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Florence Ligozat
Kirsti Klette
Jonas Almqvist *Editors*

Didactics in a Changing World

European Perspectives on Teaching, Learning and the Curriculum

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Florence Ligozat • Kirsti Klette • Jonas Almqvist
Editors

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Editors
Florence Ligozat
Faculté de Psychologie et des Sciences de l'éducation
Université de Genève
Geneva, Switzerland

Kirsti Klette
Department of Teacher Education and School Research
University of Oslo
Oslo, Norway

Jonas Almqvist
Department of Education
Uppsala University
Uppsala, Sweden

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Foreword

The present book brings together contributions from the main regions of continental Europe following a call for proposals from the European Educational Research Association (EERA) Network 27 "Didactics – teaching and learning." It contributes to the vital international dialogue among European scholars in the scientific field of didactics. This field, as the editors remind us in their introduction, is particularly specific to this part of continental Europe and also to Latin America. There are many reasons for this, which are undoubtedly to be found in the long history of pedagogy as an academic field, on the one hand, and in the traditions of teacher training, especially in secondary education, on the other. The name of the network itself is already a compromise between two traditions. It was chosen in 2006, during the founding EERA congress that we organized in Geneva, during which we heard very contrasting guest lectures by Yves Chevallard, representing the French-speaking tradition of didactics; Stephan Hopmann, from the Central and Northern European tradition; and Neil Mercer, coming from the Anglo-Saxon tradition who did not refer to didactics at all. Since then, several books and special issues, mentioned in the introduction, have brought together European didactic researchers. A journal, aiming at transnational and transdisciplinary dialogue in didactics, *Research in Subject Matter Learning and Teaching* (*RISTAL*), testifies to the growth of the discipline. These means of scientific communication deepen mutual knowledge while showing the different national traditions at the same time. For in didactics, and also generally in educational sciences, more than in other scientific fields, the local – national, regional, and cultural – anchorage is strong. Besides the fragmentation mentioned by the editors, between general and subject matter didactics and between the different subject matter didactics themselves, one can observe local or national specifications in the way research questions are formulated. They are indeed determined by local factors, regional and/or national data, or reference frames. This is unavoidable since the research contexts depend on these factors: syllabus in one Swiss canton, particular forms of teaching using individualization in one German region, teaching material in elementary school with its specific contents in Spain, teaching traditions in Norway and more generally Scandinavian countries, radical change of arts education in Czechia to give but some examples

from the contributions. Reference is also made to didactics in French-speaking (and even French) educational research, which is different from others. The specifically didactic core concepts used – be they theoretical or linked to the specific analyzed context – are essentially local or are often borrowed from scientific fields other than didactics.

One could conclude that European didactics is not yet really "European." But let us look at this the other way round: fragmentation and specification are strengths under the condition that researchers from different orientations and regions communicate and that common viewpoints can be detected: this is what happens in this book. Indeed, the contributions are united by a common viewpoint defined by what it means to do research in didactics. What Saussure (1916/1959, p. 8) once said for linguistics could easily be translated to didactics: "Far from it being the object that antedates the viewpoint, it would seem that it is the viewpoint that creates the object." The object of didactics as a viewpoint is what Chevallard (1997) named "the didactic" [le didactique], in analogy to the religious, the political, or the economic, large social realities that become objects of sciences that adopt a viewpoint. The didactic as object could be defined as the system formed by teacher(s)-student(s)-content(s) functioning in a specialized institution that constitutes this system. "Docere – discere – scire" [teaching – learning – knowing] was the definition of didactics by its first theorist Comenius. In his approach, "scire," knowing, has three modalities: thought, language, and material creation (see Comenius, 1648/2005, p. 159). The entering of "scire" into the didactic system – this is a constitutive condition – is its moving from social contexts where it is used (in science, in arts, in communication, etc.) into a context where it has to be learned, appropriated in order to transform one's thought, language, and creation: didactic transposition. Therefore, the sense and form of the "scire" profoundly changes in the triangular structure, depending on many factors, among them the kind of institution (school, museum, university, kindergarten), the characteristics of the media in which it is embodied (be they games by ludicization in a teaching relation; see Bonnat et al.),[1] and the long history of practices of teachers as a profession to transmit it. Most contributions in this volume adopt this viewpoint and explore empirically the object that it creates. They analyze how contents are transformed in order to be taught – in arts education, reading instruction, science education, physical education, etc. – and when they are taught; what the forms of these transformations are; and, a much more difficult question, what the eventual explanatory factors of their transformation could be. Others discuss concepts necessary for doing this research: the very useful concept "subject didactic knowledge," much more precise than the commonly used "pedagogical content knowledge" (Vollmer & Klette), different possibilities for defining a tertium comparationis in order to do comparative didactics (Ligozat).

Let us look more specifically at the contributions that present empirical data. We can note that, apart from the general viewpoint just presented, another dimension

[1] Names without other details refer to the contributions in the volume.

unites them. It doesn't appear explicitly in the papers, but can be reconstructed through an interpretation of the texts by means of a tertium comparationis. In reading the contributions, one can notice that the authors, more or less explicitly, report about discrepancies between what was intended or what was expected for teaching and what was really observed. As for examples, Breidenstein shows, by an ethnographic study, the difference between the officially expected individualized learning to allow children to be more active resulting in fact in quite strongly routinized activities with task sheets; Amade-Escot and Verscheure describe a physical education teacher, strongly aware of gender biases using teaching practices that reproduced gender-oriented habits; and Blikstad-Balas notes a surprisingly low use of ICT in a highly digitalized society that would or could expect other kind of teaching practices. Reading the contributions from this particular point of view uncovers some common – and subtle – dimensions in the texts.

Note that there is necessarily a gap between officially promoted ways of teaching – activity orientation, critical thinking, and gender neutrality – and real teaching, a gap that could be described, in using the terminology of ergonomics, between prescribed and real labor. This is a very commonly observed phenomenon, here shown concretely in the domain of teaching. One way of interpreting it is to understand it as the result of sedimentation processes. New approaches and new ways of teaching never appear on a tabula rasa. They are superimposed on longstanding, historically evolving practices elaborated by the teaching profession. All the observed phenomena could be described as the result of such sedimentation processes in which one can observe ways of acting coming from different historical strata that mix together in different forms).[2] Let's take the example of "worksheets" (as in Breidenstein) in the context of individualization: they appeared in new education already in the 1920s (a good example is Dottrens, 1936, inspired by Washburne's Winnetka Plan). The gendered nature of physical education is often described in the long historical run and has indeed a very heavy load in practice (for a recent history in French-speaking Switzerland, see Czaka, 2021). To analyze current teaching practices didactically as being the result of sedimentation processes implies knowing the history of subject matter teaching as one duty of didactic research.

As one can see, behind an apparent diversity, the didactic viewpoint allows fascinating observations on the system, on the different poles interacting significantly and transforming each other at every point in processes that depend on many factors and in different dimensions. These transformations are the core of didactic research that has to document them in order to understand the real functioning of the system and its basis, for instance, like in the contributions to this volume, the discrepancy between prescribed and real teacher labor. One can question the radical postulate made by one author in the volume that "every form of didactics has a normative and prescriptive bias in observing classroom activities" (Breidenstein). It is true, however, that we need didactics that avoids this bias and that analyzes what happens not so much in terms of absence or deficiency but in an attempt to reconstruct and

[2] For the definition and discussion of this concept, see Ronveaux & Schneuwly, 2018

understand the logic and reason behind teacher and student actions as creative interactive processes in a constrained institutional situation.

The common topic in most contributions to this volume, the analysis of teachers' labor as sedimented practice, has in fact two dominant poles, teacher and knowledge, and a subdominant which is the student in the didactic system. In a certain sense this is surprising: the function of didactic systems is to transform persons, students, or, to put it more precisely, to offer opportunities to students, certainly in constraining situations, by appropriating cultural, semiotic means – concepts, linguistic forms, and material cultural practices – for them to transform themselves. Students and their development should therefore be a central topic of didactic research. This is a much more complex question than it seems at first sight since teaching and development follow very different rhythms. To put it in Vygotskij's words:

> Teaching and development do not coincide directly, but represent two processes that are in very complicated interrelations. Teaching is good only when it is the pacemaker of development. Then it awakens and calls into being a whole set of functions that are in the stage of maturation, in the zone of the next development. This is the main role of teaching in development (Vygotskij, 1934, p. 275; my translation)

One can, of course, observe immediate learning according to teaching, which is simpler. But, in fact, development is at stake, i.e., the continuous reorganization of thinking, speaking, and creating. One way of looking at this from a didactic perspective could be to analyze it in the long term of schooling as a possible process of progression, in order to understand how students develop in different school subjects at different school grades, in a comparative perspective. In playing with the French word for "subject matter," namely "discipline scolaire," one could say that one has to observe the process of "disciplination" through which students, by appropriating the means offered by each school discipline, transform their relationship to the subject matter and therefore, in fact, to the didactic system itself, continuously redefining the contract that relates teacher, student, and (knowledge) content. This could be another field for empirical didactic research to explore.

This book, in bringing together different research traditions in the rapidly evolving domain of didactics, opens challenging perspectives of debates on central topics of teaching and learning, among them the ones pointed to in the present foreword. It constitutes a new cornerstone in the building of a European didactics.

Faculté de Psychologie et des Sciences de l'Éducation
Université de Genève
Genève, Switzerland

Bernard Schneuwly

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Chapter 1
Didactics in a Changing World – Introduction

Florence Ligozat, Kirsti Klette, and Jonas Almqvist

Issues of teaching and learning have been discussed for many years in Europe by considering the contents at stake in different layers of organization and functioning of school systems. These discussions encompass (i) the definition of formal educational contents present in curricula, (ii) the elaboration of teaching resources (e.g., manuals, teaching units, lesson planning, digital learning environments, etc.), (iii) the way in which contents take shape in the interactions between teachers and students in classrooms, and (iv) the assessment of learning objectives. Thinking systematically about teaching and learning in relation to the knowledge contents and domains structured in the curriculum traditionally belongs to the broad field of *Didactics*. Far from being unified, this field is characterized by its fragmentation and broad interest linked to the historical evolution of educational goals in European countries, but also to the diversity of institutional solutions in education as an academic discipline and in pre- and in-service teacher training structures. One of the most prominent drivers of this fragmentation is the presence of specializations in terms of *general didactics* and *subject-specific didactics*. Another driver of the fragmentation is the variation in the epistemological, theoretical and methodological approaches of the fields of *Didactics* as built from different cultures marked by the linguistic areas in Europe. Hence, the mapping of the realm of European research related to *Didactics – learning and teaching* – is a major challenge, to which this book attempts to contribute.

F. Ligozat (✉)
Faculté de Psychologie et des Sciences de l'éducation, Université de Genève, Geneva, Switzerland
e-mail: Florence.ligozat@unige.ch

K. Klette
Department of Teacher Education and School Research, University of Oslo, Oslo, Norway

J. Almqvist
Department of Education, Uppsala University, Uppsala, Sweden

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Building on different research traditions for conceptualizing the relationships between teaching, learning and the contents taught/learnt, this book pursues a threefold aim: i) it presents certain recent theoretical developments of *Didactics* and, more particularly, the development of *general subject didactics* and *comparative didactics*; ii) it provides a sample of the diversity and complementarities of methodological approaches for the empirical study of teaching and learning in the classrooms; and iii) it addresses certain societal challenges that didactic research faces in a changing world.

In this introduction, we first recall some aspects of the development of research in Didactics in continental Europe to highlight the specificity and the complexity of this field. Then, we introduce the authors' chapters, sketching the most salient relations between them within each part of this book. Based upon an open call to the participants of the EERA network 27 "*Didactics – Learning and Teaching*", this book presents a snapshot of the scientific discussions that have been ongoing in the network in recent years.

"*Didactics*" – Specificity and Complexity, a European Research Trend

The European landscape of *Didactics* stems from a long tradition that can be traced back to the humanist philosophies of Jan Amos Komensky – known as Comenius – and Johann Friedrich Herbart in the seventeenth century (Hopmann, 2007, 2015; Meyer, 2012; Schneuwly, 2011). In seeing education as a source of development occurring through the mastery of the techniques and concepts featuring the bodies of knowledge built by human beings, Comenius' "Didactica Magna" paved the way for knowledge structures to be thought of within subjects and the methods for teaching them. Over time, and especially in the context of the massification of secondary education in the 1970's, *Didactics*, as a field of educational research thinking systematically about teaching and learning in relation to the knowledge contents and domains structured in the curriculum, has become a broad area, including different trends such as *general didactics* and *subject-specific didactics* (Hudson & Meyer, 2011; Krogh & Qvortrup, 2021; Meyer, 2012; Schneuwly, 2011). There are distinct cultural differences in ways of "thinking about school, knowledge, teaching, and learning through teaching that are crystalized in the different national traditions and languages" (Schneuwly, 2021, p. 164). In German-speaking countries, the notion of *general didactics* ("Allgemeine Didaktik") has been strong in thinking of the educational contents and the institutional conditions for *Bildung*, i.e. the development of the "concept of humanity in our person" (von Humbolt, quoted by Schneuwly & Vollmer, 2018, p. 38). In parallel, and somewhat in tension with *general didactics*, *subject-specific didactics* ("Fachdidaktiken") have developed as empirical explorations of teaching models centered on the school subject contents (e.g., Cramer & Schreiber, 2018; Bayrhuber et al., 2017; Vollmer, 2014). In the French-speaking

countries, "*les didactiques des disciplines*" as *subject-specific didactics*[1] have developed since the 70's, exploring the conditions for teaching and learning school subjects as disciplines resulting from the transposition of knowledge in use in social practices (Chevallard, 2007; Chevallard & Bosch, 2014; Dorier et al., 2013; Ligozat, in Chap. 3, Schneuwly, 2021). In the Nordic countries, "*Didaktik*" is either related to *general didactics* or to *subject-specific didactics* often aligned with classroom studies. While *general didactics* focuses to a larger degree on the policy level and the institutional framing of teaching, such as national and international policies for schooling and assessment, subject-specific approaches keep a closer connection to the classroom level and what might be described as "enacted teaching" (Kennedy, 1999; Klette, 2007). Although often referred to as a Northern and Continental European tradition, *subject-specific didactics* are also very influential in Southern Europe, and known as "*le didattiche disciplinari*" in Italy (e.g., D'Amore & Fandino Pinilla, 2007; Martini, 2001) and "*las didácticas específicas*" or "*las didácticas de las áreas curriculares*" in Spain (e.g., Brovelli, 2011; Jimenez & Barrabés, 2004; Perales, 2001). Similar patterns exist in Eastern countries (Svatošová and Fulková, in Chap. 11) although there are not yet many publications available in English.[2] The debate on the epistemological relationships between general didactics and subject-specific didactics is also vivid there (e.g., Pace et al., in Chap. 5; Zollo, 2018, Maruhenda & Bolívar, 2012).

In contrast, the notion of *Didactics* (Didaktik, Didactique, Didattica, Didácticas, etc.) as means to discuss the triadic relation between teaching, learning and contents, is almost non-existent as such in the Anglo-American research in education. First, there are linguistic reasons for this: as observed by Gundem and Hopmann (1998), the English adjective "didactic" usually refers to authoritative teacher-centered pedagogies and/or teacher centered/teacher-led whole-class instruction with little room for student involvement. Second, the notion of "curriculum" – oriented toward the building of school systems responsive to the students' needs and abilities to live and work in changing societies – strongly influences reflections about what should be learnt and how. The search for similarities and differences between "*Didaktik*" (according to the German and Northern European cultures) and "Curriculum" as research traditions has had a long career that will not be expanded here, but that can be traced in the works of Gundem & Hopmann (1998), Hopmann (2015), Deng (2020) and, recently, Krog et al. (2021).

[1] The French term "les didactiques des disciplines" is sometimes translated by the English term "*Disciplinary didactics*" (e.g.,Schneuwly, 2021) to account for the cultural specificity of the subject-specific research on teaching and learning in the French-speaking context (where general didactics is not developed – see Ligozat, in Chap. 3). However, in this book, for the sake of clarity and the construction of a consistent international discourse about the research traditions in Didactics, the French authors have chosen to use the broad term "*Subject didactics*" (or subject *didactique* in Chap. 10) to stress the family resemblance with other similar trends in other countries (e.g. Fachdidaktik in German-speaking countries, las didácticas específicas in Spain, le didattiche disciplinari in Italy, etc.).

[2] See the webpage on « Subject Didactic Research » developed at Charles university in Prague, Czech Republic: https://cuni.cz/UKEN-483.html

It is worth noting that, despite its historical quest to find "practical" ways to implement liberal education through deliberative practices within school, the field of "Curriculum and instruction" also faces a fragmented evolution where "on-going work is being transferred again to subjects, to policy analysis, to psychology and even to teacher education" (Ian Westbury in Ruzgar, 2018, p. 682). For Gericke et al. (2018), "(the) dichotomization between curriculum and pedagogy as well as teaching and learning is not fruitful since most of the outcomes of teaching, that is, the powerful knowledge that students acquire through their teaching, depends not only on the knowledge and the teacher, but also on the learner and the milieu (Brousseau, 1997)" (p. 432). From a European perspective, the kernel of *Didactics* as systematically thinking teaching and learning in relation to the knowledge contents and domains structured in the curriculum provides possible ways to fill some of the gaps lying between "*pedagogy*" and "*curriculum and instruction*" to a certain extent.

Beyond the fragmentation of Didactics as a research field, and after years of dialogues and theoretical comparisons between the different traditions of research in *Didactics* (Schneuwly, 2021, Vollmer & Schneuwly, 2018, Wickman, 2012), it is now possible to identify certain significant shifts in the European landscape of *Didactics*.

As noted by Krogh et al. (2021), the German-rooted term "*Didaktik*" (strongly tied to that of *Bildung* and the prospect of adequate conditions for fostering it) now appears too monolithic to account for the distinctions between the different research traditions related to different educational cultures. European regions and nations have configured their academic disciplines and teacher education structures differently. In turn, this has given rise to different interpretations of the triadic "teacher-students-contents" relationships in the light of the kind of educational goals nations strive to achieve.

In countries where it exists, like Germany, for example, the tradition of *general didactics* is undergoing a form of crisis related to its lack of empirical data and its normative dimension, which tends to distance it from the standards of scientific disciplines (Vollmer, 2021). In Nordic countries, research in "*Didaktik*" has moved away from the classroom level to the bigger issues of schooling, such as national policies and governance structures (Klette, 2007; Wahlström & Sundberg, 2018). Consequently, *general didactics* appears less relevant for discussing teaching and learning, and for supporting teachers in developing new practices in their classrooms.

Against this background, an important evolution of *Didactics* as a broad European research field, is the growth of *subject-specific didactics* as a set of scholarly research fields exploring the teaching and learning process of specific contents. From a sociological perspective, it is established that the pressure that curriculum reforms impose on the definition of school subjects – e.g., framework for competences – is generating increasing reflections on the role of subjects in teaching-learning (Schneuwly, 2011; Young, 2013). The notion of *Bildung*, which is historically central to the development of *general didactics* is now re-interpreted and extended from the perspective of *subject-specific didactics* (Schneuwly and Vollmer, 2018). The rise of subject-specific studies of teaching and learning

practices is also triggered by the academization of teacher education and the need to build a scientific basis for teacher professional development. In France, Amade-Escot (2013) argues that the elaboration of the *Joint action framework in Didactics* (JAD) (Ligozat & Schubauer-Leoni, 2010; Sensevy, 2011, 2012; Sensevy & Mercier, 2007; also see Amade-Escot & Verscheure, in Chap. 10 and Ligozat, in Chap. 3), providing a generic model of teaching and learning as a joint action in the (re)construction of knowledge contents in the classroom, is an attempt to respond to this need. In Germany, another path is taken with *general subject didactics* as a meta-theorization from the common components *subject-specific didactics* (Bayrhuber, et al., 2017; Rothgangle & Vollmer, 2020), and heading toward a body of *subject didactic knowledge* to be integrated by teachers (Vollmer and Klette, in Chap. 2). In Norway/ the Nordic countries (see Klette, in Chap. 9), the notion of *comparative classroom research* serves a similar ambition.

Certain contributions in this book make it clear that subject-specific studies in didactics (as shown by Rodríguez-Martín et al., in Chap. 6; Hamza & Lundqvist, in Chap. 7; Amade-Escot & Verscheure, in Chap. 10; Svatošová & Fulková, in Chap. 11) are capable of providing a scholarly knowledge foundation for the teaching profession aligned with scientific standards, i.e., models that can be empirically tested in classrooms, discussed and compared among each other to assert their validity range. However, the shift toward subject-specific studies should not be understood as a reduction of research interests in the teaching and learning of school subjects only. This shift encompasses empirical classroom research able to consider the consequence of teaching methods or approach on the contents learnt (or not) by the students (as shown by Amade-Escot & Verscheure, in Chap. 10; Breidenstein, in Chap. 8; Hamza and Lundqvist, in Chap. 7; Svatošová & Fulková, in Chap. 11). It also encompasses the study of the consequences of societal changes on the content taught and the manner of teaching it, e.g., gender effects – see Amade-Escot & Verscheure, in Chap. 10; Svatošová & Fulková, in Chap. 11) and the integration of digital tools in complex learning environments such as museums (Bonnat et al., in Chap. 12), in regular classrooms, and also in remote teaching and homeschooling (Blikstad-Balas, in Chap. 13). From this set of contributions, it is clear that thinking teaching and learning systematically in relation to the knowledge contents and domains structured in the curriculum, is a powerful means of handling the classroom complexity, as well as an open way to address concrete evolutions occurring in curriculum, and schooling forms under the pressure of societal changes.

Finally, an important evolution is that *subject-specific didactics* develop along with *comparative studies in Didactics*. Earlier studies have suggested that the latter can be structured in different levels (Ligozat et al., 2015; Ligozat & Almqvist, 2018): (i) theoretical comparisons between the different traditions of research in *Didactics* (e.g., Hudson and Meyer, 2011; Meyer, 2012; Gericke et al., 2018; Schneuwly, 2021; Vollmer & Schneuwly, 2018), and different conceptualizations of teaching and learning practices (e.g., Amade-Escot & Venturini, 2015; Ligozat et al., 2018; Wickman, 2012); (ii) empirical comparisons among educational contexts, school subjects' contents, and content-specific classroom practices (e.g., Almqvist & Quennerstedt, 2015; Forest et al., 2018; Marty et al., 2018; Sensevy

et al., 2015; and also Nissen et al., 2021; Stovner & Klette, 2022 to name but a few). In this book, the role of comparison in the development of *Didactics* is discussed at a theoretical level as the reconstruction of certain conceptual tools built in *subject-specific didactics* to model the generic dimensions of teaching and learning from subject-specified occurrences (Ligozat, in Chap. 3); at an epistemological level, as a function to unveil some under-estimated dimensions of teaching and learning (Almqvist et al., in Chap. 3), and at a methodological level as a means to measure teaching qualities in different national contexts and concerning different subjects (Klette, in Chap. 9). At each level, *comparative studies in didactics* offer some concrete ways to overcome the fragmentation of the complex but rich field of research in Didactics in Europe.

