (Comprehending texts through listening,

reading, and viewing), Numeracy (Interpreting statistical information), Critical and Creative Thinking (Inquiring—identifying, exploring and organizing information and ideas).

A special website[7] was developed to support this approach, it allows users to browse the curriculum in a nonlinear way, linking educational outcomes, competences and contents, as well as helpful pedagogical and assessment resources—and even to modify and download a personalized version of the curriculum depending on the educational outcomes selected.

At the same time, traditionally in many countries disciplinary contents is often described not in terms of learning outcomes, but rather in terms of topics to be taught. This is the case of England, Russia, and China. We argue that, in these countries, the idea of key competences development encounters significant difficulties. The curriculum is focused mainly on producing a list of content areas or smaller academic units in which particular facts, dates, rules, formulae are specified. The degree of detalization is fairly high, as it in fact makes the very essence of this approach: to regulate what exactly pupils are to study ("to cover"). Learning objectives are merged here with the list of topics and are formulated to emphasize the disciplinary knowledge of facts. When "contents to be covered" is regulated, it is next to impossible to bridge subject content and ways of action (no matter, general or specific). This is why in China and in Russia key competences have to be attached as a separate list of learning objectives. It is clear that in such a disjunct mode the new competences and the existing disciplinary curriculum—which is usually overloaded anyway—do not really stick together and there are few chances for pupils to really master the competences. (It should be mentioned, however, that we are analyzing only what is stated explicitly in the curriculum. Educational and cultural traditions which are taken for granted may not be described in the official documents but they do change the teaching and learning practice and, thus, learning outcomes. The idea of an essay or the tradition of debates make a good illustration to this thesis.)

Sometimes, in the pursuit of new learning objectives, suggestions are made to introduce new school subjects, in which thinking, communication and self-regulation skills become but declarative knowledge, subjects per se. This has not been a widespread practice, although the influential International Baccalaureate program does introduce two specific subjects: *Theory of Knowledge*, and *Creativity, Activity, Service*. Special experimental courses aiming at key competences development are developed in China and Korea.

Values and personality traits are often declared by education policymakers as a new objective, but they are hardly ever operationalized by curriculum developers. Although they surely make an essential part of education and it would have been logical to start with them and only then to proceed to competences, learning outcomes, and disciplinary content. But values are difficult to measure and assess, therefore it is seldom that they are listed among expected outcomes. This is one of the most interesting intellectual challenges reflected, for example, in the ongoing large-scale OECD project *Education-2030* (it brings together about 30 countries).

[7] http://www.australiancurriculum.edu.au/.

We should underline that in many discussions new learning outcomes seem to "displace" traditional knowledge. Indeed, some ideologists of radical reforms propose to dismiss school subjects. However, in the past decade, the climate has become more moderate, and the question of how to find a productive balance between key competences, on the one hand, and disciplinary competences and knowledge, on the other, has drawn increasingly more attention.

15.3 The Role of Centralization and Autonomy for Developing Key Competences

Curriculum regulation affects educational policy according to the level of centralization and academic autonomy. How are goals formulated in national education standards are transmitted to school and teachers? One extreme of the continuum is characterized by a close control all the way down to lesson plans, the structure and contents of textbooks and other learning materials are controlled, centralized exams are held regularly which control if learning outcomes expected for each specific period are achieved. On the other extreme (it is fairly common in the USA), schools and municipal districts enjoy broadest autonomy. Technically, it is limited by certain nation-wide examinations for school graduates. Yet formally even this is not a limitation. However, in the US, the voluntary Common Core State Standards Initiative has been slowing down and even shrinking.

Depending on how explicitly the goal of key competences development is articulated in the national education policy, the following typology of implementation modes can be observed (Table 15.3).

The situation when *goals of national education policy do not mention development of key competences as a priority for mass education and schools have a low degree of autonomy* (type 1) seems to be the easiest case in terms of analysis. As Polish (and partly also Russian) experience demonstrate, private sector of school and additional education then enters the field to saturate the demand expressed by part of the population and business; schools, in their turn, increasingly differentiate their learning tasks into advanced and standard levels (the former require well developed thinking skills, whereas the latter are focused on rote learning). In Russia,

Table 15.3 Key competences in national education policy: a typology of goals and exemplary countries

	Goals of key competences development are not reflected in national education policy	Goals of key competences development are clearly reflected in national education policy and assessment instruments
Low level of school autonomy	Poland, Russia (type 1)	China, Korea (type 3)
High level of school autonomy	USA, England (type 2)	Finland, Canada, Netherlands (type 4)

the *Kvantorium* technological parks for teenagers (12+)[8] have become widespread. This is a network of extracurricular educational clubs which are now springing up in every Russian region (the initiative is part of the *National Project "Education"* launched and supported by the Ministry of Education). In these clubs, children are introduced to competence-based learning practices, while implementing their own technological projects; special training sessions aimed at "soft skills" development are held. Another Russian extracurricular educational network (*IT-cube*) seeks to develop digital skills.