Didactics – Empirical Realm and evolutions in a Changing World

Part I: Theoretical Reflections on Research Orientations in Didactics

The first part of this book presents four perspectives concerning the theoretical developments of research traditions in *Didactics* in different European countries. Three of these perspectives rely upon comparison as a means to highlight what is not immediately "visible" (i) from a single theoretical framework (in Chap. 2), (ii) from the fragmented *subject didactics* approaches (in Chap. 3), or (iii) from a single teaching tradition aimed at by teachers (in Chap. 4). The fourth perspective presents a retrospective of the development of *Didactics* in Italy – hardly disseminated in English until then – and its branching with new developments in cognitive sciences (Chap. 5). All the chapters in this part point towards the need to address the challenges of a better professionalization of teachers.

In Chap. 2, *Helmut J. Vollmer and Kirsti Klette* explore the possible components of teachers' professional knowledge in the light of a comparison of two research traditions supported by different models: the *pedagogical content knowledge* model developed in the USA by Lee Schulman and the *subject didactic knowledge* model developed in Germany. While both research approaches focus on the different types of knowledge that teachers need to develop in order to teach – and thus aim at improving teacher professionalization – the authors point to some of the limitations of the PCK model. They argue that *subject didactics* conceptualize the differences between academic disciplines and school subjects, integrate the study of school subjects into teaching and learning processes and relate them to educational goals and values. This chapter thus contributes to the intercontinental dialogue between *Curriculum* and *Didactics* but by taking *subject didactics* – and not *general didactics* or "*Didaktik*"- as its starting point.

In Chap. 3, *Florence Ligozat* presents the rationale of *comparative didactics* as a reconstructive move from *subject didactics* in France and Western-Switzerland. This development differs with the meta-theorization aimed at by *general subject didactics* in Chap. 2. Comparison, in the French-Speaking approach, is rather a way of revealing invisible or underestimated dimensions in teaching-learning practices, which leads to a rethinking/complementing of the conceptual frameworks that operate in *subject didactics*. The author shows that (i) the consideration of the triadic relation [teacher-student(s)-contents] as a system (as in Chap. 5) and (ii) the bottom-up consideration of the knowledge taught in the classroom as a transposition of various social practices, provide a theoretical common ground for the development of comparative didactics. The elaboration of the *Joint action framework in Didactics* (JAD) serves as a "tertium comparationis" for examining, relating and comparing different forms of teaching and learning practices (in different subjects, different school grades, different educational contexts, etc.).

In Chap. 4, *Jonas Almqvist, Malena Lidar and Anette Olin* rely upon certain rationales of comparative didactics in the French-speaking context (in Chap. 3) to work on the professional development of teachers in Sweden. Four fundamental aspects of *comparative didactics* are considered by the authors: i) the overall ambition to analyze what is taken for granted in different educational practices; ii) a way of organizing research beyond the fragmentation of subject didactical research areas; iii) a contribution to the wider field of comparative education that is often found to be restricted to educational policies and institutional structures; and iv) the development of teachers' knowledge of alternative ways of selecting goals, contents and manners of teaching. The first aspect is used to characterize "teaching traditions", as patterns of selection of contents, manners of teaching and educational goals in different subjects. The fourth aspect is operationalized in the framework of a model of teachers' professional development, named "didactical development dialogues", that has been used to support teachers dealing with dilemmas in choosing contents and organizing their practices in science education.

In Chap. 5, *Erika Marie Pace, Iolanda Zollo and Maurizio Sibilio* portray the historical background of the development of different didactic research traditions in Italy. First, the authors recall the educational reforms that paved the way to the development of a *general didactics* tradition of research in faculties of education, whereas *subject didactics* flourished in academic departments related to the school disciplines (mathematics, biology, etc.). This pattern is similar to that occurring in other European countries, although the discrepancy between *general didactics* and *subject didactics* is less significant in Italy than in Germany. The authors acknowledge a common systemic perspective, which values the interplay among students, teacher, subject-matter and the surrounding environment, and that positions itself as an autonomous science within the field of educational sciences (somewhat similarly to the purpose of comparative didactics, in Chap. 3). Recent developments involve the interconnection of Italian research in *Didactics* with cognitive psychology, neurosciences and A. Berthoz's "theory of simplexity" to support teachers in disentangling the complexity of the didactic system, to organize their action more efficiently.

Part II: Methods and Lenses for Exploring Teaching and Learning in the Classroom

This second part of the book illustrates the diversity and complementarities of methodological and theoretical and approaches for the empirical study of classroom practices within contemporary European *Didactics*. It comprises four chapters drawing on different data sources and theoretical lenses to investigate aspects of classroom teaching, be they subject specific aspects or generic ones. All four chapters use classroom observations (e.g., video records and/ or ethnography) as a basis for discussing key aspects of the teaching and learning activities, either in concert with other data sources (e.g. learning resources and textbooks) or by applying the observation data to different available didactic models and theoretical frameworks. They further provide a span of grades – from Kindergarten to lower secondary classrooms – as well as subject areas covered (science, language arts, mathematics and early literacy education). Two of the chapters (Chaps. 7 and 9) use didactic models and theoretical frameworks to discuss convergences and divergences in contemporary empirical classroom studies. In addition, Chap. 9 links convergences in theoretical frameworks to technological and methodological developments in video recording. Chapter 6 highlights the crucial role learning materials play in the interactive classroom practices. The purpose here was to study the alignment between the teaching approaches to initial literacy prompted by curricular materials and classroom practices with pupils in Early Childhood Education. A fourth chapter (Chap. 8) problematizes the notion of individualization and student-centered pedagogies in contemporary primary classrooms. Together, the four chapters provide an updated sample of the diversity and complementarities of methodological approaches in contemporary empirical studies of classroom teaching and learning.

In Chap. 6, *Inés Rodríguez Martín, Jorge Martín-Domínguez, María Clemente Linuesa and Elena Ramírez Orellana* use learning materials from literacy education in early childhood classrooms in Spain to discuss qualities of the materials and also the quality of the teaching approaches and interaction they support. Based on video recordings of 39 teaching sessions from nine teachers located in different schools, the authors first identify a moderate alignment between the materials used and the teaching practices enacted. Results indicate that the decisions these teachers make regarding the materials are closely linked to their professional duties and autonomous teacher role. Second, despite multiple goals and ambitions made available through the learning materials, 'teaching the reading and writing code' (e.g., phonological awareness, alphabetic principle) dominated across all the lessons analyzed. Finally, the authors suggest that it would be pertinent to include certain principles for the design of curricular materials, in which the proposed use of the resources contains the wealth of tasks highlighted by the analysis of the practice.

In Chap. 7, *Karim Hamza and Eva Lundqvist* draw on video records from six middle school science teachers, to discuss and compare two didactic models of teaching, i.e. *subject focus* and *curriculum emphases*, as a tool for analyzing science teaching in Swedish classrooms. Using two analytical scales (that of the succession

of teaching episodes and that of the whole teaching unit), they show how different conclusions can be drawn based on (a) how the models can be extracted from classroom data in conjunction with theory, and (b) how extracted models need to be 'mangled'– in other words, how the models need to be adapted to make them more useful and practical for the participating teachers. While the subject focus model indicates a rather clear pattern that is how 'induction to science' rather that 'learning from science' dominates the lessons analyzed, the curriculum emphasis model points to a rather indistinct and mixed pattern. The authors use the two models to highlight how complex an endeavor teaching and analysis of teaching is and how all didactic models run the risk of oversimplifying and reducing this complexity. They suggest collaboration with teachers – which they term "mangling" – as a third model to overcome this simplicity.

In Chap. 8, *Georg Breidenstein* draws on an ethnographic approach of German primary L1 classrooms to discuss child-centered pedagogy and especially the notion of 'individualization' as a didactic model and theory. While individualization is considered the best way of handling the complexities of classrooms in certain educational theories, the author argues that supporting evidence from enacted teaching at the micro-level is missing. By using in-depth analyses of two classroom situations to illustrate the issue, the author shows how most of the activities, interaction and communication that took place is 'rote and routine', focusing on skills and accuracy of problem solving rather than understanding. Based on these analyses, the author questions how child-centered pedagogy and 'individualization' highlight 'keeping the students busy' as a means of organizing autonomy and self–reliant learners.

In Chap. 9, *Kirsti Klette* discusses recent developments in video research and argues that the technological and methodological developments (small, miniaturized cameras, nested and integrated designs combining qualitative and quantitative data) have paved the way for a new generation of classroom studies using classroom video data as a platform to investigate comparative didactics. The author reviews existing didactic frameworks targeting classroom teaching, i.e., *observation manuals* in her vocabulary. She points to similarities and differences between the various frameworks and manuals. She argues that developments in research design (i.e., video design) and theoretical frameworks (i.e., observation manuals) facilitate what she terms programmatic comparative research – that is, targeted investigation of key facets of teaching across subjects, students and contexts.

Part III: Didactics Meets Societal Challenges

In Part III, two contemporary challenges are addressed: *gender issues* in relation to teaching and learning educational content, and the use of *digital tools* in education.

In Chap. 10, *Chantal Amade-Escot and Ingrid Verscheure* present a research program that explores how institutionalized teaching and learning processes in physical education can participate in the societal challenge of gender justice at school.

Specifically, they focus on the way gender is addressed within the French *didactique* research tradition at the micro level of didactical transactions. They use the key concepts of the *Joint Action framework in Didactics* (JAD) shaped by comparative didactics (as described in Chap. 3) to illustrate a twofold contribution to the research program: (i) investigating didactical interactions through a non-binary gender analytical lens; (ii) implementing emancipatory didactical strategies that foster non-gendered learning. A first empirical example underscores the subtle gendered didactic phenomena that are co-constructed through teacher and student transactions within a specific learning environment where stereotypical masculine and/or feminine forms of action can be valued (or not) by participants. A second example provides an overview of how the collaboration between teachers and researchers can envision undoing gender in the class without sacrificing the quality of the content in physical education. The authors highlight the specific forms of gendered embodiments, discourses, values and cultural experiences that undergird unequal knowledge construction in everyday classroom life.

In Chap. 11, *Zuzana Svatošová and Marie Fulková* focus on the productive culture of teaching art education in the Czech Republic. Since Czech society officially became democratic in 1989, the curriculum has been permanently transformed and the current Czech didactics theory uses a liberal postmodern approach to support the teachers in understanding the current curriculum objectives. First the authors present the stakes involved in teaching and learning visual literacy as a broad perspective encompassing art education. Second, from a qualitative analysis of art teachers' discourses on gender issues in teaching visual literacy in secondary schools, the authors present a theoretical model of the components of the creative process in which masculine and feminine approaches to teaching are integrated. The authors argue that the "model of gender-balanced teaching" can support art teachers who reflect on their teaching strategies and thus improve their teaching of visual literacy towards an equilibrium between symbolic analysis and imagination.

In Chap. 12, *Catherine Bonnat, Eric Sanchez, Elsa Paukowics and Nicolas Kramer* address the second challenge tackled in this part of the book, i.e., the digitalization of learning environments. They use the *ludicization* model to enable the contextualization of knowledge in game-based learning. The authors first present an analysis of the didactic transposition of Anthropocene in the Western Swiss curriculum, as a new, complex and interdisciplinary concept. Then, they describe "Geome", a game dedicated to museum school visits in the Nature Museum of Wallis (Switzerland), as a game-based learning approach to Anthropocene. The collaborative design of "Geome" enables a didactic transposition model to be built, integrating the *ludicization* model as a tool to contextualize a target situation (a situation to be taught) into a source situation (a game-based learning situation) considering the complex relationships between actors, concepts and artefacts.

In Chap. 13, *Marte Blikstad-Balas* discusses why access to technology it not enough to digitalize education, and what kind of knowledge-specific educational research we need to address digitalization in the classroom. Digital competence is considered as a crucial aspect of education, but it is often too general and does not consider subject-specific differences in what digital competence may be across

disciplines and grades. The author draws on empirical data from two different projects to shed light on these questions: the large-scale video study Linking Instruction and Student Achievement (LISA) and a national survey addressed to parents in Norway about what characterized teaching and homeschooling during the outbreak of the COVID-19 pandemic. The author points to important implications of these results for the field of didactical research and underscores the need for more studies looking systematically into what digital competence means within specific didactical contexts.

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Florence Ligozat is Professor in Comparative Didactics at the Faculty of Psychology and Educational sciences, University of Geneva, in Switzerland. During her doctoral and post-doctoral studies, her research focused on mathematics didactics and science didactics. Her current research investigates the didactic transposition of knowledge in classroom practices and the specific / generic dimensions of teaching through the modeling of the teacher and student's joint actions in different educational contexts. She is particularly interested in cross-cultural comparisons of classroom practices and research traditions in Didactics in European countries. She chaired the French-speaking Association for Comparative Research in Didactics (2012–2016). She is currently convenor of EERA Network 27 Didactics – Learning and teaching, and she acted as Main Link convenor of this network in the period 2016–2021.

Kirsti Klette is a distinguished professor at the Department of Teacher Education and School Research, University of Oslo. Her research interests include research on teaching and learning, teaching quality, classroom studies and comparative studies. She has been the principal investigator for several international and comparative projects targeted classroom learning including the large-scale video study "Linking Instruction and Student Achievement" (LISA) analyzing how instructional practices in mathematics and language arts impact student learning, and the "Synthesizing Research on Teaching Quality" (SYNTEQ) summarizing how classroom video documentation develop our understanding of teaching quality. She is also the Director of the newly funded Nordic Center of Excellence "Quality in Nordic Teaching" (QUINT) drawing on comparative classroom video data from all Nordic countries. She is one of the founder of the EERA Network 27 Didactics – Learning and Teaching, and she acts as convenor of this network since 2005.

Jonas Almqvist is Professor at the Department of Education, Uppsala University in Sweden. He is the scientific director of the Research Group for Comparative Didactics. He develops research in comparative didactics with a focus on issues of teaching and learning in different subjects (mainly biology, chemistry and physics) in compulsory school and in preschool. He currently leads the international research network "Comparative didactics and professional development for teachers" funded by the Swedish Research Council. He is currently convenor of the EERA Network 27 Didactics – Learning and teaching and he acted as Deputy Link Convenor of this network in the period 2014–2021.

Part I
Theoretical Reflections on Research Orientations in Didactics

Chapter 2
Pedagogical Content Knowledge and Subject Didactics – An Intercontinental Dialogue?

Helmut Johannes Vollmer and Kirsti Klette

Introduction

The article addresses a relevant issue worldwide: what are the components of a teacher's professional knowledge, how can we identify, mediate and measure its development and how support its improvement over time? How can a teacher proceed from general knowledge (disciplinary or pedagogical) to professional application and concrete action based on this knowledge?[1]

More than 30 years ago the American educator and educational philosopher Lee S. Shulman designed a model for the description and analysis of necessary teacher competences for efficient teaching and for a better teacher education. His professional model, integrating different sources of knowledge, became known above all in association with the notion "Pedagogical Content Knowledge" (PCK), although this is only one aspect of many, but perhaps the most striking one. Shulman's approach was and still is highly influential not only in the US, but in almost all parts of the world.

In *Europe*, similar approaches for defining teacher competences for professional teaching have been developed under the notion of didactics, in connection with

[1] From the start we are confronted with the theoretical issue of Knowledge versus Competence: What is the difference between them? How can we define each of them and their relationship? We prefer to speak of Knowledge as the super-ordinate term for cognitive insights, command of factual knowledge and basic capabilities, dispositions for further learning and applications.

H. J. Vollmer (✉)
University of Hamburg, Hamburg, Germany
e-mail: johannes.vollmer@uni-hamburg.de

K. Klette
Department of Teacher Education and School Research, University of Oslo, Oslo, Norway

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general pedagogy (overview in Cramer & Schreiber, 2018). Recently, a new approach of focusing on subject-specific considerations of teaching and learning and thus on identifying professionalism in a specialized, subject-didactic perspective has evolved. Subject-Matter Didactics (short: Subject Didactics, SD) is the umbrella term for the different sciences or theories and practices of teaching and learning in specific areas of content, related to school subjects and to an institutional curriculum. Subject didactics have developed as research disciplines (especially in the European countries) over the last 20–30 years and are relatively well established by now as academic fields and as providers of knowledge, competences and practical skills (*Handlungskompetenz*) for future teachers. This has led to a great amount of empirical research and to several obligatory training courses within teacher education.

In the current chapter we will discuss the relationship between Pedagogical Content Knowledge (PCK) and Didactics, more specifically Subject Didactics (SD). We will point to some commonalities as well as to differences between the two approaches. As such, this chapter contributes to an emerging body of research discussing didactics at the intersection of general didactics and subject-specific didactics arguing for subject didactics as a cornerstone for integrating the study of school subjects into teaching and learning processes and relate them to educational goals and values. Within this chapter, it will only be possible to sketch the topic and its many dynamic facets in a rather selective way (also see Rothgangel & Vollmer, 2020; Vollmer, 2021b).

Major Achievements and Criticism of Shulman's PCK-Approach

Shulman's move to provide a knowledge base for teaching can be seen as a response to criticism of the quality of American schooling in the 1980s. In addition, it is also addressing a very important "missing paradigm" (Shulman, 1986) in research on teaching in the 1970s and 1980s, namely the lack of attention to content. As to the first point, the criticism mentioned was really severe: it almost caused a crisis in American education, because schools did not perform well enough, and this was largely blamed on teachers. Therefore, to improve the quality of American schools, Shulman and colleagues argued for professionalizing teaching. They claimed that teaching, like other professions such as medicine, had a professional knowledge base which had to be identified and made transparent. This knowledge base was linked to research, collective practices, existing teaching manuals and personal experience. Past research on teaching had more focused on teacher behaviours, on attitudes, motivations etc.—variables that might have impact on teaching and learning in the classroom and most likely have. One thing lacking, however, was knowledge/knowing about the knowledge base, especially about content knowledge. More concretely the question became: How to understand and conceptualise teachers' content knowledge?

Components of the PCK Model

In analyzing Shulman's construct, we can identify seven interrelated components, with which the author looks at essential mental/contextual conditions for teaching (Shulman, 1987):

- general pedagogical knowledge,
- knowledge of learners and their characteristics,
- knowledge of educational contexts,
- knowledge of educational ends, purposes, values,
- content knowledge,
- curriculum knowledge,
- pedagogical content knowledge.

The first four categories cover general aspects of the educational process and related teacher knowledge. The very first one, (1) "General pedagogical knowledge", refers to familiarity with "broad principles and strategies of classroom management and organization" (Shulman, 1987, p.8) i.e., competences at the level of general teacher action. The second one, (2) "Knowledge of learners and their characteristics", is considered equally important; it relates to familiarity with the learning prerequisites of the learners, their momentary learning levels and their dispositions. This also includes knowledge of "students' misconceptions" (Shulman, 1986, p.8; 1987, p.11), as identified by empirical studies. Thirdly, there is knowledge of the administrative framework of learning, a category broadly defined by Shulman as (3) "Knowledge of educational contexts" and meaning knowledge "ranging from the workings of the group or classroom, through the governance and financing of school districts to the character of communities and cultures" (Shulman, 1987, p.8). All the above must be connected with (4) "Knowledge of educational ends, purposes, and values", and their philosophical and historical grounds (cf. Shulman, 1987, p.8).

These four general pedagogical dimensions are complemented by three content-specific ones, labelled (5) "content knowledge", (6) "curriculum knowledge" and (7)" pedagogical content knowledge" (PCK) (Shulman, 1986, p.9–10), which has given the model its name. These dimensions and particularly the last one mark the special character of Shulman's approach: the combination of pedagogical and subject matter aspects blended, which was unique and innovative. In Shulman's own judgment, this is an attempt to overcome a known deficit in broad areas of educational research and institutional framing in the US during those years (1970/1980s). At the same time, Shulman's approach established a new subject-matter related paradigm which was "missing" before (Shulman, 1986, p.7–8; confirmed in Shulman, 2015, p.6). In another context, he even speaks of a "lost planet", meaning the importance of subject-matter content which was found again. In the following lines, we will elaborate on this and summarize our criticism around five issues, namely (i) the notion of content; (ii) the role of curriculum; (iii) the necessary transformation of content into teachable units or segments, (iv) teachers and students as the subject of study, and (v) the institutional framing of schooling.

1. By *'content knowledge'* Shulman understands knowledge of "the structures of subject matter, the principles of conceptual organization, and the principles of inquiry" (1986, p.9–10). In general terms, he qualifies "the accumulated literature and studies in the content areas, and the historical and philosophical scholarship on the nature of knowledge in those fields of study" as the basis of content knowledge (Shulman, 1986, p.9). This implies that it is the academic disciplines which constitute the core of 'content knowledge', an understanding based on the concept of the 'Structure of the Disciplines'by Schwab (1964; see also Shulman, 2015, p.4; Deng, 2018, p.156). Accordingly, Shulman distinguishes between "knowledge of the substantive structure (essential concepts, principles, frameworks) and the syntactic structure (modes of inquiry, canons of evidence, ways to proof) of an academic discipline"(ibid.), quite analogous to Schwab. Teachers are supposed to gain such knowledge based on accumulated literature and studies – an assumption, which is problematic: again, it does not distinguish enough between academic and school knowledge (see Deng, 2009). The latter therefore speaks of a "conflation of academic disciplines and school subjects"; for him 'the amount and organization of knowledge per se in the mind of a teacher' can be considered the first condition for better teaching.
2. Shulman speaks of *curriculum knowledge*, but he does not acknowledge the importance of the *institutional curriculum* (national curriculum guidelines i.e., curriculum policy defining the purposes and expectations of schooling in relation to society and culture).[2] Also, the programmatic curriculum is not topicalized, which translates the purposes and expectations into school subjects and related programmes of study – in the form of a curriculum framework or syllabuses. Both are shaping and determining a teachers' knowledge of content. And both matter for understanding what teachers need to know and be able to do about the content: taking the curriculum as the starting point for their instructional planning, teachers work with the content of a school subject (*not* of an academic discipline) within the institutional curriculum in a classroom; teachers interpret and transform the content of a school subject into instructional events in the light of students' existing knowledge and experiences, with reference to the expectations and aims of the policy curriculum (cf. Deng, 2009, 2019).
3. *Pedagogical content knowledge* (PCK) as the centre piece of the whole model of teacher professional competences topicalizes the unresolved relationship between content knowledge and pedagogy, and how these two sources interact or can be combined for teaching. The PCK model is not very clear in this matter,

[2] We are fully aware of the differences in educational tradition between the US and Europe in this matter (see for example Gundem & Hopmann, 1998; Künzli, 2000; Hamilton, 1999; Gundem, 2010; Hudson, 2007; Kansanen, 2009; Doyle, 2017; more recently Krogh et al., 2021). On the other hand, the situation has changed over the years: Shulman's texts were written in the 80s of last century – 30 years before the introduction of the Common Core Standards in most states of the US (cf. Opfer et al., 2016).

but it assumes that the teacher necessarily has to transform the content (of an academic discipline) into forms suitable for teaching. In doing so, there are three basic components involved: pedagogical representations, students' prior knowledge (including misconceptions) and learning difficulties, and instructional strategies that tap on their prior knowledge and address their learning difficulties. But beyond such formulations, Shulman's ideas (1987) remain rather vague. From subject-didactic research, however, we know that this transformation or "modelling" entails pedagogical reasoning – preparation, representation, adaptation and tailoring – toward the selection and identification of pedagogical representations and strategies catered to students of particular backgrounds and characteristics (cf. Bayrhuber, 2017). This transformation is also informed by the teacher's knowledge of educational purposes, of the school curriculum, of general pedagogy, and of the school context as a whole.

4. Another critique has been pointed out repeatedly (e.g. Amade-Escot, 2000; Kansanen, 2009; Deng, 2016, 2018; more recently Vollmer, 2019). It relates to the *processes of teaching* itself: Learners are not just recipients of knowledge transmitted by a teacher; they interact in themselves with the content, with the teacher and with one another, turning teachable into actually taught or acquired content. Shulman's focus on the teacher only or mainly is too one-sided in this respect.
5. Finally, the larger social context in terms of school subjects, curriculum and societal demands on education is not really dealt with, in the PCK framework. For Shulman, school subjects or the making of disciplines into school subjects (e.g. Goodson, 1993, 2003) are virtually non-existent; accordingly, a conceptualization of teachers' understanding of the content of a school subject is largely absent. In this perspective, a lack of reflecting the necessary transpositions of knowledge and the socio-political sedimentation of educational practices is noticeable. In the streamline of Chevallard (1985/1991),[3] Schneuwly (2019) claims that school knowledge is *essentially* the result of a didactic transposition, external and internal, that fundamentally transforms the initial academic, disciplinary knowledge. In addition, school subjects ("disciplines scolaires" in French, "Schulfächer" in German) are cultural products that organize school knowledge in a specific way in function of aims and values. In sum, school knowledge is the historical product of long-lasting didactic and teaching practices: as such the teaching profession has a strong history and memory, which must not be overlooked.

[3] Chevallard (1985/1991). See also Chevallard et al. (Eds.) (2022) for an overview in Engllish of the concept of Didactic Transposition in the Frankophone tradition of Didactics.

Recent Developments

From early on, Shulman's followers have discussed and widened the number of components for professional competence e.g., by adding "knowledge and beliefs about the purposes of teaching the subject" (Grossmann, 1990, in Language Art) or more specifically "science teaching *orientation*" and "knowledge of assessment" (Magnusson et al., 1999). Moreover, Ball et al. (2008) have underlined the central role of content once more by formulating: "i) knowledge of content and students, ii) knowledge of content and teaching, and iii) knowledge of content and curriculum", whereas Loughran et al. (2012) specify that it is not content knowledge *per se*, but "content representations (CoRe)", which count as professional competence. This debate about additions or specifications has continued over the years, which throws light on a certain vagueness of the PCK model.

There are numerous publications on the Pedagogical Content Knowledge approach and framework in the international educational literature. Several of these are written in the field of natural sciences, mostly in physics, chemistry and mathematics. These subjects, and the teachers teaching them seem to lend themselves better or easier for the conceptualizations of Shulman than teachers in other content areas. As to recent developments in Shulman's thinking and that of his many followers, a First PCK-Summit took place in 2012 (Berry et al., 2015): a re-conceptualization of PCK in the form of a new "Consensus Model" emerged in order to further science education research. Three years later, on the Second PCK-Summit in 2015, it became clear that this Consensus Model had to be refined because there was still an amazing amount of divergence about it. Meanwhile all the empirical studies on PCK accessible worldwide had been reviewed and analyzed with the simple and sobering result, "that researchers conceptualize and operationalize PCK differently" (Kennedy & Hume, 2019, p.3).

Reactions to Shulman in Europe

In the European context, we can distinguish two different lines of reception: Quick adaptations of PCK by pedagogical-psychological research groups versus alternative modelling towards subject-didactic knowledge.

Pedagogical-Psychological Adaptions of Shulman

Within many European countries, particularly in France, Switzerland, Netherlands and Germany, Shulman's concept of PCK has been widely acknowledged and used within empirically based research on teacher professionalization, mainly by educational scientists (although often in cooperation with subject didacticians e.g., in

math, but also biology, physics, foreign languages or mother-tongue education). The concept was introduced via direct translation into the respective languages (e.g. Baumert & Kunter, 2013; Krauss, 2009; Blömeke, 2011; Krauss & Schilcher, 2016; Cross & Grangeat, 2014 or Coquidé et al., 2010; also Schneuwly, 2019). This resulted in several important studies with specific approaches of operationalization and new differentiated insights into the structure of a subject teacher's professional knowledge, centered on the content base of his/her teaching and the pedagogical considerations and decisions related to it (e.g. Kunter et al., 2013 for mathematics; Kröger, 2019 for physics; Krauss et al., 2017 for a large number of school subjects). In this chapter, we will not deal with the details of the many studies, which have used the PCK concept by now, and "experimented" with it in, what we might describe as, a rather superficial way. The very fact that many scholars found it necessary to "optimize" Shulman's model and try out additions or improvements, indicates a built-in weakness of the construct.

Seen from a Northern Europe perspective, pedagogical content knowledge is a rather narrow concept anyhow. It is the teacher's professional knowledge, knowing how to prepare content for the students in a way that studying and learning can be as effective as possible. But as Bromme (1995) already remarked, this does not contain the processes of how to transform the disciplinary content into subject-matter content in the classroom – which is exactly at the heart of subject-didactic activities. A detailed analysis of the different PCK-inspired models which rely on a narrow understanding of Shulman, is presented in Frederking & Bayrhuber (2019) for Germany and in Schneuwly (2019) for France/Switzerland. But even if those adaptations of PCK were made by claiming didactic considerations, the models developed were not *(subject-) didactic in nature*, at least they were not defined fundamentally and comprehensively enough so to grasp the complexities of teacher professionalization, as seen from a subject-didactic point of view.

In other words, the appropriation of PCK, directly translated into "Subject Didactic Knowledge" does not necessarily reflect what the term expresses semantically and how it has been conceptualized in Europe, namely professional knowledge provided by subject didactics on a number of different levels (e.g. capabilities to observe and interpret classroom interaction, competence to understand what a specific subject didactics does and offers, and last, but not least, looking beyond one's own subject or field so to discover new proximities or differences). One could even speak of "invading subject didactics" in the European sense by replacing it through a similar term with reduced meaning, as Schneuwly (2019) does. The existing discourse on didactics in Europe, widely unfolded and differentiated within the last decades, is somewhat neglected and a research reality well established in this context – subject didactics – is taken over and thus occupied without respect for its original definition and meaning: for example, the German term "*Fachdidaktisches Wissen*" has a history and a comprehensive meaning of its own (Bayrhuber et al., 2017; König et al., 2018; Frederking & Bayrhuber, 2019) which is now reduced by equalizing it with PCK. This seems to be an invalid equivalence in terms of substance and conceptual implications.

Subject Didactics in Europe

Didactics, the science of teaching and learning in school and beyond, is well established in almost all of Europe (e.g. Hudson & Meyer, 2011; Ligozat & Almqvist, 2018), whereas "Subject-Matter Didactics" exists in Germany, large parts of Scandinavia and elsewhere, next to "Didactique(s) Disciplinaire(s)" in Francophone countries (e.g. Vollmer, 2014, 2017; Bayrhuber et al., 2017; Rothgangel et al., 2021; Schneuwly, 2011; Dorier et al., 2013). Subject-Matter Didactics (or short "Subject Didactics", SD) is an academic discipline still under construction, yet developed over the last 20–30 years, with traces long before. Its object is "subject-specific teaching and learning within and outside of school" (KVFF, 1999, p.13). In most subjects ("*Fächer" in German*) taught in school there are nowadays respective "subject didactics" (like chemistry didactics, biology didactics or music didactics) as scientific fields, anchored in the academic structures, with representatives on the professorial level in most Northern-European teacher training institutions and universities. These subject didactics (as specific fields of research and expertise) exist alongside the subject-related academic disciplines (like biology or music as a science) and the educational sciences in general, often as a part of an institutionalized teacher training. The teachers are primarily focused on the knowledge accumulated within their school subjects to which they relate and upon which they act accordingly: it is the school subjects that normally provide the frame of reference for professional thinking and acting (Künzli, 1981).

This subject didactic approach is much less known to the rest of the world than Shulman's Pedagogical content knowledge framework, but it allows us to identify some important teacher competences at play in the formation of professional development over time. Within the last two decades the different subject didactics have communicated and networked strongly, they organize their own exchange on a regular basis, leading to different projects of comparative (subject-) didactics in France (e.g., Ligozat, in this book) or Scandinavia (e.g. Almqvist, in this book; Klette, *Comparative Classroom Research*, in this book). In Germany, a more systematic approach of comparing commonalities and differences of individual subject didactics was chosen, moving towards the formulation of a theory of Subject Didactics, called "General Subject Didactics".[4] Within this framework of subject-didactic theory-building one arrives at the notion of "Subject Didactic Knowledge" in a new light as an alternative to PCK, comprising much, if not all that a teacher needs to know and be able to do in his or her profession. This Subject Didactic Knowledge (SDK) reflects the structure of necessary teacher competences for the future: it is thus the central notion of a new way of didactic thinking and of professional teacher education, which will be explained in more detail.

[4] There are two basic volumes published in German within a series entitled „General Subject Didactics", Volume 1 (Bayrhuber et al., 2017), and Volume 2 (Rothgangel et al., 2021). The latter one is in the process of being partly translated into English (Vollmer & Rothgangel, forthcoming). See also an English-speaking summary in Rothgangel & Vollmer, 2020).

Towards Subject Didactic Knowledge

General Subject Didactics

In Germany, the development from general didactics towards subject didactics and beyond has led to a new theoretical platform labelled "General Subject Didactics" and further to an outline of the concept of Subject Didactic Knowledge (SDK) as the central notion of a new way of didactic thinking and of professional teacher education. Based on the authoritative self-definitions of the respective *Fachdidaktiken*, a first comparison between the approaches and findings of seventeen different subject didactics was done (on the basis of the Grounded Theory; cf. Strauss & Corbin, 1996), with striking results concerning differences between them, but also commonalities and joint perspectives among them (cf. details in Rothgangel et al., 2021; Rothgangel & Vollmer, 2020, in English). In these largely bottom-up processes of relating and comparing the existing subject didactics as independent scientific research agencies, new insights and knowledge came up, from historical linkages, theoretical orientations, terminological conventions, empirical preferences, or tendencies to cooperate with other subject areas, depending on interest, topic/issue or common goals. One of the most important findings of this analytical endeavor has to do with goal setting as an integral part of didactics (value-driven, normative or pragmatic). All the seventeen subject didactics compared are claiming to contribute to subject-based *education* (in the emphatic, fundamental sense of the term) or *Bildung as one of their ultimate goals*. In fact, they are striving for a sound subject-matter knowledge acquisition and in or through that for *Bildung* in subject-specific terms simultaneously, on a personal and a functional as well as on a social or communicative level.

By relating and comparing different subject didactics as the object of study and reflection, we have moved away from the former level of individual observations related to questions, procedures and results of *one specific* subject didactics as a field of scientific inquiry. Instead, we are now operating on a comparative or meta-level of observation as a scientific activity, which has been qualified as *General Subject Didactics* (GSD). This new scientific platform *requires* a meta-theoretical look at the different content-based didactic sciences and thus of subject didactics as a whole (see the first two volumes of "*Allgemeine Fachdidaktik"* by Bayrhuber et al., 2017 and Rothgangel et al., 2021).

This theoretical approach of Luhmann (1992)[5] can now be applied to the subject-didactic field and namely to the individual subject teachers and particularly to their

[5] Based on the Philosophy of Science by N. Luhmann (1992) we can distinguish between three levels of observation: first order observations (e.g. those of a teacher about his/her classroom); second order observations (e.g. those of subject didactics and their theories, formed in a scientific manner, relying on objectivity, reliability and meaningfulness); third order observations (e.g. by comparing data and findings as well as theories of subject didactics on a meta-theoretical level). These ideas were introduced into the didactic discourse by Rothgangel (e.g. 2017) and later applied to subject didactic knowledge of three different types (cf. Rothgangel, 2021).

subject didactic knowledge (cf. Rothgangel, 2021). Accordingly, we can distinguish between three different types of such knowledge:

1. Experience-based subject didactic knowledge – on the basis of one's own practice, of everyday observations and subjective theory-building about subject-specific teaching and learning (type 1)
2. Scientifically based subject didactic knowledge – on the basis of scientific insights and research results from the individual subject didactics which have meet standards like objectivity, generalizability or empirical testing (evidencing) (type 2)
3. Meta-scientifically gained subject didactic knowledge – on the basis of re-analyzing and theorizing what was found out either on the subjective, experience-based level or on the level of scientific didactic research, now expressed within a meta-theoretical framework (type 3).

With this third type of subject didactic knowledge (SDK) a reflection about the individual contributions of all subject didactic disciplines for defining the common good of all education comes into focus: facets of cross-curricular goal setting, links and cooperation among different subjects and contribution of each for the overall perspective of personal and functional empowerment, accompanied by joint attempts to define what learners need for the twenty-first century. In Germany, this meta-theoretical perspective is in the process of being developed under the notion of a "Theory of Subject-Based Education as Bildung" – with active participation of the different subject didactics, of the relevant socio-political agents and the subject-based teaching professions themselves. A similar meta-theoretical attempt has been applied across classroom observation instruments; see Klette (Chap. 9, in this volume) and Charalambous & Praetorius (2020). Without being too normative, this is suggested as the starting and reference point for a meta-theory of subject didactic knowledge, type 3 (cf. also Frederking & Bayrhuber, 2019; Vollmer, 2020, 2021a, b).

In sum, the research done by each Subject Didactics on a theoretical, historical or empirical basis about their different subject areas and the comparison, re-analysis and theoretical framing done through General Subject Didactics on a higher (meta-theoretical) level has provided us with a general orientation towards a theory of subject-based education as Bildung. Derived from that model we can rightly understand "subject-matter didactic knowledge" as the knowledge of teachers (and of the teaching profession), which is powerful and reflective towards students' basic educational needs (Bildung) and follow these via subject-specific awareness, teaching and reflection. The educational substance ("Bildungsgehalt" in German) of content is determined by elemental categories or aspects (e.g. penetrating cases, concepts, principles, values) that could contribute to Bildung (Deng, 2019). Content, by virtue of its educational substance, can bring about fundamental changes in the perspectives, modes of thinking, dispositions and ways of relating to or being-in-the-world of individual students (cf. Schneuwly & Vollmer, 2017; Frederking & Bayrhuber, 2017; Deng, 2016, 2019; also Krüger, 2008). In the next section, we will discuss what this professional orientation towards Bildung (in a multiple sense) consists of in detail, and what the core components are.

Designing a Model: Subject Didactic Knowledge

A Theory of Subject-based Education with its three facets of personal, functional and social/communicative *Bildung* and the entire foundational as well as applied research going along with it will be the main source for describing and designing such a subject-didactic competence model of teacher professionalism. This is the highest level of knowledge and reflection that we possess in subject didactics, gained through the meta-theoretical insights and comparisons between all subject didactics and transformed once more by General Subject Didactics: this level equals type 3 of subject didactic knowledge (SDK), as outlined above. We could start by suggesting positive criteria for components of competence, which a professional teacher should be able to have or master, relying on his or her subject didactic knowledge, having Bildung at the center of his/her attention, and of professional concern. We could then see how individual teachers or subject-specific groups of didacticians react to these suggestions, before further elaborating them together. These components could be:

1. *Subject didactic knowledge about content* e.g., relationship between academic disciplinary knowledge available and content actually teachable or taught, processes of didactic transposition which fundamentally transforms academic or disciplinary knowledge, relating content decisions to goals of subject-specific education or Bildung, structuring content, applications of subject-matter knowledge, etc.
2. *Subject didactic knowledge about teachers and students* e.g., defining the role of a teacher in relation to activities of learners, teachers' understanding of "content", motivation, interest and orientation as teacher variables etc.
3. *Subject didactic knowledge about subject-specific teaching-learning processes* e.g., close interaction between teaching and learning, as expressed in the Joint Action Theory of Didactics[6] for example, school knowledge as a product of long-lasting teaching practices and their sedimentation, overcoming/replacement of transmission approaches etc.; cf. also Klette, 2009).
4. *Subject didactic knowledge about values and goals of education* e.g., goals derived from society/the state, goals constructed socially, but also subjectively; explaining the WHY of education; values and goals always embedded into an "educational theory".
5. *Subject didactic knowledge about the institutional level of school subjects and the curriculum* e.g., school subjects as historical units/outcomes, school knowledge as conventional, socio-politically mediated dynamic cultural products.

All these aspects have a clear *subject didactic knowledge base,* they are related to one another and *will have to be integrated by an individual teacher* in view of his or her own subject(s) to form the basis for successful subject-matter teaching under the perspective of developing "subject-based Bildung for All". This knowledge can be

[6] Sensevy, 2011, 2012, 2019a, b.

largely located on the first level of SDK (type 1, as described above) where the teacher draws on his or her own observations, subjective theories and inferences made through experience. But in some cases, this knowledge could also be anchored in mental activities on the second level of SDK (type 2 above) where the teacher already draws on insights from research gained within his/her specific subject field. Also, hybrid forms of professional behavior are thinkable: experience-based generalizations – application of suggested principles for concrete situations. Overall, the acquisition and mastery of those aspects will indeed require some contact with the scientific developments in the field, particularly through ways of noticing, relating and integrating the results of ongoing research into one's own awareness and professional actions – perhaps even participating partly in their production. It is not very likely that any one individual teacher will develop professional competence on level 3 (type 3 of SDK), although interdisciplinary cooperation in the school will necessarily lead to reflections in this direction. That might even true for most subject didacticians, unless they deal exactly with issues of cross-curricular advantages and planning. Nevertheless, based on recent theory-building in subject didactics and above all on our empirical findings so far (cf. Rothgangel et al., 2021), we can claim that the command over forms of SDK constitutes a core element of powerful professional educational knowledge for teachers.

PCK – SDK: Perspectives of *Didactic Thinking*

Looking back, we have interpreted Subject Didactic Knowledge (SDK) more in terms of a competence model, as a structure of related items of perception and consideration than as a list of isolated, measurable knowledge components. This is also motivated by the fact that no knowledge will automatically imply or lead to action, however reflected and careful this might be done. Whether PCK will continue to dominate the floor or whether the SDK approach will become equally interesting and accepted, once it has been further developed, better tested and proven valid, remains to be seen in the future of professionalism research worldwide. The problems of comparing internationally different didactic research traditions in different countries have not diminished over the years (cf. Gundem & Hopmann, 1998) nor will the necessary discourse between different educational systems and academic cultures underlying PCK and SDK be easy, but it is worth trying (again). This task will be complex, if not complicated (cf. Hopmann, 2007; König et al., 2018).

Scholars like Deng (2018) have suggested a re-envisioning of PCK altogether through exploring what is entailed in teachers' understandings of content within the framework of the institutional curriculum, with a central concern for the development of human *powers* (capacities or abilities, ways of thinking, understanding worlds, etc.). His shift of focus lies on *Didaktik thinking* (*curriculum thinking* and *curriculum making*) rather than on factual or stable knowledge. Following this idea would mean to revitalize Klafki's later works (2000), and his variety of a "Bildung-centered Didaktik". Klafki himself propagated "didactic analysis" as a central part

of lesson planning and for choosing the right content in view of the students' global as well as subject-based education. Similarly, Schneuwly suggest to re-interpret PCK as *one* aspect of a broader mind-set of teachers called "savoirs didactiques" in French. Frederking & Bayrhuber (2019) or Vollmer (2020, 2021a) equally suggest a re-conceptualization of what teachers know (or should know) and how this integrates internally for them to be able to act competently – informed by the idea of Bildung and a content-didactic way of thinking (cf. also Westbury, 2000; Horlacher, 2017). Accordingly, they plead for a potential substitution or replacement of PCK by the notion of Subject Didactic Knowledge in the true, authentic sense of the term, as defined by General Subject Didactics and as presented here.

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Helmut Johannes Vollmer is Professor Emeritus in the Faculty of Languages and Literature, University of Osnabrück, Germany, where he taught English linguistics, English as a Foreign Language and English Didactics. His research interests include pragmalinguistics, discourse analysis, bilingualism and bilingual education as well as subject-matter didactics. He directed the Research Center for Bilingual Education and Multilingualism in Osnabrück and published widely in Germany, Europe and North America. He is the co-founder of German Association of Foreign Language Research, and co-editor of the RISTAL.org. He has been convenor of the EERA Network 27 Didactics – Learning and Teaching in the period 2010–2019.

Kirsti Klette is a distinguished professor at the Department of Teacher Education and School Research, University of Oslo. Her research interests include research on teaching and learning, teaching quality, classroom studies and comparative studies. She has been the principal investigator for several international and comparative projects targeted classroom learning including the large-scale video study "Linking Instruction and Student Achievement" (LISA) analyzing how instructional practices in mathematics and language arts impact student learning, and the "Synthesizing Research on Teaching Quality" (SYNTEQ) summarizing how classroom video documentation develop our understanding of teaching quality. She is also the Director of the newly funded Nordic Center of Excellence "Quality in Nordic Teaching" (QUINT) drawing on comparative classroom video data from all Nordic countries. She is one of the founders of the EERA Network 27 Didactics – Learning and Teaching, and she acts as convenor of this network since 2005.