Experience of countries in which *goals of national education policy do not mention development of key competences as a priority but schools have a high degree of autonomy* (type 2) reveals that the pressure of social, cultural, and technological change forces its way into educational system, if it is open enough, no matter enhanced by the pressure from the state or not. It is apparent by the diversity of projects aimed at key competences development which are being launched by individual schools, school associations, forward-looking municipal councils, and charitable organizations both in England, and the USA. In fact, a "fashion for key competences" is created in these countries, while school autonomy allows school leaders and the majority of teachers to follow this fashion at their own discretion. Thus, powerful horizontal channels for the new practices to spread widely can appear. Such channels are often supported by philanthropes who often have a braver vision on educational development than governmental officials (the case of the US Summit Schools[9] would make a good example of this point).

Interestingly enough, in the USA it is not curriculum change as such that has been the main driver of the key competences agenda, but public programs of technological transformation. A great variety of educational resources which require critical analysis and information processing skills; personalized learning trajectories which require self-organization and self-control skills; collaborative projects in technological environment—they all stimulate development of key competences. The growing US High Tech High network of schools, which seeks to engage and prepare more young people for the high-tech industry, is based on these principles.

Experience of countries in which *goals of key competences development are formulated clearly but schools have little or no academic autonomy* (type 3) reveals that their national goal of competences development is articulated from top downwards together with the regulation of teaching and learning, while teachers and schools are not in a position to significantly change it. It should be stressed that, if this is the case, the responsibility to achieve this goal remains with educational authorities. They have already had the tradition of describing disciplinary knowledge in great detail. Therefore, it will also be their responsibility to explain to teachers and parents what exactly will be changing. In this model, educational authorities are to develop methodical guidelines, new textbooks, instruments of assessment. Last but not least, they are to organize in-service teacher training. And doing so they

[8] https://www.roskvantorium.ru.

[9] https://summitps.org/the-summit-model/the-summit-experience/.

should not forget to convince all the stakeholders that what they are doing is really important.

The case of South Korea seems to be the most consistent and advanced example of this approach. Chinese education policy follows the same path, though at somewhat a slower pace. In Russia, education leadership for many years has been content with a declaration of similar goals, though the way they could be practically achieved remains entirely unspecified and not operationalized.

Both in Korea and in China, national educational standards and programs have been revised quite significantly. Besides disciplinary contents, they explicitly (though as separate learning objectives) included key competences and values (in the Chinese education system the latter play a special role). Teachers have been advised to use cooperative and group learning techniques.

What can we learn from the real steps undertaken by Korea and China? First of all, we have to admit: it has not been possible so far to deeply integrate the ideology of competence-based learning into the traditional disciplinary core of school education. The pressure of exams, of long-held assumptions by teachers and parents about the basic curriculum in national language, history, and mathematics,—and this does not allow for any significant transformations of expected learning outcomes and teaching practices, even though educational programs and textbooks have been revised and updated. In such a situation, education leaders have to look for a "circuitous manoeuvre." Four distinct courses of action are usually resorted to then.

(1) To advance key competences through "non-academic" subjects, like arts, technology, physical education. In this vein, China has worked out really fascinating formats combining technical creativity and arts. Collaborative arts projects are also widely supported in the country. Whereas in Korea, it is physical education that has become a principal vehicle for development of cooperation and self-regulation skills. Both countries are also active in professional re-training of teachers for these subjects.
(2) To create free time and space to develop key competences outside the main traditional curriculum. Thus, China provides support and resources for school clubs and social projects. In some provinces, schools are allowed to replace part of the curriculum with their own courses. In its turn, Korea, famous for its "exam fever", has had the courage to venture a revolutionary experiment: to announce a whole exam-free semester (half a year in grade 7; for more detail see Chap. 7 in this book). This is not just a symbolic action. The Ministry of Education had conducted experiments, developed methodological guidelines, and spared schools of its extensive control during this semester. Its main task is to make key competences a visible learning outcome—a new and valued one—for children and their families, as well as for professional pedagogical community.
(3) To designate experimental schools, in which the new education goals are pursued, also through traditional subjects. These schools are also granted freedom and resources and can be promoted by the government (like in China) as instances of the new practice which gradually will be changing public expectations and teachers' beliefs.

(4) The most important element in such an "indirect" advancement of key competences lies with external assessment. In countries with strict centralized regulation, high stakes examinations usually dominate casting a long shadow on what and how is taught at schools. It may be argued that Russia has recently been quite successful in this direction—the contents of exam tasks has been changed to assess the development of key competences. In Moscow, for example, so-called "meta-disciplinary assessments" are widespread aimed at certain elements of key competences. But even in this case there is no connection between these assessments and national summative assessments.