Chapter 3
Comparative Didactics. A Reconstructive Move from Subject Didactics in French-Speaking Educational Research

Florence Ligozat

Introduction

Since the 2000's, a field of "*didactique comparée*" (comparative didactics) has been developing in the French-speaking educational research community. Unlike the "*didactiques des disciplines*" (subject didactics), *comparative didactics* is not defined from the outset in relation to the division of knowledge into academic disciplines or school subjects. The denomination of this field often raises many questions about what is compared and for what purposes. In addition, different trends of comparative studies in *Didactics* have also developed in recent years in Europe, in response to the need for dialogue and greater coherence between the traditions of research in teaching, learning and curriculum, within and between different countries (cf. Almqvist et al., in this volume; Klette, in this volume; also see Krogh & Qvortrup, 2021).

This chapter aims to clarify the purposes of the development of *comparative didactics* in French-speaking educational research, as a reconstructive move based on the conceptualization of teaching and learning provided by subject didactics. I argue that in its current state of art, comparative didactics is an epistemological act seeking to overcome the fragmentation of subject didactics, and to provide a common ground of conceptual tools for investigating curriculum –both knowledge content selection and transformation processes and pedagogical practices – from a bottom-up perspective, i.e., starting from classroom studies.

In the first section, I recall some salient characteristics of *subject didactics* development in French-speaking research in education. Both the consideration of the triadic relationship between the teacher, the students and the knowledge contents

F. Ligozat (✉)
Faculté de Psychologie et des Sciences de l'éducation, Université de Genève, Geneva, Switzerland
e-mail: Florence.ligozat@unige.ch

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(didactic system) and the consideration of the knowledge taught and learnt in schools as a transposition of social practices (didactic transposition) paved the way for the emergence of comparative didactics. In the second section, I take the seminal paper by Mercier et al. (2002) as a basis to explain the rationale of the development of comparative didactics, as a comprehensive science of knowledge transmission[1] (or re-construction) in teaching and learning practices. As suggested by these authors, the modelling of the generic characteristics of didactic systems relies upon comparison of their specific manifestations about different knowledge contents, in different cultural contexts, and at different time scales. However, such a development faces certain epistemological and methodological issues inherent in comparison. In the third section, I unfold some conditions to avoid the pitfall of explaining classroom events with concepts built in a single context, which would function too quickly as a universal model. One of these conditions is the selection of a sufficiently generic framework for examining the different terms to be compared with the same "lens". Hence, in the fourth section, I present the main features of the Joint Action framework in Didactics (JAD) elaborated as a "tertium comparationis" for operating the comparison of classroom events from one discipline to another, from one institutional context to another. Finally, in the fifth section, I draw some future lines of development for comparative didactics.

Subject Didactics in French-Speaking Educational Research

For more than 40 years, research fields named "*les didactiques des disciplines*" (subject didactics) have developed within the educational research community in France and in some French-speaking regions, such as Western-Switzerland. This development is characterized by being anchored in the school subject-matters and, in certain cases, their related academic disciplines. This trend is not isolated; similar developments have taken place in other Continental European countries (or have been influenced by them), as shown by Schneuwly and Vollmer (2018), and Pace, Zollo & Sibilio (in this volume). In this section, I present some characteristics of the French-speaking tradition of *subject didactics* to explain the rationale of the emergence of comparative didactics.

The French-speaking *subject didactics* were built on the idea, increasingly shared since the 1970s, that the knowledge taught/learned irreducibly shapes teaching and

[1] In this paper, and in the Francophone context more generally, the use of the term "transmission" qualifies ways of doing, saying, and thinking that are learned (or re-constructed) from those who already master these ways of doing, saying or thinking. The use of the term "transmission" stresses the need to consider teaching-learning practices as socio-historical processes marked by the continuity of some cultural traditions (school disciplines or other normative forms of activity) in which knowledge takes shape. Hence, "transmission" here does not presuppose a specific conceptualization of teaching and learning as "transmissive" or "constructivist" in the French-speaking educational discourse.

learning practices (i.e., textbook designs, lesson plans, classroom management and discourse, assessment criteria, etc.). This idea is formalized by the triadic relationship between a teaching pole, a learning pole, and the knowledge content as the third pole, which constitute a didactic system.[2] The didactic system can be regarded as the founding act of the development of *subject didactics*, marking a paradigm shift[3] from the dual "teacher-learner" model of pedagogy and educational psychology (Schubauer-Leoni, 2000).

In *subject didactics* studies, a central concern is the analysis of the epistemological gap between knowledge built and used in various kinds of social activities, and the knowledge contents that are defined in the curriculum texts and studied in classrooms. This gap is theorized as a *didactic transposition*, occurring within schools, classrooms, tutorials, etc. as instances of didactic institutions (Chevallard, 1985/1991; also see Chevallard & Bosch, 2014). In this view, knowledge does not exist as "something" that can be directly "passed on", transferred or acquired.

> "Knowledge is not a given, the theory says, it is built up, and transformed, and – such was the keyword – transposed. (…). The main point in the didactic transposition theory is that it considers knowledge as a changing reality, which adapts to its institutional habitat where it occupies a more or less narrow niche" (Chevallard, 2007, p132).

Knowledge is encapsulated in social practices, as ways of doing and as discourses in the various social spaces in which humans participate. The way that knowledge contents are constructed / formalized in discourses depends on the aims pursued by these practices. This principle is at the core of the didactic transposition process. Teaching and learning are purposive social practices that target the study (by the students with the help of the teachers) of pieces of knowledge built in certain social activities. Hence, when they enter the classroom, the contents taught in teaching and learning activities are recontextualized to fit the organization and purposes of schools, and the cognitive abilities of the students.[4] It follows that the contents learnt by the students in the classroom are always genuine (re)constructions regulated by the teacher, and not mere "transfers" or "acquisitions" of something. A major aim pursued by the French-speaking *subject didactics* is to analyze, model and improve the compatibility of this reconstructive process with the social practices that feature the many domains of academic knowledge and fields of human expertise (Schneuwly, 2021).

The French-speaking *subject didactics* pursue the twofold ambition of (1) being descriptive/explicative sciences that contribute to the broader social sciences

[2] The triangle linking the teacher, the students and the knowledge content is also emblematic of the European traditions of research in Didactics, but its meaning differs according to the conceptual background of these traditions.

[3] The word "paradigm" is used in a general sense without keeping the Kuhnian principle of incommensurability. Didactic research may rather be regarded as a research program in Imre Lakatos's sense.

[4] Programming over time, collective management of activities, and the assessment of the learning outcomes. The notion of didactic transposition shares some similarities with Basil Berstein's notion of "recontextualization" in pedagogic discourses (Bernstein 1990/2003).

studying learning conditions and knowledge diffusion in society and (2) being design sciences that support teaching and learning in schools by providing inputs to the construction of curricula, teaching resources and the professional development of teachers. These ambitions complement each other but they are not pursued in the same way in all the fields and at the same time. The first ambition – being a descriptive / explicative science – was an important driver in the development of the didactics of mathematics until the 2000s:

> "Drawing lessons from the innovative activism of the New Math period with the disillusions it had generated, French didacticians gave priority to understanding the complex interaction between mathematics learning and teaching in didactic systems. Building solid theoretical foundations for this new field in tight interaction with empirical research was an essential step. Theories were thus, and still are conceived first as tools for the understanding of mathematics teaching and learning practices and processes, and for the identification of didactic phenomena" (Artigue et al. 2019, p.14).

The elaboration of the Theory of Didactic Situations in mathematics (Brousseau, 1997) and the Didactic Transposition Theory (Chevallard, 1985/1991), which evolved toward the broader Anthropological Theory of Didactics (Chevallard 1992; Bosch et al., 2020), have influenced the development of other *subject didactics*, and very importantly, that of *comparative didactics*.[5] This is particularly obvious for the didactics of physical education (Amade-Escot, 2006) and the didactics of arts and music (Mili & Rickenmann, 2005), which developed through the descriptive/ comprehensive analysis of classroom practices. In contrast, the didactics of natural sciences and technologies developed mainly by supporting curriculum changes and the design of innovative teaching approaches in the 80's-90's. Since the 2000's, this field has been heading toward more descriptive approaches concerning the implementation of inquiry-based teaching and socio-scientific issues in ordinary classroom practices (Simonneaux & Simonneaux, 2014). The didactics of the French language brings together many subfields (reading, writing, spelling, grammar, language arts, etc.) and it is supported by a range of influential social sciences related to language (linguistics and semiotics, communication sciences, language arts, psychology of development, etc.). It developed by both designing and testing teaching resources and describing / explaining the practices developed (Daunay & Reuter, 2008). The didactics of social sciences (history, geography, citizenship education) remains very focused on the epistemological analysis of curricula and textbooks and the teachers' and students' discourses, since the selection of the knowledge contents and related values in these subjects is very sensitive to societal changes (Audigier, 2013).

This quickly drafted picture of the French-speaking *subject didactics* is, of course, too general to be fair to the diversity of work done in each field. There is much more to say and, above all, there are many comparisons to be made concerning the ways in which the various fields have been constructed, the conceptual tools

[5] The emergence of comparative didactics in the early 2000s, which proposed the Joint action framework in Didactics as a generic set of analytical categories for the study of ordinary didactic practices, may have reinforced the influence of the Didactics of Mathematics on other fields. This aspect will be developed in the third section of this chapter.

that they have developed, and the types of research and interventions that they produce. The comparison of *subject didactics* as a set of research fields forms part of the history and epistemology of educational sciences. The recent gain in interest in the question shown by the French-speaking community is tied to the need to strengthen *subject didactics* as a more unified research domain to face the challenge of the reforms of teacher training structures (e.g., Dorier et al., 2013). The "Association pour les Recherches Comparatistes en Didactique"[6] [Association for comparative research in didactics] promotes important dialogues to find coherence among these fields. The participation of French-speaking researchers in the EERA Network 27 has also supported many attempts to better characterize the French-speaking tradition of *Didactics* in relation to other traditions (Caillot, 2007; Schneuwly, 2011, Schneuwly & Vollmer, 2018; Schneuwly 2021).

The Emergence of *Comparative Didactics*: A New Perspective on Teaching and Learning

The development of *subject didactics* has been fruitful in showing the importance of considering the knowledge contents at the heart of the teaching-learning process. *Subject didactics* have developed their own conceptual tools to analyze and design new teaching practices. The division of *subject didactics* according to school disciplines or curriculum domains has ensured its usefulness and legitimacy in teacher training programs. But does this mean that each *subject-specific branch of didactics* is an autonomous research field? How can we make sure that didactic research does not miss any important teaching and learning issues that are not directly related to the well-established school disciplines? Or that exist at the crossroads of several of them? These issues have generated, and still generate, lively debates within the French educational research community.

An important step forward was made in the early 2000's, with the publication of a special issue of the "Revue française de pédagogie" entitled "Vers une didactique comparée" [Towards Comparative Didactics]. It contains a series of comparative empirical studies conducted from the perspective of different subject didactics, which helped to establish a new strand of didactic research. In the editorial paper, Mercier et al. (2002) summarized some critical questions on the subject of didactics, and formulated the following challenge:

> "[subject] didactics, even when well established in the disciplinary provinces, cannot do without a comparative production, which is the only thing that can ultimately justify their provinciality. It is then a matter of showing, first, how the didactic purposes of [human] relations constrain the possible forms of interaction, then how the different knowledge contents, which are the daily stakes [of these interactions], feed these forms in a specific way, at least in certain dimensions, which it is necessary to identify". (Mercier et al. 2002, p. 7, my translation).

[6] www.arcd.fr

To proceed, Mercier et al. (2002) suggested two fundamental dimensions for furthering subject didactics towards a comparative field of didactics research:

(i) clarify the function of the contents in learning and teaching practices and how these contents are (re)constructed in the classrooms.
(ii) within the activities of the teacher and the students, clarify what is "generic", i.e. can be related to a teaching (or learning) process, and what is "specific", i.e. related to the knowledge taught/learned.

The first dimension addresses the empirical study of the knowledge transposition process using a bottom-up perspective., starting from knowledge contents that are observed to be taught and learnt in teacher and students' interactions, and that can prove to be different from what the curriculum texts, teaching resources, lesson plans, etc. of the school institutions claim is taught and learnt. The second dimension addresses the empirical study of human practices involved in knowledge transmission (e.g., any person taking the position of "teacher" and that of "student" with respect to a content to be learnt, see Chevallard, 2007), for which the seminal anthropological distinction between the specific and the generic is postulated.

The unit of analysis is the *didactic system*, a triadic model of social organization (or institutions) formed to convey some pieces of human culture (Fig. 3.1). The most obvious didactic systems are those that exist in perennial forms, such as schools. But they can also be modelled in ephemeral or diffuse social forms of educational, professional or leisure contexts, in which some pieces of knowledge are deliberately conveyed and learnt.

The didactic system becomes the very object of *comparative didactics* for considering the contents emerging in learning activities, and not only the knowledge that institutions claim to teach. In this view, the epistemological function of the school disciplines changes: the discipline is no longer the starting point of the study but a component among all the dimensions at play in teaching and learning situations.

The analysis and modelling of the specific and generic characteristics of didactic systems is envisioned through a comparison of its empirical manifestations:

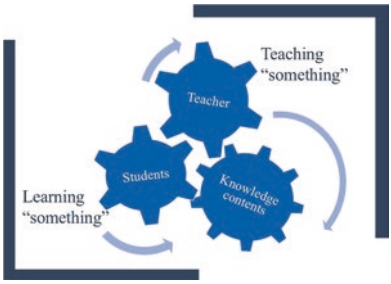

Fig. 3.1 Scheme of the didactic system

different knowledge contents and subjects (e.g. mathematics and science), at different school levels (e.g., contrasting primary and secondary school practices), according to different pedagogical practices (e.g., inquiry-based learning versus more transmissive approaches), in different cultural or national contexts and even, to a certain extent, in different social contexts (not only in schools, but also in nurseries, museums, vocational training, leisure clubs, etc.).

To a certain extent, this French-speaking strand of *comparative didactics* converges on the project of building a "science of didactics", first posited by Yves Chevallard in the early elaboration of the Theory of the didactic transposition (1985/1991). In this view, "la didactique", as a singular noun, which can be translated by the single word "Didactics", is

> "a science of the conditions of diffusion of knowledge in any institutions, such as a class of pupils, society at large…etc. More particularly didactics is the scientific study (and the knowledge resulting thereof) of the innumerable actions taken to cause (or impede) the diffusion of such and such a body of knowledge in such and such institution" (Chevallard, 2007, p.133).

However, nowadays, the "Anthropological Theory of the Didactic" that was developed by Chevallard and his colleagues (Bosch et al. 2020) provides a rather strict epistemological program (Mercier, 2008) about how bodies of knowledge become transformed within didactic institutions (e.g., the study of praxeologies in textbooks) or could be better reconstructed (e.g., the elaboration of inquiry-based teaching designs). Adopting another path, the ambition of *comparative didactics* is to make a comprehensive study of social facts at the heart of didactic systems through the study of the teacher's and the students' actions and discourses. The emergence of *comparative didactics* research is a shift from research focusing on knowledge contents in *subject didactics*, to a pragmatic approach to teaching and learning practices, which echoes the actional turn in the human and social sciences.

Comparing Teaching and Learning Practices: Epistemological and Methodological Issues

The development of *comparative didactics* does not avoid certain epistemological and methodological issues faced by the comparative approaches in the humanities and social sciences more generally. The following lines summarize these issues, which have been discussed in detail by Schubauer-Leoni & Leutenegger (2002), Leutenegger (2009) and Ligozat & Leutenegger (in press). To give them concrete meaning, I provide examples drawn from research that was conducted in the Geneva Research group for comparative didactics (GREDIC).

Comprehensive Approach of Complex and Dynamic Systems

Adopting a descriptive / comprehensive approach, *comparative didactics* relies upon observations of teaching and learning practices in ordinary classrooms. Video-recordings of lessons or teaching units are used, coupled with the collecting of all types of traces useful for the interpretation of the facts observed in the classroom, for example students' writings, the teacher's lesson plans and notes, etc. The participants' discourses, from teachers and students, are also collected through semi-directive interviews. Upstream, a study of school textbooks and teaching materials available to teachers helps to relate direct observations to institutional norms and constraints. From the observation of the system and its internal relations, the researcher tries to understand what is going on. In comparing teaching and learning practices modelled as didactic systems, the challenge is to reduce the uncertainty about the interpretation of the numerous traces of events that are collected.

In tracing the development of medical clinical practice at the end of the eighteenth century, Foucault (1994) showed that the scientific turn taken by medical studies was determined by a change in the relations between the observer and the facts observed.

> "The medical gaze was also organized in a new way. (…) it was a gaze that was not bound the narrow grid of structure (forms, arrangement, number, size), but that could and should grasp colors, variations, tiny anomalies, always receptive to the deviant. Finally, it was a gaze that was not content to observe what is self-evident; it must make it possible to outline chances and risks, it was calculating" (ibid, p.89).

The phenomenon of 'disease' does not exist as such in Nature, it is a human construction based on signs themselves drawn from observable symptoms, but not reduced to them. Each perceived element (symptom) is recorded as part of a random series, so that it can be grouped in convergent or divergent series at different steps of the clinical reasoning. Among the symptoms, only those elements that make sense to the clinician become signs; his/her role is to make the symptoms speak, to erect them into signs by relating them to already established knowledge.

Leutenegger (2009) draws an analogy with the "didactic gaze" when addressing events in the classroom. She formalizes a clinical and quasi-experimental approach to didactic systems.[7]

(i) the clinical dimension consists of constructing a meaningful series of signs from "classroom symptoms" found in recorded discourses, writings, pointing, movements, etc. with respect to available knowledge on the functioning of the didactic system (e.g. the didactic contract, Brousseau, 1997).

[7] The analogy with medical clinical practice supports the idea that the interpretation of classroom events relies upon multiple series of signs found by the observer and, hence, that the methods for investigating classroom events should favor the collection of signs through different perspectives (at least that of the three poles of the didactic system) to compare multiple series. This analogy is epistemological, not methodological.

(ii) the quasi-experimental dimension consists in controlling the construction of meaningful series by cross-checking the series between one another. In this perspective, the multiplicity of points of view on the functioning of a system favors the solidity of the interpretation.

Comparisons between series of recorded facts provide an increased opportunity to reduce the uncertainty about interpretation. Making the didactic system the object of inquiry ensures that the meaning of series of signs (or "clues") is not constituted externally, but it stems from the system where it made sense. In this perspective, and similarly to criminal inquiries, seemingly unimportant facts can prove more productive than the sole account of category-based information. The clinical and quasi-experimental approach of the didactic system belongs to the evidential paradigm that characterizes comprehensive approaches in the humanities and social sciences (Ginzburg, 1992).

With this approach, Leutenegger (2009) showed that the difficulties of certain students in mathematics at primary school have a social origin, linked to the time management of the mathematical contents in the didactic systems in which they participate. By comparing the interactions of these students with the teacher in their usual class (main didactic system) and in the support class (auxiliary didactic system) in the Geneva school, Leutenegger showed that i) the knowledge learnt in the support class (calculation techniques) lags behind the progression of the learning in the usual class; ii) students having learning difficulties stick to the mathematical techniques learnt in the support classroom whereas the tasks to be achieved in the usual class require the construction of new procedures. Hence, the students "having difficulties in math" seem irreducibly "delayed" in learning, as the result a of tacit "contract" (or habit) between them and their teachers about what should be done in the usual classroom. This is what can be termed a "didactic" phenomenon. The breakthrough is to no longer consider the student in isolation, as a cognitive subject, but as an interactant in dynamic and correlated systems, in which the content progression is a major component. This didactic perspective allows different support solutions to be thought of for students having learning difficulties, such as teaching new contents in the support classes, ahead of the teaching in the regular classroom.

"Estrangement"

For comparative didactics, comparison is not – or not only – a matter of method, since, basically, any science calls upon forms of comparison at some point to validate its results. Comparison is an essential process in anthropological studies for revealing dimensions of human activity that are not observable or recognizable at first sight within the native (or mainstream) cultural perspective. Encountering otherness to reconsider local and/or familiar facts and events was discussed by Ginzburg

(2001) as an "estrangement" process.[8] In most social sciences, calls for comparison are often invoked to improve the functioning of human societies: to escape from national closure, to improve national law, to regenerate education, to promote equity between peoples, etc. In history and political sciences, for example, comparison is often understood as taking place between two or more nations, or across one or more borders, or at different times (Sartori, 1991). Comparisons can be made between different cultures or within the same culture to detect essential changes over time and to highlight problems specific to that culture (Julien, 2005).

The comparison of teaching and learning practices in various school subjects is a major source of "estrangement". The purpose is to better understand the specificities of each of the practices for themselves, while identifying common roots that are related to the social functioning of didactic systems. But different sources of "estrangement" can also be productive, for example comparisons with other forms of educational practices in which knowledge is transmitted in a less formal way (e.g., nurseries, sports and leisure clubs, support associations, etc.), or even where learners are supposed to learn by themselves within environments designed to develop autonomous learning paths (e.g., museums).

As an example, in her doctoral work, Munch (2009) compared educational practices in Geneva nurseries for 3–4-year old children and school practices at the beginning of school for 4–5 year old students. The nursery educators stated that they do not want to "school" young children too quickly and analyses of the succession of activities proposed to the children over the day showed that they aimed to respond primarily to their needs (e.g., talking about family events, preparing to eat, getting dressed, playing with peers, etc.). Conversely, at the beginning of school, activities aim to introduce the young students to shared culture organized according to pre-disciplinary areas (reading, writing, counting and logic, drawing / painting, environment observation, etc.). The construction of learning progression over time is confirmed as a major feature of formal didactic systems in schools. However, the analysis of the games proposed to the children in nurseries unveils genuine forms of didactic contract (Brousseau, 1997) in the regulations of the activities. On the one hand, there are clearly some specific expectations from the educators about the children's achievement, similarly to what can be observed in schools. In many activities, there are some contents to be learnt that cannot be related to a specific school subject (e.g., deciphering symbolic representations of moves to be performed in a physical activity). On the other hand, the educators tend to involve themselves in the games in a way that reduces the typical dissymmetry observed between teachers and students. The "estrangement" offered by comparing activities in nurseries and schools works in two ways: i) by reconsidering nurseries as places where children

[8] In the preface of "Occhiaci di legno" ("A distance" in French), the Historian Carlo Ginzburg explains: "*I have been teaching since 1988 in Los Angeles. Addressing a student audience at the University of California, whose background is far removed from my own, and which is itself made up of ethnically and culturally diverse individuals, has forced me to consider my long-familiar research themes in a different way*" (2001, p.11; my translation).

learn some contents, and ii) by reconsidering the spectrum of the didactic contract to include situations in which someone learns to do something by working together with someone who knows how.

Symmetry Principle

For comparative didactics, comparison is not – or not first – a matter of finding similarities or differences between directly comparable facts and events.[9] Comparative approaches in the humanities and social sciences strive to achieve a necessary distancing by virtue of a principle of symmetry i.e., the common element allowing the two terms of comparison to be questioned (Stengers, 2011). In comparing the historical process of territorialization in different cultures, the anthropologist Marcel Detienne explains the functions of the selection of the concepts of "founding, foundation, founders" as "tertium comparationis" (a third comparing term):

> "To access the teeming variety of modes of territorialization, we needed to select a category, making sure that it was generic enough to allow the beginnings of a comparison but neither too general nor too specific to any particular culture. The category we chose was that of "founding, foundations, founders". From the reactions of the various members of the group – Africanists, Japanese specialists, Americanists, and Hellenists – it became clear that, although this category was complex, it was useful in that it prompted a whole series of questions. It was neither too strong nor too weak. Had it been too strong, too powerfully classificatory, it would have impeded the work of comparison; if too weak, it would have produced nothing to think about as a group, whatever the sites and forms of the beginnings and inauguration that seemed to be covered by the common meaning of "to found"(Detienne, 2008, p.25).

The definition of a third comparing term enables comparable terms to be built from the diversity of the social practices of different peoples at different times, which are not directly comparable through obvious differences and similarities. The power of the third comparing term to describe and explain a spectrum of social practices relies upon its generic / specific gradient. However, the meaning of the categories chosen at the outset for performing the comparison remains open to clarification during the study. As Detienne recalls,

> "But we experienced a salutary heuristic shock when we discovered what appeared to be an instance of incomparability. One day, two Japanese specialists, who had long remained silent as we fumbled our way forward, came to confess, to their chagrin, that according to the most ancient texts, in Japan there simply was no founding, no founder. I thanked them most warmly and told them that now we could at last begin to think about what to "found, to establish lastingly" really meant" (ibid, p.26).

[9] In experimental methods, direct comparison is possible through the relation between a test group and a control group, in which all variables but one are the same.

Beyond the heuristic power of the comparison for clarifying the meaning of third comparing terms themselves, this example also makes it very clear that the objective of comparison in anthropological sciences is not to value certain practices over others, but to use the same characteristics identified in the diversity of human practices to model socio-historical processes (e.g., territorialization) or more fundamentally, to deepen a concept (e.g., the "founding").

For *comparative didactics* as a "reconstructive move" furthering *subject didactics*, the selection or identification of third comparing terms ("tertium comparationis") is vital to allow the comparison of different – if not perceived "incomparable" – teaching and learning practices, without overlooking their specificities. Paying attention to the theoretical and methodological construction of this third term is already a means to avoid the projection of one, a priori normative, point of view onto the other.

Let us consider, for example, the double devolution/institutionalization process formalized by the Theory of didactic situations in mathematics (Brousseau 1997). Devolution is the process by which the student takes responsibility for his/her actions in a learning situation designed by the teacher, in the sense that the student can observe the consequences of his/her actions and draw knowledge from them. Institutionalization is the process by which the classroom collective agrees about what counts as valid knowledge with respect to the situation. The teacher plays a prominent role in the institutionalization since he/she is the warrant of the knowledge contents to be learnt. This double process has been studied in numerous didactic situations for the teaching of mathematical knowledge (Margolinas, 2021). It is both specific to the contents learned (i.e., responsibility about "what"), but it is also generic because it concerns the responsibility of the participants in the didactic system in making meanings and validating them.

In her doctoral work, Ducrey-Monnier (2014) compared the teaching and learning practices in primary classes (grade 2) in the canton of Vaud, in French lessons (the reading-comprehension of tales) and mathematics lessons (decimal numbering system). One of the comparative terms she used was the "devolution/institutionalization" pair. In both disciplines, she showed that there is a balance between the share of responsibility left to the students in the construction of meanings, and the interventions of the teacher confirming these meanings as valid knowledge. However, the devolution process takes different forms in mathematics and in reading. In mathematics, devolution is visible in the time lapses given to students to research a problem, in the teacher's prompting to find solutions and in the comparison of the efficacy of these solutions. In the case of reading, devolution shows up in a more subtle way, in the degree of exploration of possible justifications for the behavior of characters in the story being read. Ducrey-Monnier's work shows the relevance of using a third comparing term to consider teaching and learning in different subjects, not only to characterize the generic / specific dimensions of these practices but also to deepen the fund of conceptual tools that can be used.

Hence, the necessities of comparison, in addition to the epistemological and methodological aspects discussed here, have led comparative didactics researchers

to develop a conceptual framework, the first function of which is to serve as a "tertium comparationis"for examining different forms of teaching and learning practices.

Teaching and Learning as Joint Actions: Towards a Generic "Tertium Comparationis"

Mercier et al. (2002) suggested using certain concepts initially elaborated in the didactics of mathematics as candidate generic descriptors of the "reality" that is played out in all didactic systems characterized by a knowledge transposition process. A decade later, the "Joint Action framework in Didactics (JAD)" proposed an analysis of the contents taught and learnt in the classroom that is both situated and institutional. It stems from certain concepts built up in the didactics of mathematics and re-conceptualized within a socio-interactionist and pragmatist approach to human actions (Ligozat & Schubauer-Leoni, 2010; Sensevy, 2011). In this section, I recall the basic ideas and main concepts used as a brief overview of this framework.

The notion of "didactic joint action" captures the idea that the teacher and the students jointly (re)construct some knowledge contents in the classroom within an evolving learning environment. As Schubauer-Leoni & Leutenegger put it, "we cannot understand the teacher's action in the classroom (and therefore the processes of re-actualisation of knowledge in a specific teaching project), without describing the modes of participation of the students" (2002, p. 233, my translation) and vice-versa. From this empirical statement, a set of concepts were selected to enable the description of teaching and learning as a joint process (Sensevy & Mercier, 2007; Sensevy, 2011, 2012).

(i) The "Milieu"[10] features the material and symbolic components that the teacher or students act upon, use, talk about, interpret, etc. (i.e, a worksheet, a ruler, a verbal instruction given by the teacher, the writing of a number on the blackboard, the verbal designation of "the solution" of a problem, etc.) and within which meaning-making processes take place.

(ii) The "Didactic Contract" features the interdependency of actions of the teacher and the students in the classroom in the search for an agreement[11] on what has to be done and how – and hence what knowledge content may be learnt-, within the milieu. These actions are based on a system of habits, norms, and assigned

[10] The notion of « milieu » was first conceptualized by Brousseau (1997) within the Theory of Didactic Situation in Mathematics, as anything upon which the students act with and upon, and from which they may get feedback about their action. In the JAD framework, the milieu is rather seen as the context in which the teacher and the students' action develop, featuring both the resources and the problems to address in performing a task (see Sensevy, 2011).

[11] Brousseau (1997) termed this search for an agreement a "didactic contract" at play between the teacher and the students. It is not a firmly established contract because its stakes – from the participants' standpoints – are always renewed as teaching progresses.

> expectations to each other's. Most of the components of this system are played implicitly in the classroom interactions, unless one of the participants does not act according to them, and hence make the rules, norms and expectations visible in the "response" of the others.

Conceptualizing teaching and learning as joint actions does not mean that the teacher and the students carry out the same actions together or that they share the same agendas. Didactic joint actions involve separate and distinctive lines of action that are bound together by both the evolution of the milieu and the didactic contract. The specific nature of students' actions is *reconstructive*: at each step of a lesson, the students must make sense of new tasks, questions or problems set by the teacher and based on their previous experience. The specific nature of the teacher's actions is *anticipative*: At each step of a lesson, the teacher supports the students' constructions and reorganizes them according to the next steps of the lesson plan and the curriculum objectives. Hence, the students and the teacher do not share the same perspective in the timing that the knowledge content unfolds in the classroom (chronogenesis); it follows that they do not have the same responsibilities in this process either (topogenesis). This distinction is at the core of the first theorization of didactic systems developed by Chevallard (1985/1991). The articulation of the *didactic contract* and the *didactic milieu* in the JAD framework enables us to grasp the meaning-making process evolving continuously through the teacher's and students' joint actions (a mesogenesis in Chevallards' terms, 1992).

Since its premises (Sensevy & Mercier, 2007), the JAD framework has developed in different directions: (i) through the conceptualization of learning games and epistemic games as models of human activities (Sensevy 2011, 2012, Sensevy et al., 2015), and (ii) through the conceptualization of breaches and continuity in the meaning-making process (Ligozat et al., 2018; Marty et al., in press; Amade-Escot & Verscheure, Chap. 10 in this volume). The dialogue with the Swedish pragmatist approach to classroom discourses (Wickman & Östman, 2002; Wickman 2012; Hamza & Wickman, 2013), offering tools for analyzing the participant's practical epistemologies, has been influential in the latter development.

The JAD framework provides a generic set of categories for describing relations within the didactic systems. However, these categories cannot work without an articulation with the analysis of the knowledge contents in the didactic system. This analysis involves two complementary movements (top-down and bottom-up) which enable both the situational and institutional viewpoints to be reconstructed in the transposition process. The articulation between the analysis of the specific dimensions of knowledge and the analysis of the joint action of the teacher and the students provides a global model for the analysis of didactic systems (Fig. 3.2).

This model serves as a "tertium comparationis" to address two main types of questions.

On the one hand, this model allows impacts of the school contents on teaching/learning practices to be analyzed in a given institutional context i.e., how these practices are 'shaped' by the specificity of the knowledge contents. For example, in a gymnastics lesson on performing handstands and a physics lesson on modelling

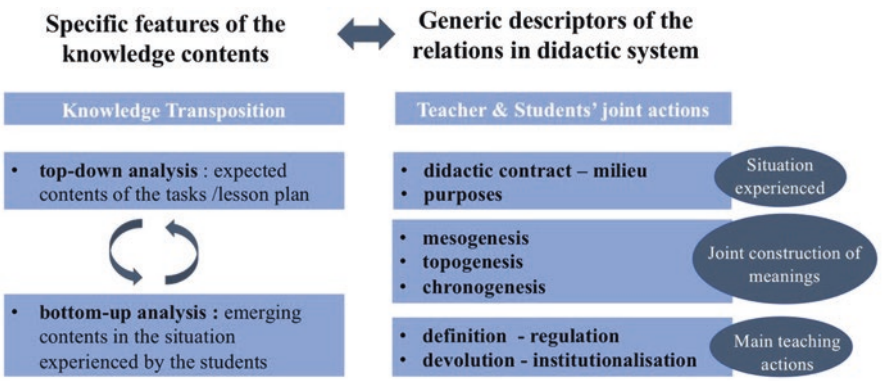

Fig. 3.2 The specific – generic articulation in the analysis of didactic systems

changes in states of the matter, how do the students participate in the knowledge construction? How do the teachers support continuity in the meaning-making process from the students' actions in the milieu to the collective construction of knowledge? These questions have been studied by Ligozat et al. (2018), and Marty et al. (in press) for example.

On the other hand, this model makes it possible to analyze the impacts of school norms and habits on teaching/learning practices about the same contents, or within a single school discipline. For example, how is the measurement of quantities taught in the French and Swiss-French contexts, at primary school? How is teaching on the states of matter similar and different at the end of primary school and at the beginning of secondary school? The first question was studied in my own doctoral work (Ligozat, 2008) and the latter in Laurence Marty's (2019). Comparisons of teaching and learning practices between different school systems behave as an anthropological "lab" for understanding the variation in the social process of knowledge transmission (or re-construction).

Toward New Perspectives on the Relation Between Curriculum and Classroom Practices

Exploring Knowledge Contents at the Crossroads of School Subjects

In most educational contexts, the alignment of the school subjects with the seemingly corresponding academic disciplines is not trivial. At primary school, the decimal numeration system for writing numbers is knowledge that is certainly part of the body of "mathematics" in general, but what of time condensed in a calendar and its uses for remembering / anticipating events? It belongs both to "History", since it

is a representation of social time lived by humans, and to mathematics as it is a representation of time as a quantity. In the higher school grades, a content such as "modeling" in sciences is certainly too general to account for specific issues of teaching and learning models in biology and models in physics. Are the models of the same kind in both subjects?

Beyond the structure of the school subjects, teachers also deal with new contents introduced into the curriculum to address certain social needs, such as education for sustainable development, health education, media education, critical thinking, entrepreneurship, citizenship, etc. It is not possible to assign these contents to a single subject since their specificity lies precisely their multiple disciplinary roots. In addition, the definition and status of these new contents also change rapidly as problems in society evolve.

Because *comparative didactics* allows us to consider what contents emerge in the teachers' and students' actions in various instances of didactic systems, it offers a bottom-up approach to the analysis of the consequence of curriculum changes. In particular, the influence of the disciplinary structure of school knowledge in the teaching and learning of new contents can be traced. In her doctoral work in progress, Sudriès (2020) focuses on the teaching and learning of chemical transformations in lower secondary school through the carbon cycle. Her project is to unveil the disciplinary dimensions that may be privileged by the teachers (e.g. molecular re-arrangement in physics, energy conversion in organic through photosynthesis in biology) but also the modes of participation that the students may develop with respect to broader environmental issues.

Changing Realities of School Subjects across Cultural Contexts and National Educational Systems

International comparisons shed light on differences in the subject structures of curricula. For example, in Sweden, science subjects are taught by general science teachers at lower secondary level. In France, "Physics and Chemistry" on the one hand and "Earth and life sciences" on the other, are taught separately by specialized teachers (Marty et al., 2018). The "Earth and life sciences" school subject groups together biological and geological knowledge in lower and upper secondary schools. In Switzerland, biology is taught separately from geology, as a school subject in its own right, certain topics of geology being included in geography (with some substantial differences between French-speaking and German-speaking Cantons). This has consequences on the teachers' professional epistemologies and the way they contextualize the contents that are described in the curriculum texts. It follows that international comparisons of teaching and learning practices cannot simply rely upon the subject structures established in national contexts, because these structures are the product of cultural norms and socio-political choices. These norms and choices should be an integral part of the study because they are the most generic

determinants of the teachers' and students' actions that can be observed in the classrooms.

On the one hand, international comparisons of teaching and learning practices make the didactic transposition process at work in the teaching and learning practices observable in classrooms particularly salient. On the other hand, international comparisons of teaching and learning practices is particularly conducive to the "estrangement" of the researchers' gaze, and hence to the study of the epistemologies that shape their conceptual tools. It is then possible to understand that conceptual frameworks in didactics emerge (or have emerged) in different socio-historical contexts of educational research, and they cannot be totally detached from the educational aims of the school systems in which they were born.

In the "cultural shock" of the encounter between different research traditions on teaching, learning and curriculum in the European educational research space, new research questions are addressed to comparative studies in Didactics (Ligozat et al., 2015). It is important to create the conditions for collaborative work between researchers through the comparison of different conceptual tools. In turn, there are opportunities for densifying the existing knowledge of teaching and learning practices that are determined by distinct socio-histories.

Concluding Remarks

To sum up, the purposes of the French-speaking stream of comparative didactics goes beyond a mere dialogue between the *subject didactics*. Nor is it oriented towards a new *general didactics* that would be created by bringing together the subject didactics in a seemingly unified scientific field. Since its very beginning, this stream of research has aimed at overcoming the fragmentation of subject-specific approaches to teaching and learning, by challenging the naturalization processes that accompany exclusive disciplinary standpoints.

Through the development of the Joint Action framework in Didactics, the strand of comparative didactics initiated by Mercier et al. (2002) has deepened the meaning of the concepts of "didactic system" and "didactic transposition". Both these concepts played an essential function in the development of *subject didactics* (Schneuwly, 2021). However, the inclusion of these concepts in the anthropological background of the study of human practices dedicated to the transmission (or reconstruction) of knowledge in diverse social contexts, frees the conceptualization of the didactic transposition process from the disciplinary structure of school knowledge only. It is no longer the school subject structures that serve as the sole reference for the study of the relationships within the system. *Comparative didactics* allows the transposition process to be (re)thought as a broader constructive process, which takes place above all in human transactions concerning a large range of contents towards specific educational goals. In this way, comparative didactics also strives to relate the stakes of specific teaching and learning contents to the broader social, cultural, and political issues embedded in educational systems.

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Florence Ligozat is Professor in Comparative Didactics at the Faculty of Psychology and Educational Sciences, University of Geneva, in Switzerland. During her doctoral and post-doctoral studies, her research focused on mathematics didactics and science didactics. Her current research investigates the didactic transposition of knowledge in classroom practices and the specific / generic dimensions of teaching through the modeling of the teacher and student's joint actions in different educational contexts. She is particularly interested in cross-cultural comparisons of classroom practices and research traditions in Didactics in European countries. She chaired the French-speaking Association for Comparative Research in Didactics (2012–2016). She is currently convenor of EERA Network 27 Didactics – Learning and teaching, and she acted as Main Link convenor of this network in the period 2016–2021.

Chapter 4
Teaching Traditions in Classroom Practice – A Comparative Didactic Approach

Jonas Almqvist, Malena Lidar, and Anette Olin

Introduction

In this chapter, we will illustrate and discuss how comparative didactics, as a growing research area in Europe, may contribute to a deeper understanding of teaching and classroom practices in different school subjects. More specifically, we describe and discuss how the concept "Teaching traditions" can be used in comparative studies. We argue that this makes it possible to do comparative studies as a way of dealing with questions about similarities and differences in teachers' selection of content and manners of teaching and how these selections may influence students' learning. We also discuss how the results from comparative didactical research may be used in the development of teaching.

In their everyday classroom practices, teachers make choices and handle different kinds of didactical dilemmas. They need to decide what content to teach, what teaching methods to apply and how to work together with students (cf. Ligozat & Almqvist, 2018). These issues are at the core of teachers' professionalism. Research on teaching traditions and learning shows that these and similar examples of didactical challenges often do not have any clear or obvious solutions, but rather need to be made visible, problematized and discussed by teachers (cf. Lundqvist et al., 2009). Let us illustrate this with a short example taken from one of our research projects to further elaborate somewhat on the practical implications of this kind of didactical knowledge.

J. Almqvist (✉) · M. Lidar
Department of Education, Uppsala University, Uppsala, Sweden
e-mail: jonas.almqvist@edu.uu.se

A. Olin
Department of Pedagogical, Curriculum and Professional Studies, University of Gothenburg, Gothenburg, Sweden

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Tanja is a science teacher in a Swedish lower secondary school. She has a clear ambition to teach according to what we call a moral teaching tradition, the overall aim of which is to teach students how to develop knowledge and skills that they can use in making well-founded decisions on scientific, moral and political issues. (cf. Marty et al., 2018). A teaching tradition is constituted by patterns in the way goals, educational content and manners of teaching are selected. In science education there is a clear division between three teaching traditions: the moral, the academic and the applied ones (Marty et al., 2018). In the moral tradition, students are expected to learn how to make decisions related to problems involving both epistemological and moral issues. The academic tradition, on the other hand, focuses on scientific facts and the scientific methods is central. In the applied tradition, finally, the use of academic knowledge in solving practical problems is highlighted and shapes the teaching (Linder et al., 2011, 2018a, b; Marty et al., 2018).

The science teacher Tanja's aim was to develop a series of lessons that would enable her to teach the students about global warming and how to use chemistry – or more specifically the detection of gases in the atmosphere – to understand and decrease the greenhouse effect. However, Tanja often found it difficult to design engaging learning activities corresponding to her ambition to teach areas where matters of the application of scientific knowledge and values – so called socio-scientific issues – were brought to the fore. Our analysis of her teaching showed that she taught according to an academic tradition, focusing on the detection of gases rather than on the socio-scientific issues about global warming (Trivic et al., 2017). With the help of the corresponding author of this chapter, Tanja modified her lessons by applying results from didactical research and the researchers' observations of her teaching. The main change was that, instead of starting from theories and methods in the discipline of chemistry, her teaching now started from questions about global warming. Thus, she used chemistry as a way of contributing to the solution of this environmental challenge working towards an understanding of global warming.

The problem that Tanja faced in her teaching is a typical didactical dilemma. By selecting one way of teaching, she, at the same time, excluded other optional methods. In addition, she had to consider the group of students she taught, as well as the preconditions at hand in her school and so on. Hence, there is no obvious solution to this problem, which means that it is the kind of dilemma that teachers need to handle rather than trying to solve once and for all. To do so, they need to have knowledge about different ways of teaching and their potential consequences for classroom practice and students' learning. This is where comparative didactics can offer useful insights and help teachers to strengthen their knowledge base and didactical judgment.

Comparative Didactics

The research field of comparative didactics has been developed during the last couple of decades. The term was first used in the context of French didactics (Ligozat & Almqvist, 2018; Mercier et al., 2002; also see Ligozat, Chap. 3 in this volume). A few years later it was also applied in a Swedish context in relation to ongoing comparative research. It is not our ambition to summarize all relevant research results, but rather to describe, to exemplify and to discuss four central aspects that characterize comparative didactics.

Firstly, one of the overall aims of comparative didactics is to analyze what is often taken for granted in educational practices and to identify non-detectable problems without comparisons with other practices. Comparative didactics contributes with empirical results of how educational choices are regarded as central and important in one educational context but not in another. These results may be used to analyze and discuss what feasible consequences one or the other alternative may have for teaching and classroom practice (cf. Almqvist, 2016, 2018; Almqvist & Quennerstedt, 2015; Amade-Escot et al., 2018; Ligozat, Chap. 3 in this book; Ligozat et al., 2015; Östman & Almqvist, 2010).

Secondly, comparative didactics is a way of organizing didactical research beyond the fragmentation of subject didactical research areas (Caillot, 2007). This should not be understood as a way of narrowing the broad field of research into studies not taking specific educational content into consideration, but rather as an attempt to study and to discuss general and subject specific issues, and to explore and test various theoretical and methodological frameworks (cf. Colomb, 1999; Ligozat et al., 2018a, b; see also Ligozat, Chap. 3 in this volume). In Sweden, teacher education includes courses (or parts of courses) focused on school subject content, on general didactics and on disciplinary didactics. One challenge in designing courses in didactics is to find a balance between general and specific contents about teaching and learning. From a comparative didactic perspective, the teacher students need to learn about general didactics as well as disciplinary didactics. The ambition is to compare subjects or contexts in order to develop and to communicate general knowledge about teaching, without losing sight of subject specific issues. The approach makes it possible to use comparisons to learn from each other over subject borders and to visualize and discuss issues taken for granted in different subjects and contexts (Quennerstedt & Almqvist, 2015).