Finally, in countries in which *emphasis on key competences is combined with a high degree of school autonomy* (type 4), the path to the new goal though seems more direct, but it is not shorter. In fact, having discussed the issue with the public and with professional teachers' associations, the state is now only starting to plan how to implement these goals. It organizes a wide and profound consultations, creates professional communities of teachers working on methodological elaboration of difficult questions. In Canada, it is not individual schools but school clusters led by school councils[10] (established in all provinces) that are the main agents of educational modernization. When planning social practice or project learning, they rely on the specific social and economic context of their provinces.

In these systems, the state does not push schools and teachers to change radically their practices within a couple of years (and it is not for nothing that the Dutch program of curriculum transformation, which was launched in 2015, is designed up to 2032). Schools are moving at different pace. The state helps describe the best assessment and teaching practices produced by leading schools and diffused "as a matter of course" over the country, as guidelines for schools lagging behind.

Yet, it is important to stress: these countries have a long historical tradition of school autonomy which has allowed to nurture several generations of parents, as well as teachers and educational managers. Without such a tradition and without such human resources, implementation of these new practices would have been impossible.

There is also another factor facilitating such a path of transformation: the tradition of "flexible mandatory curriculum"—the total amount of mandatory requirements for each subject is smaller than in countries with centralized curriculum approaches. This alleviates teachers' and parents' expectations as to knowledge and skills required for every person—and thus creates space for a more interactive learning process. This also reduces the number of "underachieving slow learners" who are confined have poor learning motivation already in primary school.

[10] Also known as Home and School Associations or Parent-Teacher Associations. https://www.canada.ca/en/revenue-agency/services/charities-giving/charities/policies-guidance/policy-statement-013-school-councils.html.

15.4 Prerequisites Needed to Successfully Support Key Competences' Development Practices

Even cases of apparently successful curriculum transformations aimed at integrating key competences cannot be evaluated with proper rigour, simply because *there are no metrics for such an evaluation.* All the case studies devoted to curriculum transformations which were examined in this and other publications lack references to large-scale and evidence-based research on the efficiency of suggested and implemented changes. It has to do with the complexity of reforms to be conducted and the complexity of expected outcomes—indeed, there is a major lack, both at the global and national level, of instruments which would allow to assess key competences' development.

At the same time, a culture of "partial innovations"—in the form of specific provisions aimed at key competences—is gradually striking root. Thus, Korea attempts experimental assessments of the "free exam semester," China is designing an experimental course of technology, several regions of Russia conduct "metadisciplinary assessments." However, this is not enough.

This vulnerability of the reforms conducted is clearly felt in different countries. This is why many national education systems are trying to design tools—based on various theories of cognitive and social development—which would assess elements of key competences. International agencies join in, and especially interesting should be the OECD with its plans to assess key competences in PISA (creative thinking is to become the 2021 focus).[11]

The lack of clarity as to what the system of indicators in key competences' development should be results in *the lack of evidence-based pedagogical approaches that consistently and surely lead to development of key competences in schools.* Of course, it would be common sense to remind that skills are developed when they are practiced. It is from this idea that various group learning, project-based learning and inquiry-based learning approaches designed for students of any age stem from. Developmental psychology, however, does not support this assumption. On the contrary, it argues that social and cognitive skills have their special logic of development and require a special sequence of pedagogical actions. What should this sequence be is yet to be answered—research on the topic has been fairly slow and chaotic. But even results of this research will not help find an answer to the question—what should be done, if the sensitive period for a specific skill is gone and the pupil is behind the expected level in terms of key competences' development.

Having said that, we cannot deny the significant user's experience in the countries which incentivize teachers' work and creativity. This experience signals that active forms of learning, including project-based learning and inquiry-based learning, have a good potential. However, it is difficult to disseminate this experience because the right balance of key competences and mandatory disciplinary outcomes is not yet found, as well as the issue of learning motivation does not have clear answers either.

[11] PISA Creative Thinking Framework (third draft). April 2019. OECD. https://www.oecd.org/pisa/publications/PISA-2021-creative-thinking-framework.pdf.

The thing is that active learning requires (evidently) pupils' activity, and the latter depends on their general learning motivation. This motivation, however, may have been subdued at the very beginning of formal schooling. Besides, active learning requires more time that direct transmission of disciplinary contents. Does it mean that active learning would be compelling to sacrifice a significant amount of traditional contents? There cannot be an abstract answer to these questions in any concrete situation. More comprehensive, detailed and practice-oriented research is needed.

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Our analysis of competence-based curriculum reforms reveals that there is no single correct path to achieving this goal. It requires coordinated efforts through various mechanisms to advance the new and overcome resistance from the old.

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