Thirdly, comparative didactics could to a certain extent, be seen as part of the wider field of comparative education as there are similarities in their ways of trying to understand specific educational situations (cf. Cowen & Kazamias, 2009; Manson, 2011). However, while comparative education has mainly focused on studies of educational systems, institutions and policies in different national contexts, there is a strong call in the field for didactical studies of issues about educational content and the complex processes of teaching and learning in different contexts

(cf. Alexander, 2009; Broadfoot, 2009; Kazamias, 2009). This could be done by deepening the understanding of how selections of content, manners of teaching and educational goals affect classroom practice and student learning.

Finally, comparisons between educational practices contribute with knowledge of a wide range of alternative ways of selecting goals, content and manners of teaching and can be used in the development of teaching. For example, studies of teachers' ways of dealing with didactical challenges and dilemmas are useful as a starting point in collegial dialogues for professional development. In the didactical dialogue model, a model for research in collaboration with teachers that we have developed, the fundamental basis is dilemmas formulated by teachers. Descriptions of their problems are sent to teacher colleagues and researchers who send written comments from their respective perspectives back to the teachers who, in their turn, write a concluding remark (Almqvist et al., 2017, 2019; Olin et al., 2019; Olin et al. 2021). The idea behind this is to start off from classroom practice and to compare it with results from other classrooms. This dialogue makes it possible to become aware of and to highlight what has been taken for granted in the practice and to develop teaching further based on research and proven experience. The comparison through dialogue is centered around alternative ways of prioritizing and to re-design teaching in order to better handle didactical dilemmas.

In the following, we expand further on the first and last of these four characteristics, with the specific ambition to focus on issues about teaching, classroom practice and educational content. We take our departure in research in the Nordic and French traditions of didactics and describe how research contributes to analyses and critical discussions about teaching and learning in various school subjects (Ligozat et al., 2015). More specifically, we turn to research on teaching traditions (cf. Lundqvist et al., 2009).

On the Use of Teaching Traditions in Comparative Didactics Analyses

In our research, we use comparisons to clarify and discuss issues taken for granted in various practices, to search for knowledge about teaching and learning beyond the cases studied, and to use the concept of teaching traditions to do so. Thus far, we have mainly focused on research on teaching and learning in science education, but we are also involved in studies of teaching in preschool and in physical education and health.

The concept of teaching traditions is applicable to describe different patterns of selection of content, manners of teaching and educational goals. In a Swedish context, Englund (1986) introduced the concept of selective traditions in curricula from which the concept of teaching traditions has been developed. Englund analyzed curricula texts, that is what was selected, what was opted out as well as the potential consequences of these selections for teaching, learning and socialization. In our

analyzes of selections made by teachers in classroom practice, we have chosen to use the concept of teaching traditions instead of selective traditions. For a short summary of research on teaching traditions and nearly related concepts in science education, see for example Lidar et al., (2017), Marty et al. (2018) and Linder et al. (2011). As shortly introduced above, in the academic tradition, teaching focusing on concepts, theories, models and ways of thinking and studying nature as it has been developed in the science disciplines. In the applied traditions, on the other hand, the focus is the application of scientific knowledge and inquiry in solving everyday problems. The moral tradition focuses on teaching dealing with political and moral issues connected to science, technology and society.

Among science teachers at Swedish lower secondary schools, there is a clear divide between those who maintain that they teach in accordance with an academic tradition and those who adhere to an applied tradition in their teaching (Lidar et al., 2017). Furthermore, studies show that there are major differences between the dominating teaching traditions in different countries. For example, the French and Swiss science curricula are based on an academic tradition, while the Swedish ones also include both an applied and a moral tradition (Marty et al., 2018). This means that a comparison between the national curricula makes it possible to learn from each context, but also to problematize and discuss various attempts to compare the results from international assessments of teaching in different countries.

The same phenomenon is also noticeable in physical education (Forest, 2017; Forest et al., 2018; Forest & Lenzen, 2018). Focusing on the French national curriculum, Forest (2017) shows how teachers have developed teaching habits largely related to subject specific teaching traditions, as is the case in science education. These traditions are also visible in the curricula for physical education (PE) in countries such as Sweden and Switzerland. There are four different teaching traditions present in the field of PE and Forest et al. (2018) have identified differences in the three countries related to matters of privileged goals, content and manners of teaching. The first one, "Teaching PE as sport-techniques", primarily shapes French and Western-Swiss curricula and focuses on teaching techniques and skills taken from sports, in order for the students to learn how to perform various sports activities as closely as possible to competition standards. Forest et al. argue that there is a clear similarity between this tradition in PE and the academic tradition in science education. Both traditions relate the educational content to facts, theories and methodologies in the 'mother' disciplines. The second one, "Teaching PE as health education", on the other hand, prevails in Sweden and, to a minor extent, in Switzerland. It focuses on teaching students how to develop a healthy lifestyle, thereby applying knowledge about physical activity and health to problems in society and everyday life. The authors argue that this tradition has clear similarities with the applied tradition in science education. In addition, "PE for values and citizenship" focuses on teaching "/…/ pupils' self-responsibility, respect for differences, conflict resolution and participation in the democratic life of the class" (Ibid., p. 4). This tradition is similar to the moral tradition in science education in that its focus is on the ability to solve practical and value-laden problems. Interestingly, this tradition is clearly formulated in research, in different projects and in the debate about PE, but not in

the analyzed curricula. Finally, "Teaching PE as physical culture education", tends to be more visible in France than in the other countries, and focuses on sport adapted for children in the context of education. The main difference between this tradition and the tradition "Teaching PE as sport-techniques" is that it takes a holistic perspective on children's physical activity rather than on isolated techniques from different sports.

The studies of teaching traditions lead to an understanding of what didactic choices look like in teaching. One of the most important results is that teachers apparently do not apply one particular teaching tradition in any simple and unambiguous way. They orient their teaching to a certain extent, but our studies show that in their actual teaching situation they organize their choice of aims, content and working methods in ways that are not as clear or uniform (Hamza & Lundqvist, 2018; Ligozat et al., 2018b, Lundqvist et al. 2009).

Comparative didactics for Professional Development

Thus far, we have argued that comparative didactics is a useful tool in clarifying and discussing what is taken for granted in different classroom practices. In our research, the concept of teaching traditions is a way of describing patterns of selection of educational goals, content and manners of teaching that teachers do. However, teachers, as individuals, do not adapt to well-defined traditions once and for all. Thus, they tend to teach in the way that they are accustomed to, whatever the situation. They also have clear answers to questions of what they want their teaching to achieve, although their ways to arrive at their goal may vary (cf, Lidar et al., 2017, 2019).

As said above, teachers sometimes meet with various didactic dilemmas about the choice of goals, content and manners of teaching (Almqvist, 2018). An interesting point then is if and how teachers' profession can be developed on the basis of such dilemmas. The point of departure in a didactical development dialogue is that teachers' written reports from teaching can be compared with research results and with other teachers' experiences, thereby making it possible to clarify, compare and discuss their selections of educational content and teaching methods. In this way, dialogues between teachers and researchers arise with the teachers' specific dilemma in focus. This model, based on didactics and action research contributes to new ways of studying and dealing with teaching. The outcome of a didactical dialogue is, that in the end, the teacher, by the help of colleagues and researchers, has been given an opportunity to write a reflection on his/her specific teaching dilemma. This model has also led to studies of how teachers and researchers collaborate in teaching in various contexts (Olin 2017). The framework contributes to research in comparative didactics by using the variations and patterns identified in various practices as a base for reflection (cf. Ligozat & Almqvist, 2018). Scholars in didactical research tend to cooperate more and more with professional teachers (Ligozat & Almqvist, 2018) in Sweden as well as in France and Switzerland. For example, in a

Swedish context the didactical modelling approach has been developed and used (cf. Hamza et al. 2018) In the French context, the Cooperative engineering framework has been used and further developed in several studies (cf. Le Brun et al., 2018; Sensevy et al., 2013) and in Switzerland, physical education didactics has been combined with action research (Lenzen et al. 2017). In these approaches, the teachers are full members of the research team. Thereby both researchers and teachers contribute and learn from the project (Olin et al., 2021).

Tanja, the science teacher, was influenced in her teaching by results from research about teaching traditions. She became aware that, even though she had an ambition to work within a moral tradition, she rather taught within the academic one. Our model helped to develop her teaching and to relate it better to her overall educational goals. The three people who were invited to comment in writing on her dilemma – two researchers and one teacher colleague from another school – focused on different aspects of and perspectives on the challenges she had formulated (Trivic et al., 2017). The first comment dealt with the importance of dialogue in the development of teaching, both in planning, implementation, and follow-up and how research can contribute to development. The second reader commented on the importance of understanding teaching from a theoretical perspective and teachers' responsibility for organizing teaching whereas the third reader gave a number of examples of how teaching can be further developed. Thus, all comments handled didactic issues about teaching and the development of teachers' professions in different ways, depending on the perspective in use. Tanja's case is, together with the three comments, an example of how comparisons can help teachers understand what a complex phenomenon teaching is characterized by different considerations that teachers make and take responsibility for. Acknowledging this complexity Tanja wrote in her concluding remark how, as a teacher, she can reflect on and further develop her practice and her knowledge about teaching by cooperating with her colleagues.

Concluding Remarks

In this chapter, we argue that research on teaching traditions may be used for deepening our understanding of classroom practice, for dealing with didactical dilemmas and for working with professional development. Thus, comparative didactics is a useful tool both as an approach in research and as a way of understanding and working with challenges and dilemmas that teachers meet with in their teaching practices.

Our example, Tanja, the science teacher, struggled with issues of selecting and opting out educational content and manners of teaching. She received written comments from three people – two researchers and one colleague from another school. The development of her teaching was thus made in dialogue with researchers and colleagues. Tanja's ambition was to teach in accordance with a moral tradition, and the development work that she did had important implications for teaching and

learning in her classroom. The comments she received from different perspectives showed her what she had taken for granted in her teaching, but also suggested possible ways forward. In other words, a comparative didactics approach was used for analyzes, discussion, and design in relation to a specific kind of didactical dilemma that she and her colleagues often face in their everyday teaching practices.

Thus, the results from comparative didactical research may be useful in teachers' development of didactical competence and professional judgment. Teachers may belong to specific teaching traditions and believe that they teach accordingly, but our results nuance that view and provide a deeper understanding of the challenges and dilemmas that teachers face in their teaching when students are expected to learn a specific content. Comparative didactics provide empirical insights into what is taken for granted in various educational situations. In this chapter, we have mainly focused on two of the four central aspects characterizing comparative didactics: Firstly, to analyze what is taken for granted in different educational practices and to identify issues not possible to see without comparing them with other practices. Secondly, the comparisons between educational practices contribute with knowledge of alternative ways of selecting goals, content and manners of teaching and can be used in the development of teaching. These results can in their turn be valuable as a common ground for discussions about teaching and learning in different school subjects, for different ages and in various countries. As such, comparative didactics is an answer to the call for comparative studies of teaching, educational content and learning within the wider field of comparative education. Finally, we want to argue for more research in line with what has been described in this chapter, there is still a lot to investigate and develop when it comes to understanding teaching in different subjects and educational contexts but also to further explore the other two characteristics of comparative didactics. There is a need to further investigate the relation between general didactics and subject specific didactics in teacher education and to learn from and contribute with knowledge about teaching and learning to the field of comparative education.

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Jonas Almqvist is Professor at the Department of Education, Uppsala University in Sweden. He is the scientific director of the research group Studies of Comparative Didactics. He develops research in comparative didactics with a focus on issues of teaching and learning in different subjects (mainly biology, chemistry and physics) in compulsory school and in preschool. He currently leads the international research network "Comparative didactics and professional development for teachers" funded by the Swedish Research Council. He is currently convenor of the EERA Network 27 Didactics – Learning and teaching and he acted as Deputy Link Convenor of this network in the period 2014–2021.

Malena Lidar is Associate Professor at the Department of Education, Uppsala University in Sweden. Her field of research is teaching and learning, mainly within Science Education with a focus towards sustainability issues. Recent studies and projects deal with co-construction of learning and teaching models with practicing teachers, how knowledge, values and power relations are linked in the classroom and how science teaching and science teachers' views of science can change because of educational reforms.

Anette Olin is Associate Professor at the Department of Pedagogical, Curriculum and Professional Studies at the University of Gothenburg in Sweden. Her research concerns three main areas; professional learning and development for teachers, teacher-researcher collaboration, and teachers´ middle leading in school development. She often works together with teachers in action research supporting teaching development. She is the leader of a Swedish network for Action Research, and also one of the coordinators in the international research network "Comparative didactics and professional development for teachers" funded by the Swedish Research Council during the period 2019–2021.

Chapter 5
The Rise, Evolution, and Future of Didactics in Italy: Branching Out Towards New Research Horizons

Erika Marie Pace, Iolanda Zollo, and Maurizio Sibilio

Introduction

This chapter aims to outline the historical progression and current status of Didactics in Italy and share the profound reflections, often available only in Italian, that have characterized the process of distinguishing itself as an autonomous research field. In addition to identifying the differences and similarities with other European countries in terms of its fragmentation between general didactics and subject-specific didactics, it illustrates how, over recent years, it has expanded its boundaries to embrace other fields of research such as cognitive neurosciences. Hence, it contributes to the mapping of European research related to Didactics and how Italy addresses the societal challenges that didactic research faces in a changing world.

Italy is a country with a longstanding history in educational research, boasting pedagogists of international acclaim (Cambi, 2003; Trisciuzzi et al., 2002; Crispiani, 2016). It pioneers a system where all students irrespective of their ability are taught in mainstream schools (D'Alessio, 2011; Mittler, 2000; Aiello & Pace, 2020). It treasures a rich body of pedagogical reflections that has kindled reciprocal influence especially with western European countries such as France and Germany, possibly due to their traditional philosophical approach to education (Mantegazza, 1998; Caillot, 2007; Ligozat & Almqvist, 2018). In recent years, it has also embraced the acknowledgment that "what teachers know, do and care about" (Hattie, 2003, p. 2) is key to student achievement along with other educational priorities (World Bank, 2015; OECD, 2019; UNESCO, 2016).

The influence of the European economic and geopolitical scenario cannot be overstated. From the beginning of the twentieth Century, industrialization, the settlement and expansion of cities, the fight against illiteracy, and the central role

E. M. Pace (✉) · I. Zollo · M. Sibilio
Department of Humanities, Philosophy and Education, University of Salerno, Salerno, Italy
e-mail: epace@unisa.it; izollo@unisa.it; msibilio@unisa.it

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attributed to the school as a mass producer of knowledge and skills (Schneuwly & Hofstetter, 2020), to which were conferred new tasks and responsibilities, are only some examples. This backdrop led pedagogical debate to reach its height internationally, including Italy. Convergence of thought in relation to the philosophical underpinnings of education, similarities in school practices and the evolution of Didactics as a discipline can be identified among the works of prominent pedagogists as well as policy documents in Europe and beyond. Amid these conceptual and practical transformations, worth highlighting is the gradual detachment of Didactics from Pedagogy and its extension to other fields of research driven by the need to respond to the additional pressures emerging from this complex interplay of cultural, historical, economic, and political factors (Burns & Köster, 2016) characterizing even Italian educational contexts (D'Alessio, 2011) mainly in the second half of the twentieth Century.

As other European Union, UN, UNESCO and OECD member states, Italy has endorsed an array of world policy documents with goals to be reached in future years (e.g., EP, 2000; UN, 1989; UNESCO, 1990; OECD, 2005) which led to various reforms. Two Laws, issued 20 years apart, are just two of the examples of why Didactics has grown into a broad field of research. The first reform, which may be said to have paved the way is Law n.118/1971 that abolished all special schools. As a result, teachers were suddenly faced with extremely heterogenous classrooms, yet very little preparation to deal with this new scenario. Indeed, as outlined by Zanniello (2016), due to the socio-political pressure placed on universities, who immediately took the urgency on board, studies on teaching methods that promoted learning among students with disabilities started to flourish. In addition, a subsequent law in the late 70's delegated teachers full responsibility for curriculum design and lesson planning. In this context, didacticians had to address these needs.

Driven by such urgencies, the concomitant worldwide developments on teacher competency profiling, and the central role of the teacher to guarantee quality education for all, Law n. 341of 1990 reformed the qualification requirements for prospective teachers. These were raised to bachelor's degree level for primary school teachers (since 2010 it has become a master's degree), and post graduate teacher education courses were established to equip prospective secondary school teachers with the pedagogical content knowledge required. In addition, in-service teachers were encouraged to seek further specialization by following courses offered by Higher Education Institutions, often subsidized by the Ministry of Education. As in French-speaking countries, this scenario contributed to highlight the importance of "an extensive analysis of classroom transactions in order to grasp the content taught and the dynamics of teaching and learning process as a joint-action" (Ligozat et al., 2015, p. 314, italics in original). Furthermore, it led to another strong impetus to research in Didactics (Zanniello, 2016).

Similarly to the evolution of Didactics in other European countries (Caillot, 2007; Meyer, 2012; Meyer & Rakhkochkine, 2018; Chevallard, 2007), in parallel to its fight for recognition as a separate field of research with its own ontology and epistemology, Didactics in Italy underwent a subsequent initial bifurcation between domain-specific Didactics (or subject Didactics) and general Didactics (Damiano,

1996; Frabboni, 2000; Rossi, 2011; Zollo, 2017). Indeed, there has been, and still exists, a hegemonic struggle for the demarcation of boundaries between the two. Traditionally, the latter is a discipline within the Faculties of Education, it stems from Educational Sciences and its proponents have an educational/pedagogical academic background. The former is linked to the respective faculties, depending on the disciplines. Subject Didactics hardly takes educational implications into account and scholars whose professional specialization is in the discipline concerned (mathematics, biology etc.), find difficulty in acknowledging studies in general Didactics because they are used to experimental research designs (D'Amore & Fandiño Pinilla, 2007).

For the generalists, their discipline is a science which can identify autonomously the most suitable strategies, methodology and tools to ensure that all students acquire indispensable competencies to approach any subject matter (Nigris, 2012). On the opposing pole, the promoters of domain-specific didactics claim that it is sufficient to know the discipline to be able to teach the related contents. On acknowledging the wide spectrum of competencies teachers require to work in today's classrooms, there have been efforts in bridging these two sub-disciplines (Frabboni, 2000; D'Amore & Fandiño Pinilla, 2007; Nigris, 2012). Evidence of this may be the teacher education course programs in which both are given due importance. In fact, comparing the Italian reality with the data Meyer (2012) presents regarding other European countries, the local situation seems to bear similarities with Finland, Germany, and Eastern and Southern parts of Europe where both the sub-disciplines are present in university course programs. However, the discrepancy between general Didactics and subject Didactics is not as significant in Italy as it is in Germany. For example, whereas general Didactics is envisaged in all programs, domain-specific Didactics is given mainly more prominence for preparation courses targeting secondary school teachers. Further to this bifurcation, other sub-disciplines have made their way and have become fundamental compulsory components of teacher education courses such as the introduction of the study units 'special Didactics' and 'inclusive Didactics'. By virtue of the worldwide impetus promoting inclusive education systems and the succession of reforms in Italian educational policy since the aforementioned 1971 Law (Zanniello, 2016), studies in this area have flourished and competency acquisition inherent to the implementation of inclusive teaching practices, irrespective of the subject and grade taught, is steadily becoming a must in all course programs (Aiello, 2015, 2019). Other examples of branches within the realm of Italian Didactics comprise intercultural Didactics and media and technology education (although the title does not include the word 'didactics', it is still considered one of its subdisciplines).

Notwithstanding the constant debate among these new strands in Italy and beyond, by now, there is common agreement on the fact that "Didactics is the scientific study (and the knowledge resulting thereof) of the innumerable actions taken to cause (or impede) the diffusion of such and such a body of knowledge in such and such a situation" (Chevallard, 2007, p. 133). In other words, a systems perspective which values the interplay among the student, the teacher, the subject matter, and the surrounding environment (Meyer, 2012; Hudson & Meyer, 2011). Indeed,

among its aims, research in didactics in Italy is now called to address issues regarding the identification of the right combination of professional competencies (Shulman, 1987) that teachers require. It looks into the most suitable and feasible teaching practices that can be adopted in schools, based on empirical research. It attempts to provide solutions to manage exceptionally heterogeneous classrooms, devise practical ways to use technology and other media effectively, and suggest techniques to improve collaboration among professionals and communication with parents and other stakeholders. It studies the potential of a wide spectrum of teaching methods and resources aimed to ensure that all students, irrespective of their differences, reach their maximum potential.

Thus, Didactics in Italy has gone through a complete metamorphosis since the twentieth Century. A young yet robust discipline, it has been steadily gaining ground as the science that can respond to the challenges of twenty-first Century schools. Taking into account the lack of a universal semantic interpretation of the term 'didactics' within the Western cultural tradition (Meyer, 2012; Hudson, 2007) and that literature in English on Italian Didactics is relatively scant, raises the need to delineate the key milestones of the historic developments in the field. The final section of this chapter describes the new paths currently being pursued in the search of innovative approaches to improve school effectiveness.

Tracing the Roots and Evolution of Didactics

Research on the etymology of the word 'didactics' leads us to the Greek verb didáskō that means 'to teach', 'to show'. Originally, it indicated the literary genre of didactic poetry, whose ultimate goal was to impart a form of teaching or to pass on knowledge through discussions on scientific, technical, moral, and theological themes (Zollo, 2017). This understanding of didactics, already connected to schooling albeit with slight semantic variations, continued to prevail not only in the Hellenistic and Roman eras, but also in medieval periods and up to modern times. Nevertheless, there is common agreement in literature, including Italian sources, that the birth of Didactics as we know it today is to be attributed to Comenius in the seventeenth Century (Schneuwly, 2011; Gennari, 2006; Meyer & Rakhkochkine, 2018) and whose definition outlines its object of study: the interrelationship among the teacher, the learner and all that emerges during the act of teaching.

Nevertheless, it was not until the twentieth Century that Didactics started to establish itself as a scientific discipline to the extent that the 1900s are referred to as 'the Century of Didactics' (Laneve, 2011). In his historical analysis of the evolution of Didactics in Italy, Frabboni (2000) divides these one hundred years, defined as the 'Century of the child, women, the masses and technique' (Cambi, 2003), into two seasons: the first sixty years were plagued by bad weather, whereas the last forty were illuminated by warm rays of sunshine. Initially, Didactics was merely considered to be a branch of Pedagogy that was responsible for the practical aspects, and which had no theoretical foundations to be self-legitimized epistemologically

(Frabboni, 2000). Therefore, it was conceived as the operational aspect which transformed the pedagogical principles developed at the time into the act of teaching. Similarly, in French-speaking countries (Caillot, 2007) as well as Germany (Meyer, 2012), in this same period, the relationship between these two disciplines revolved around the distinction between theory and its application: Pedagogy focused on the reflection on praxis whereas Didactics translated this reflection into action.

In addition, however, Damiano (2013) identifies a third category constituted by the practitioners who were the direct actors in education. As a consequence of this tripartite division, in Damiano's (2013) view, a 'hierarchy of irresponsibility' (p. 284, authors' translation) took place. On the one hand there were the pedagogists who were vested with a prestigious role, but futile since they were not directly involved in the action. The second group were the didacticians who worked on the teaching techniques without reaching any conclusions regarding their aims and efficacy. Lastly, there were the practitioners, who concretely implemented all that was imparted from the two higher levels without having a clear understanding of the aims and tools being used. The structure and division within this pedagogical pyramid, where on top the pedagogists reigned while at the bottom lay the teachers and educators, placed those engaged in Didactics in an intermediary position. The former regarded this research branch as 'blind technology' because it lacked theory, whereas the latter did not consider it as a reliable source. Such a system weakened the three levels significantly because they were not linked in a reticular manner.

As outlined in the first section of this chapter, the situation that Frabboni (2000) defines as the second season, starting from the 1960s, was very positive. In Italy, conforming to the reflections put forth in European literature (Debesse, 1976; Mialaret, 1976), the monistic view held until that time regarding Pedagogy was critically revised. As a consequence, the process towards a scientific foundation and epistemological legitimization gradually gave this field an autonomous position constituting the research area of Educational Sciences. Hence, Didactics started to be considered a science which, in its integrated synthesis of theory and practice, encapsulates the knowledge, lexis, strategies and procedures required to reflect, interpret, choose and, consequently, act on the basis of the needs that emerge throughout the teaching-learning process (Sibilio, 2014).

Towards a Shared Definition of Didactics in the Italian Context

Although characterized by an array of interpretations and uses, the concept of Didactics has undertaken a central position in the Italian educational panorama. Its delay to acquire its right to citizenship in the *cité scientifique* [scientific society], according to Laneve (2011), was two-fold: firstly, there may have been a misinterpretation of the neoidealist paradigm which considers knowledge as the ability to teach, therefore neglecting all those issues concerning the teaching-learning

process. Secondly, he adds, it may have been due to the tendency to interpret Didactics as mere practical knowledge within the realm of Pedagogy. In reviewing the literature of the last two decades on the theoretical reflections regarding the definition and realm of Didactics, what clearly emerges is the resolute position that it is to be regarded as a separate science within the field of education. Notwithstanding this affirmation, the interpretations regarding its area of interest and boundaries with other disciplines, especially Pedagogy, are still central in the Italian scientific debate as much as in other countries.

For example, Frabboni (2000) perceives Didactics as a science of formative/educational communication that has the role of transferring essential multiple forms of knowledge and models of social life that are ideally characterized by an ethical and solidary approach. The 'broadcasters' identified are all the formal, informal and non-formal educational and cultural agencies, while the 'receivers' are people of all ages – from childhood to late adulthood. The role of this type of communication is that of mediating between the receivers' nature and the culture of their immediate physical and social setting. This non-prescriptive and flexible definition of Didactics is based on the principle of plurilateralism and problematization. Armed with its own theoretical, epistemological, and methodological foundations, Didactics is open to flexibility, modularity, and the integration of theory and methods. This new discipline inaugurates a democratic, non-discriminatory educational model whose aim is that of orienting the teaching-learning process (D'Amore & Frabboni, 2005).

Baldacci (2004) views Didactics from a completely different standpoint, considering the school as the only institution able to address the individuals' education and training needs. Hence, he defines Didactics as the science of teaching: that educational activity which mainly deals with the cognitive aspects of education. In this regard, he proposes the formula Didactics (x, y, z) where the variables x, y and z indicate the discipline, the receiver, and the context. In Baldacci's (2004) view, Didactics should not attempt to determine these variables. Rather, it should try to develop a discourse on teaching that is placed on a more abstract level and, thus, on valid assumptions that can form the basis regardless of what is taught, to whom and where this route leads in order to study the relationship between teaching and learning (Baldacci, 2004). Of significance are the reflections and the decisions made regarding the objectives to reach, the goals towards which to aim and the frameworks of meaning in which these objectives and goals lie. As a result, Didactics is to be understood as that discipline apt to devise adequate responses to the challenges of society that are influenced by context and time.

Gennari's (2006) definition of Didactics, on the other hand, focuses on its scientific identity, raising its status to a discipline that is simultaneously overarching and underpinning. He posits that Didactics, besides being an institutive part of Educational Sciences, also concerns all human sciences and a conspicuous part of natural sciences. Hence, in his view, Didactics is a general science of teaching and learning: a science, because it encompasses the systematic study of the structure and behavior of its object of interest, in this case the teaching-learning process; general, because it comprises and controls the set of models and contents, theories and practices and develops its own interpretations on the actions when education takes place.

In agreement with this definition and to further emphasize the scientific status of Didactics, Cerri (2007) claims that Didactics is a complex interplay of theoretical and practical knowledge which, although autonomous, is intricately intertwined with Pedagogy. Didactics, in Cerri's (2007) view, is endowed with clear planning, methodological, assessment and evaluation processes whose critical approach and awareness guide educational action through a cyclical and transformative process where reflection and action influence one another. Within this definition, Didactics is considered as critical knowledge that links experience to culture and vice versa. As regards the relationship between Didactics and Pedagogy, Cerri postulates that the former is independent from the latter, but at the same time correlated with one another in a circular manner. In the same year, Calvani (2007) defines Didactics as one of the most relevant communication activities whose aim is to reproduce social knowledge that is transferred from experts to novices within intentionally created institutions. Although it can be considered as a succinct definition, it may also be viewed as a reductionist approach because it restricts the studies on the teaching-learning process to formal education contexts and neglects the conquests which the discipline has made in education arenas that go beyond the school. This is definitely not the case since professionals specialized in the field have attracted the attention of local entities, cultural associations, businesses, and publishers, expanding the boundaries to include informal and nonformal settings (Bonaiuti et al., 2016). Thus, studies in Didactics span throughout all lifelong education processes.

In the attempt to reach a possible shared definition and to delineate the boundaries of this discipline from an Italian perspective, Laneve (2011) and Rossi's (2011) reflections provide a theoretical and practical synthesis for those engaged in Didactics (scholars, researchers, teachers, educators and practitioners). According to Laneve (2011), Didactics is "composite knowledge with its own investigative autonomy" (p. 19, authors' translation) that is made up of three distinct elements:

– an object - that is teaching: the teacher's actions aim at learning, but these actions don't necessarily determine it.
– a field - that is not only represented by the school, but can also be other formal, informal and non-formal contexts.
– a research methodology - that relies upon quali-quantitative methods and tools which can vary from experimental design to action-research, from surveys to ethnographic accounts, and from participatory observation to the analysis of teaching practices.

This should be done while being constantly aware that (Rossi, 2011):

– there exists a strong relationship between theory and practice, and therefore action should be associated to systematic ongoing reflection.
– in order to teach, strategies have to be designed on the basis of the context, students' needs and interests. Hence, a professional approach must be adopted – common sense, naïve theory, and the adoption of strategies with no theoretical foundations are of little or no use.

– subject content knowledge is not sufficient to teach. The teacher needs to be able to transpose the subject content according to the context one finds himself or herself in.
– the teacher, as a professional, needs to plan and be responsible for his or her own lifelong learning.

Therefore, what has become central to the teaching profession and of equal importance are the teachers' ways of knowing, doing and their work ethic or beliefs (Hattie, 2003; Sharma & Pace, 2019). Rivoltella and Rossi (2012) affirm that there have been major developments in Italian research in Didactics, as in other countries, on the teachers' pedagogical identity (Altet & Vinatier, 2008; Shulman, 1987) and the teacher as a reflective practitioner (Schön, 1983; Hudson, 2002). This is evidence of the importance being given to the central role of the teacher in the inextricably linked teaching-learning process. There has been a shift from a constructivist to a post-constructivist view of teaching and learning, ascribing to action the place where the trajectories of these two processes intertwine and communicate with one another in the form of a recursive dialogue among the teacher, the student, and the context (Rossi, 2011). In this sense, Didactics refers to a panoply of theoretical knowledge that encompasses procedures, actions, and theoretical awareness and which generates a dialectic continuum between theory and praxis.

Branching Out: The Present and Future of Didactics in Italy

In the endeavor to provide a holistic understanding of the complexity within the teaching-learning process, researchers in Didactics have recently started to explore new avenues by reaching out to other fields of research. Indeed, the research advances in cognitive neurosciences and its progressive recognition as a robust paradigm to understand human behavior have not gone unnoticed (Rivoltella, 2018). In the 1980s, the French proposal of biopedagogy (Debesse & Mialaret, 1967/1978) had called the attention of the Italian pedagogist, Elisa Frauenfelder, who started exploring the possible relationship between pedagogy and biology (Frauenfelder, 1986). In the early 2000s, Frauenfelder & Santoianni (2002) coined the term 'bio-educational sciences'. This research branch is intended as a field of studies which interconnects conventionally distant fields of research spanning from pedagogy, psychology, philosophy, biology, and neuroscience. Starting from the concept of the potential of 'educability', intended as the study of the constraints and possibilities readily available in nature to overcome the nature-culture dualism, Frauenfelder's main aim was to understand whether it is at all possible to 'activate' an educational process in any individual. Inspired by this orientation towards the natural sciences, another three proposed paths have become the research frameworks of reference for theoretical reflection and initial empirical research. These paths are:

– enactive didactics, which brings together constructivism and embodied cognitive science.

– neurodidactics, which intertwines biological and social psychology, educational sciences, neuroscience, and didactics and proposes new teaching methods on the basis of brain function.
– simplex didactics, which is based on Berthoz's theory of simplexity and the properties and principles governing action within any Complex Adaptive System (Berthoz, 2012; Sibilio, 2014; Di Tore et al., 2020; Aiello et al., 2021).

Each of the four research branches bears its own characteristics. Yet, there are some common threads joining them together. First, they all view the education system as a complex socially-constructed phenomenon that constantly needs to recreate itself to adapt to time and context. Secondly, they are all rooted within an ecological perspective where the interaction among the teacher, the student and the environment is central to understanding the efficacy and effectiveness of the act of teaching. Thirdly, they aim at guiding teachers to reflect on their actions to bring about transformation within inclusive educational contexts. Nevertheless, their aims and approaches differ. For example, the former two research strands have led to the design of two teaching methods. Based on an enactivist approach, the PROPIT model (Planning for personalized instruction and inclusion using technology) (Rossi, 2014) proposes the construction of digital artefacts to create personalized learning experiences that are apt to engage all students. This was stimulated by the promotion of the use of technology in the classroom, the quest to find feasible strategies to promote inclusive practices and envisioning the teacher as a project planner on a microlevel. The 'Episodes of Situated Learning' (Rivoltella, 2015) is a teaching method aimed at guiding the planning of meaningful learning experiences to stimulate self-directed learning. Both methods have been widely adopted in primary and secondary schools in various Italian regions. Initial results, although qualitative, are very promising in terms of guiding teachers in designing effective lessons that are highly participatory, and helping students acquire problem solving skills through learning by doing. In addition, both methods stimulate reflection in action and upon action among teachers and students (Rossi & Giaconi, 2016).

Sibilio's (2014, 2015, 2017) conceptual framework on Simplex Didactics proposes a theoretical reflection on teacher agency. The aim is to create awareness about the simple rules that govern the sequence of actions taking place during the teaching-learning processes (Sibilio, 2014; Aiello et al., 2016, 2021; Zollo, 2018) and the implications these have on students' learning (Sibilio, 2017; Di Tore et al., 2020). The underpinning idea of this framework is that in gaining cognizance of their innate resources and capabilities (Aiello et al., 2021), teachers may feel better prepared and more efficacious in dealing with the complexities they are faced with in their day-to-day encounters with their students and the surrounding environment. Indeed, exploratory research carried out during a continuous professional development course has shown that training on simplex didactics may offer the possibility to bridge pedagogical content knowledge and subject content knowledge although the need for more training emerged (Zollo, 2018). These theoretical foundations aimed at disentangling the complexity in the didactic transposition, have led to other

studies in the area of technology in education (Di Tore, 2016, 2018), empathy and perspective taking abilities (Di Tore et al., 2020), among others.

Despite the fact that research on these propositions is still in its initial phases, these frameworks are gradually proving to be invaluable in orienting educational research, policy, and practice. They are increasingly informing curriculum design by providing scientific grounds for the choice of specific teaching methods to suit different learning needs and styles. They are stimulating further research to provide the much-needed evidence base that Italian research seems to lack (Cottini & Morganti, 2015). More particularly, they are accentuating the significant role of the teacher within the triadic interaction (teacher, student, environment), underlining the urgency for restructuring teacher education course programming and delivery. In summary, the attention is being shifted from the provision of pedagogical knowledge and the specialization in content areas to the idea that teachers are to be reflective practitioners, lifelong learners, and researchers.

In conclusion, one can claim that Italian Didactics has come a long way over the past fifty years. It is now a widely acknowledged discipline whose signature strength is its ability to adapt itself "to the changing nature of its object of study" (Chevallard, 2007, p. 131; Sibilio, 2015) and whose focus continues to gradually shift to "causal explanations that are not linear and not reductionist" (Cochran-Smith et al., 2014, p. 19). It aims to explore the processes that take place within this complex adaptive system where a unique and unrepeatable combination of different processes inevitably interact, producing an authentic teaching-learning event whose emergent result is an experience that brings about change in the teacher, the student, and the environment (Hudson, 2002, 2007; Sibilio, 2014). Studies are theory-driven and are based on evidence, in line with the recent trends in educational research on an international level that are increasingly guiding policy and practice (Slavin, 2019). In summary, didacticians are responding effectively to Rivoltella's (2018) claim that this field:

> can no longer be the space in which concepts are not univocally defined and phenomena are interpreted in such a way where anyone can sustain any opinion. If Didactics is to be thought of as a science, then the assumptions and claims made need to be falsifiable – and this cannot happen if they cannot somehow lead back to experimental evidence (authors' translation, p. 2).

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Erika Marie Pace is researcher in Didactics and Special Pedagogy in the Department of Humanities, Philosophy and Education at the University of Salerno in Italy and visiting lecturer at the University of Malta. After obtaining her Bachelor of Education at the University of Malta, she furthered her studies in Health Promotion and Education at the University of Perugia and in Adult and Lifelong Education at the University of Salerno. In 2017, she earned a PhD in Didactics, Technology and Inclusive Education. Her research interests focus on teachers' commitment and agency to implement inclusive classroom practices, teacher education course programming, and inclusive school development using strengths-based approaches.

Iolanda Zollo is researcher in Didactics and Special Pedagogy in the Department of Humanities, Philosophy and Education at the University of Salerno in Italy. She graduated at the University of Naples "Federico II" in Philology, literature and civilization of the Ancient World and she holds a PhD in Didactics, Technology and Inclusive Education. Her research interests include the relationship between General Didactics and Subject Didactics within a simplex perspective, and teacher education to promote the development and implementation of inclusive processes.

Maurizio Sibilio is Full Professor in Didactics and Special Pedagogy in the Department of Humanities, Philosophy and Education at the University of Salerno in Italy. He has progressively developed research activities on the pedagogical and didactic meaning of corporeality from a bio-educational perspective, on the inclusive potential of the body and movement, and on the mechanisms that regulate teaching-learning processes. In recent years, through a fruitful scientific collaboration with Alain Berthoz, his scientific interests are oriented towards a possible pedagogical-didactic declination of the theory of simplexity, highlighting the non-linear bio-educational nature of educational research.

Part II
Methods and Lenses for Exploring Teaching and Learning in the Classroom

Chapter 6
Curriculum Materials in Initial Literacy: An Instrumental Approach in Spain

Inés Rodríguez Martín, Jorge Martín-Domínguez, María Clemente Linuesa, and Elena Ramírez Orellana

Introduction

Beyond the abundant research analysing and assessing materials on a standalone basis, there also many studies that address the use teachers make of them. There are two trends accordingly: the first one recognizes the direct influence materials (mainly textbooks) have on classroom practices; the second one questions whether this influence is so decisive, and instead focuses on a complementary role of both elements: content and teaching practices. Nevertheless, recent studies on classroom materials and practices reflect the diversity of elements propounded for explaining the influences between them. In fact, studies on innovations based on the use of information and communications technology (ICT) have highlighted the role teachers play as mediators and interpreters of the materials: teachers select, combine and adapt resources and include them in the management of their classroom practices (Spillane et al., 2002).

The main objective here is to study the role materials play in the classroom, as well as the extent to which they shape teaching practices in initial literacy (ages 3, 4 and 5) in Spain. This would lead to an in-depth understanding of individual teaching methods about literacy, which are especially valuable for certain educational goals and specific classroom contexts. Today, living in societies in which the access to information and knowledge is conditioned by the inevitable presence of reading and writing, mastering these processes in a highly proficient manner becomes an

I. Rodríguez Martín (✉)
E.U. Educación y Turismo de Ávila, Universidad de Salamanca, Ávila, Spain
e-mail: inesr@usal.es

J. Martín-Domínguez · M. Clemente Linuesa · E. Ramírez Orellana
Facultad de Educación, Universidad de Salamanca, Salamanca, Spain

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essential pre-requisite for a successful academic, social and personal performance, which means that writing is considered a major cultural tool that we need to learn both explicitly and purposefully (Eurydice, 2012, p. 7). Therefore, accessing the teaching practices that teachers use in the contexts in which they develop and analysing the role that resources play in these practices will allow us to understand how initial literacy teaching is actually shaped and help teachers to reflect on and analyse what they do in their classrooms.

This research is part of the European didactic tradition that gives teachers and students a significant role in the process of teaching and restructuring school subjects (Gericke et al., 2018). Our study extends the debate on subjects, academic content, and classroom knowledge by addressing the role that materials may play in the transformation of academic content into classroom knowledge, as an added feature that may qualify the transformation process. One of the features of teaching practices involves the use of different kinds of materials and resources to support actual classroom content and tasks. The decisions teachers make regarding the use of resources in their teaching may be linked to, among other aspects, the subject being taught. Indeed, teaching different subjects calls for different practices and resources (Cohen, 2018). The topic of this study is whether there is a link between the materials teachers use and the teaching practices on initial literacy. This also includes whether the types of activities that the classes are based on can be associated with this particular subject.

Theoretical Underpinnings

Classroom Practices

We understand classroom practice as the actions regulated through methodological patterns that are planned beforehand and focus on the achievement of goals, which could be of a short, medium or long-term nature. These actions that teachers develop in interaction with students constitute the focal point of the teaching process. If we ask ourselves about the actual structure of classroom practices, there are certain aspects that help to define common points. For example, Ruthven (2012) has identified a series of defining features: (1) the teaching environment, (2) the system of material resources, (3) the activity's format, (4) prior planning sheets, and (5) time management. Other scholars also include practical action plans and "types of activities" (Leinhardt et al., 1987; Vázquez & Angulo, 2010). All these analyses coincide over two aspects that we will be focusing on here: material resources and the teaching activities undertaken directly in the classroom. Teachers interact with their resources, selecting them and working on them (e.g., by adapting, reviewing, and re-organising them) in processes in which the planning of the action overlaps with the action itself (Gueudet et al., 2012; Remillard, 2005).

The Role of Curriculum Materials in Teaching Practices

Studies on the classroom use of resources report findings that show how teachers are fairly self-sufficient when they make decisions on which materials to use and how, even with internal differences for each individual teacher as regards different curricular content (Sosniak & Stodolsky, 1993; Spillane, 1999). Nonetheless, this use of materials seems to depend on several factors: curricular context, school culture, and each teacher's understanding of the content or level they seek for their students (Valencia et al., 2006), the specific content the materials present, the teachers' knowledge, and their own practical experience (Ligozat, 2011). As regards the curricular framework in the stage that concerns us here, Early Childhood Education (ages 3–6), it is defined by features that cannot be attributed solely to the students' age or even to their very nature, as their way of thinking is syncretic, because it is a non-compulsory stage in Spain. In at least 16 EU countries, the last year of Early Childhood Education or Pre-Primary Education is compulsory; for example, compulsory education in France begins at the age of three (Eurydice, 2019). This not the case in Spain, where it begins at six. This explains why the official curriculum has a more advisory than prescriptive nature. In consonance with many northern European countries, the content is structured around general curricular areas that prompt students' major developmental areas, with the emphasis on the learning process through discovery, exploration and play (Bingham & Whitebread, 2018). Specifically, and regarding initial literacy, the suggested content involves the differences between ways of writing and other forms of graphic expression, learning to identify the most common and important written words and phrases, and starting to learn the written code. Secondly, regarding teachers' professional expertise and the culture at that stage, it seems clear that teachers manage their classrooms in the knowledge that their students' developmental characteristics (e.g. physical or verbal skills) determine their performance in the classroom (e.g. less independent than primary education students) (Rodríguez et al., 2018). The learning environment has fewer formal learning situations, shorter activities, more varied tasks, more manual activities, less desk-based work, and closer supervision than others stages of schooling. In particular, studies on teaching practices in initial literacy have found that teachers in Early Childhood Education tend to work on aspects related to the stimulation of oral language skills (Friesen & Butera, 2012), the shared reading of stories (Lynch, 2011), segmental awareness (Kent et al., 2012), explicit teaching of letters and the alphabet in both reading (Al Otaiba et al., 2008) and writing (Gerde et al., 2015). In her review of curricular approaches in the EU, Tafa (2008) reports that this method is adopted in a similar way throughout Europe for teaching initial literacy in Early Childhood Education.

Furthermore, a single teacher is the norm in Early Childhood Education in Spain, together with organisational-didactic models such as assemblies, working in learning centers, the organisation of space by functional areas, longer breaks, the value of play as a learning strategy, and a plethora of manual and creative activities (Bejarano, 2010). Teachers in Early Childhood Education form a nucleus around

which they make decisions. In addition, each teacher stays with the same group of pupils for the three years of Early Childhood Education until they start Primary Education. Moreover, in certain European countries such as Switzerland (Ligozat, 2011), teachers reach decisions collectively about the choice of teaching resources. In Spain curriculum materials (textbooks) are chosen by teaching staff, generally by agreement with the school, although they are free to choose whether or not to use a textbook in their classroom.

Concerning the materials for teaching initial literacy, most research has focused on the first years, as this is precisely the time when reading is a topic in itself, separate from other subject areas. Reading subsequently becomes mainstream, losing its status as a separate item.

Regarding the findings of the research into the materials used in initial literacy, there is a myriad of answers about the allocation of resources, over and above the fact that their choice may or may not indicate that the teachers agree with the recommended approaches in each case. Accordingly, some teachers faithfully follow recommendations made by the authors of the resources, others feel comfortable by slightly modifying some of them, and finally, there are those who follow their own guidelines by relativizing the use of materials (Smagorinsky et al., 2002). Nevertheless, when teachers use, adapt or redesign these materials, they do so according to specific classroom activities (Boschman et al., 2014). Both the range of materials to be used and the broad array of statutory precepts involved add complexity to the interrelations between the teaching of initial literacy and *ad hoc* curricular materials (Valencia et al., 2006). Teaching materials and practices are interrelated through their selection, adaptation or reorganisation by teachers. The influence materials have on the action may be due to the different factors described, whereby the question that now arises is what happens to initial literacy teaching practices, which is the topic that concerns us here.

Teaching Initial Literacy

Initial literacy here means the explicit process of teaching reading and writing, their situational functions and uses, and their symbolic and representational value when children start to receive formal, but not compulsory, education (at the age of 3 in Spain). The debate on the best way to teach this content continues. Consistent with numerous experts (e.g., Erickson & Wharton-McDonald, 2019; Morrow et al., 2019), our position is that teaching initial literacy requires the confluence of the various aspects that the different theories have addressed partially. This standpoint is not only useful when designing teaching practices, but also permits an impartial view when investigating how teachers undertake their practices (Pressley et al., 2006).

This perspective of teaching initial literacy involves the use of activities (tasks) that can be grouped into four main actions:

a) *Functional aspects*: to engage students in the process of learning to read, thereby enabling them to enjoy other realities, communicate with others in a new way, acquire information, etc. (Barton, 2007); b) *Representational aspects*: to help them understand that writing can be used to express themselves and describe the world around them, just as they can with gestures, drawing and talking (Vygotsky, 1979); which therefore means enriching the students' level of the spoken language in terms of its formal and functional dimensions (Morrow et al., 2016), providing opportunities for acting out stories through symbolic play (Overstreet, 2018), or arranging spaces and times for expressing their ideas through drawings; c) *Teaching the code, reading and writing*: designed to appropriate and automate the code (phonological awareness - Defior & Serrano, 2011 – and the alphabetic principle – Piasta & Wagner, 2010), in both reading and writing; and d) *Comprehension*: to furnish students with strategies to enable them to understand texts, whether they are presented orally, visually or in writing (Kendeou et al., 2009).

These main actions provide a guideline for drawing up an analytical framework for initial literacy teaching practices. Nevertheless, the practices themselves may also be conditioned by the prescriptive regulations laid down within the corresponding curricular framework. The social pressure for children to read and write as soon as possible may condition the meaning of teaching practices or the tendency to consider Early Childhood Education as a form of pre-primary school (Bingham & Whitebread, 2018) and may curtail the variety of experience provided at this stage, in this case in relation to initial literacy.

Current Study

The work presented in this chapter studies the alignment between the approaches to the teaching of initial literacy proposed by curricular materials and classroom practices with pupils in Early Childhood Education, aged 3, 4 and 5 in Spain. Accordingly, the research involves answering the following questions:

1. What is the approach to reading that explains how this content is taught in classroom practices and through materials?
2. Is there an alignment between the materials and classroom practices analysed in the pedagogical approaches to the teaching of initial literacy? What aspects underpin this alignment, if any? By contrast, what aspects give rise to a lack of alignment, if any?

This study aims to explain how content is created in classroom practices that impact upon pupils' performance throughout their schooling. Reading is a key component of all the other subjects in the curriculum, and material resources affect the formulation of practices (Al Otaiba et al., 2011; Piasta & Wagner, 2010).

Research Design

Participants

The research has adopted a case-study model involving real practices, as we have observed the classes taught by nine teachers at different schools (Table 6.1). The aim was to explore the complexity of the processes undertaken within real classroom contexts to understand the phenomenon in all its complexity (Stake, 1995). The data were gathered by video-recording the sessions with a digital camera that covered the entire classroom. In addition, each teacher wore a digital recorder with a microphone for recording her voice. No members of the research team were present during the recordings. This therefore meant a total of 39 sessions, corresponding to approximately 39 hours of recording.

This research involved the second cycle of Early Childhood Education (ages 3–6). It is a non-compulsory, free of charge and protracted period of schooling. The staff teaching in this second cycle are required to have a university degree.

Tables 6.1 and 6.2 below provide information on the participants, the classes and the materials involved. The teachers in our study were part of a group that had

Table 6.1 The sample: participants and classrooms

	Sex	Years of Teaching experience	Years in Early Childhood Education	Number of pupils in the class	Classroom observations	Curricular Material used in the classroom.
Teacher 1	Female	5	Single classroom (3–6 years)	9	5	El jardín de las letras // Letrilandia
Teacher 2	Male	10	1st (3–4 years)	19	4	Parque de papel
Teacher 3	Female	30	2nd (4–5 years)	17	3	El jardín de las letras // Papelillos
Teacher 4	Female	20	3rd (5–6 years)	19	6	El jardín de las letras // Papelillos
Teacher 5	Female	21	3rd (5–6 years)	17	6	El jardín de las letras // Papelillos
Teacher 6	Male	23	3rd (5–6 years)	17	3	Parque de papel
Teacher 7	Female	25	2nd (4–5 years)	26	6	Leo con Alex
Teacher 8	Female	12	1st (3–4 years)	22	3	Letrilandia
Teacher 9	Female	8	1st (3–4 years)	9	3	El jardín de las letras // Papelillos

Table 6.2 Some examples of lesson topics in three classes

Teacher 2	1.st Basic Colors: red, blue. The concept of empty/full
	2.nd The concept of short/long. Colors: orange, green…
	3.rd The color
Teacher 4	1.st Reading short texts. Coloring pictures.
	2.nd Counting sticks for numbering. The letter "ñ"
	3.rd Coloring pictures with the letter "h"
Teacher 6	1.st Writing pictograms. Solving riddles. Drawing a Christmas tree
	2.nd Coloring pictures. Dividing words into syllables. Solving riddles. Writing pictograms.
	3.rd The flowers: Spelling the names of flowers, coloring pictures of flowers, solving riddles about flowers.

volunteered to take part in an innovative ICT project that included research into teaching practices involving initial literacy and mathematics. These teachers were willing to take part in ICT-related innovation schemes, and they agreed to cooperate with the research in exchange for the provision of the necessary ICT resources. This agreement also included sharing and working jointly with the research team on a self-reflective scheme involving teachers and researchers. This means that the teachers were not chosen randomly, although each case was investigated in depth, with continuity over time. Classroom sessions were recorded over three years in around 60-minute periods, chosen randomly and distributed into three blocks the first year, two in the second, and one in the third. The teachers were also asked about the curricular materials they used. The market for educational materials provides a limited range of titles because, in Spain at least, the production and distribution processes tend to be in the hands of only a handful of publishers that can meet their extremely time-specific demand and have the corresponding capacity for storage and distribution (Gimeno, 1995).

Methodology for Data Analysis

Each recording was processed as follows:

– Firstly, each classroom session record was transcribed.
– Secondly, the session was broken down into Typical Classroom Activities (TCAs). TCAs refer to a series of actions that are repeated regularly over the teachers' instructive action and allow managing the learning environment in the class. These actions make generic patterns of exchange between the different agents in the educational process: teacher and students. A review of the literature, our previous work and a preliminary study of the data allow us to make a very detailed list of the most common TCAs in Early Childhood Education classes (more details in Ramírez et al., 2019, Rodríguez et al., 2018). Table 6.3 below provides a list of TCAs involving tasks related to the teaching of literacy.

Table 6.3 TCAs featured in the study with tasks for teaching literacy

	Typical classroom activities	Activity description
Performing tasks by learning Centre	**Performing tasks by learning Centre**	Perform different teaching-learning tasks in a variety of work areas. One of the work areas corresponds to the computer corner
Performing tasks	**Performing a task with an ICT (whole class)**	Perform different teaching-learning tasks using a technological resource
	Performing tasks with and without related ICTs (individual work)	Perform different tasks based on the same teaching content (lesson topic), combining technological and non-technological resources
	Performing tasks with and without independent ICTs (individual work)	Perform different tasks on a variety of teaching content (different lesson topics), combining technological and non-technological resources
	Performing tasks without an ICT resource (individual work)	Perform different teaching tasks using a non-technological resource
Other TCAs	**Date and weather**	Identify the day of the week, month of the year, and weather for the current school day
	Poetry recital	Repeat a poem, learn it by heart, and recite it out aloud, either individually or in a group
	Correcting work in class	Revise and assess the tasks performed in class by each pupil individually
	Task explanation	Explain the procedure for performing the learning tasks
	Task planning organization	Organize and explain the work in the session or in part of the session
	Watching a film with an ICT resource	View an audiovisual document screened through a technological resource

– Thirdly, each one of the TCAs was broken down into tasks that reflect the objectives to be achieved as regards specific content. The task is defined as a clearly specific action that is meaningful in itself, which completes the sequence of the development of the teaching and of the practice in particular (Ramirez et al., 2019; Rodríguez et al., 2018).
– Once the tasks have been segmented, they were structured around five main categories in the teaching of reading and writing: 1) *Functional aspects* (dimension 1.1. e.g., "we're going to do riddles, we start with the riddle, what was it like?"; Teacher 7); 2) *Representational aspects of the written language* (dimension 1.2. e.g., "let's wait for a while, we must point out the animals without antennas, not bad Virginia; without antennas, birds, animals that have horns and farm animals"; Teacher 1); 3) *Teaching the code* (dimension 1.3. e.g., "its name is ef, but it sounds like ffffffff"; Teacher 5); 4) *Comprehension* (dimension 1.4. e.g., "let's tell a story about kings and queens, camels and prisons"; Teacher 6); 5)

Writing (dimension 1.5. e.g., "the first thing we are going to do is write down our own name, write down your own name, ok?"; Teacher 4). These dimensions are, in turn, subdivided into a detailed series of categories and subcategories (Rodríguez et al., 2018).

Results

To analyses and try to understand how teachers and curricular resources approach the initial literacy, in the following lines we shown the results grouped in three large sections: in first place, we are going to analyse the presence of the different initial literacy dimensions in the practices and what are the activities that teachers use when teach. After that, we are going to do the same analysis for the curricular materials that teachers use for their class. Finally, we are going to try to find alignment points between initial literacy practices and curricular resources, with the aim to understand what is the role that materials play in this teachers' practices.

Classroom Practice

How Teachers Address the Dimensions of Reading

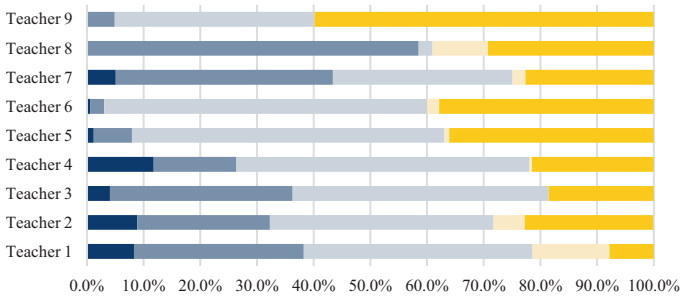
Figure 6.1 provides a snapshot of how the dimensions of teaching reading are generally addressed. Figure 6.1 also shows how all the teachers, despite certain similarities, have clearly differentiated profiles.

Functional Aspects (Dimension 1.1)

Only Teacher 4 works on dimensions 1.1. T4, however, works on dimensions 1.1., 1.2.,1.3. and 1.5., focusing especially on the last two.

Representational Aspects of the Written Language (Dimension 1.2)

This is the most important dimension for two of the teachers (T7 and T8). They are more focused on conveying the written language's symbolic potential, introducing tasks linked to vocabulary, reading pictograms, grammar building through pictograms, drawings, etc. T1 has the most inclusive profile, working with all the dimensions with a presence of more than 8%, prioritising the work on dimensions 1.2., 1.3. and 1.4.



	Teacher 1	Teacher 2	Teacher 3	Teacher 4	Teacher 5	Teacher 6	Teacher 7	Teacher 8	Teacher 9
Dimension 1. Functions of the written language	8.3%	8.9%	4.0%	11.8%	1.2%	0.6%	5.1%		
Dimension 2. The written language as a system of representation	29.9%	23.4%	32.3%	14.6%	6.7%	2.4%	38.3%	58.5%	4.9%
Dimension 3. Teaching the code	40.4%	39.5%	45.2%	51.7%	55.1%	57.0%	31.7%	2.4%	35.3%
Dimension 4. Reading comprehension	13.5%	5.5%		0.4%	0.9%	2.1%	2.3%	9.8%	
Dimension 5. Writing	7.8%	22.7%	18.5%	21.5%	36.1%	37.9%	22.6%	29.3%	59.8%

Fig. 6.1 Distribution by percentages of each teacher's tasks involving the dimensions of teaching initial literacy

Teaching the Code (Dimension 1.3)

The teachers focus on reading by dealing mainly with *Teaching the code*, which reveals that dimension 1.3 is the one mostly addressed by six of the teachers (T1, T2, T3, T4, T5 and T6). Six of the nine teachers (T1, T2, T3, T4, T5, and T6) prioritise reading over writing.

Comprehension (Dimension 1.4)

The work on text comprehension in this first stage of schooling is practically non-existent except with two of the teachers, accounting for over 10% of their practices (T1 and T8).

Writing (Dimension 1.5)

This dimension (together with the *teaching the code*) accounts for over 60% of the total practices in initial literacy with six of the teachers (T2, T3, T4, T5, T6 and T9). T8 and T9 prioritise writing over reading.

A common point is that the teachers focus on reading by dealing mainly with *Teaching the code*. Considering that the two dimensions with the highest frequencies are *Teaching the code* (dimension 1.3.) and *Writing* (dimension 1.5.), which

also abounds in teaching the code. Three of the teachers (T5, T6 and T9) appear to use a code-based approach in both reading and writing (dimension 1.3 + 1.5 > 90% of their practices). T1, T2, T3 and T4 adopt more eclectic approaches to initial literacy, tending toward more integral proposals.

The teachers create their own profiles in terms of teaching practice with a fair degree of autonomy, even though they work at the same school. For example, T3, T4, T5 and T9 work together, yet their profiles are significantly different.

How the Dimensions of Reading Are Taught in TCAs

The following are the results of the patterns of activity in which the teachers address initial literacy. The TCAs with percentages below 5% have been grouped under the heading *Other TCAs* and will be detailed in due course. Figure 6.2 shows how the teachers specifically use two TCAs to teach initial literacy: *Performance of tasks by learning centre* and *Performance of tasks*, although there is a wide array of practices.

Performance of Tasks by Learning Centre

There is a difference between those teachers (T1, T5, T7 and T8) that use methodologies involving the learning centres and those that do not, which is due to general teaching considerations that involve many more aspects than literacy alone. T1 and T7, for example, use tasks involving all the dimensions with significant percentages in this TCA, well above their presence in Other TCAs. One the other hand, other teachers seem to have different views on how to undertake the literacy process.

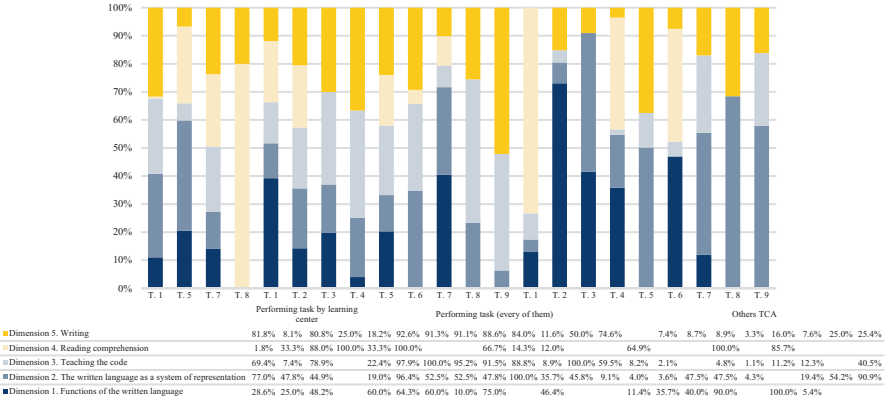


Fig. 6.2 Distribution by percentages of each teacher's tasks in each TCA involving the dimensions of teaching initial literacy

Task Performance

All the teachers use the TCAs involving the Performance of tasks, of a markedly academic nature, for dimensions 1.3. Teaching the code and 1.5. Writing, practically in its totality. Text comprehension tends to be addressed in these more academic TCAs.

Other TCAs

T4 uses "Other TCAs", above all the one called Reciting poetry, to prioritise three of the five dimensions (dimension 1.1, 90%, 1.2, 47.5% and 1.4, 100%), and T6 does so for two of them (1.1., 100% and 1.4, 85.7%), particularly in Reciting poetry, Watching a film and Explaining the tasks. T9 also uses "Other TCAs" for dimensions 1.3 and 1.5, specifically Date and weather and Correcting work in class. Only T4 and T6 use "Other TCAs" (particularly Reciting poetry, Planning tasks, and Watching a film) as the preferred way of addressing dimension 1.1. Functions of the written language (90% and 100%, respectively). T3 (47.5%) and T4 (47.5%) use "Other TCAs" to work on The written language as a system of representation (dimension 1.2.); in particular, the TCAs of Explaining the task, Date and weather, and Reciting poetry, while T9 (90.9%) almost entirely uses the TCAs Explaining the task and Date and weather.

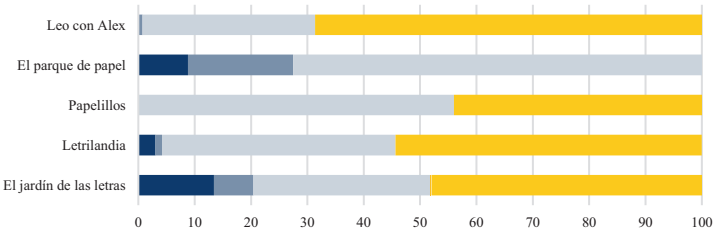
Curriculum Materials

Next, in Fig. 6.3, we show the presence of the initial literacy dimensions in the curricular materials. We're going to use the original name of the textbooks that teachers use in their practices (*Papelillos, El jardín de las letras, Letrilandia, Parque de papel, Leo con Alex*).

How the Dimensions of Reading Are Taught in Materials

Functional Aspects (Dimension 1.1)

El Parque de Papel, works on dimension 1.1. (8.82%) and Letrilandia also proposes working on it (3.04%), as does the material called El Jardín de las Letras, although it considerably expands its role (13.42%).



	El jardín de las letras	Letrilandia	Papelillos	El parque de papel	Leo con Alex
Dimension 1. Functions of the written language	13.42	3.04		8.82	
Dimension 2. The written language as a system of representation	6.99	1.14		18.63	0.73
Dimension 3. Teaching the code	31.43	41.44	56	72.55	30.66
Dimension 4. Reading comprehension	0.18				
Dimension 5. Writing	47.98	54.37	44		68.61

Fig. 6.3 Percentages of the general dimensions of teaching initial literacy in materials

Representational Aspects of the Written Language (Dimension 1.2)

The most eclectic material is El Parque de Papel, which works intensely on the written language as a system of representation (18.63%). Letrilandia also proposes working on it (1.14%), as does El Jardín de las Letras (6.99%).

Teaching the Code (Dimension 1.3)

We find that the category of teaching the code records a figure of 46.25% of the tasks featured in the books analysed. Papelillos prompts more tasks linked to it (56%).

Comprehension (Dimension 1.4)

None of the media propose tasks linked to text comprehension, or to assistance for direct comprehension or for regulating comprehension.

Writing (Dimension 1.5)

The writing dimension has a frequency rate of 37.21%, to which we may add teaching the code, which would mean an aggregate percentage of 83.46%. The most widely used strategy is to explicitly teach letters, both displaying them and practising their writing. Leo con Alex prompts more tasks linked directly to it (68.61%).

As with the teachers' practices, the materials also have their own individual profiles, although they are all characterised by the significant presence of Teaching the code in both reading and writing (dimensions 1.3 and 1.5.), in all cases higher than 70%.

Materials vs. Classroom Practice

When we observe the correspondence between the materials each teacher uses and their teaching practice in initial literacy, it is difficult to establish common profiles and relationships between them.

Among all the teachers using "*El Jardín de las Letras*" (T1, T3, T4, T5 and T9), only one (T9) adopts the publisher's proposal on *Teaching the code* and *Writing*. All the other teachers prioritise tasks related to *Teaching the code*. Three of the teachers (T1, T3 and T4) undertake more tasks related to *the written language as a system of representation* than the material suggests. Nevertheless, only the percentages of T4's practices on dimension 1.1 coincide with the publisher's suggestions regarding *Functions of the written language*, with the other teachers hardly undertaking any such tasks.

T1 and T8 use the "*Letrilandia*" proposal for working on initial literacy, although only T1 appears to use the material for *Teaching the code*, with all the other dimensions appearing in a significantly different form between the proposal and the practices. For example, dimension 1.2. *The written language as a system of representation* hardly appears in the proposed use of the material (1.14%), despite being the focal point of T8's practices (58.5%).

"*El Parque de Papel"* focuses its proposal on three dimensions: 1.1. *Functions of the written language* (8.82%), 1.2. *The written language as a system of representation* (18.63%), and 1.3. *Teaching the code* (72.55%). However, the practices of the teachers using them (T2 and T6) are much more widely distributed, paying special attention to dimension 1.5. *Writing* (22.8% and 37.9%, respectively).

T3, T4, T5 and T9 also use "*Papelillos*", which exclusively addresses reading and writing (dimensions 1.3 and 1.5), while the teachers' practices are much more widely distributed across the dimensions. Something similar occurs in the case of T7 when using "*Leo con Alex*", agreeing with the proposed use solely in terms of *Teaching the code*.

Discussion

The purpose here was to study the alignment between the teaching approaches to initial literacy prompted by curricular materials and classroom practices with pupils in Early Childhood Education aged 3, 4 and 5.

Firstly, the analysis of the materials used shows that teaching the code lies at the heart of all the texts considered. Although there is seemingly agreement between the teachers' approaches and those prompted in the materials, a detailed analysis has revealed very few occasions in which the teachers' literacy practices faithfully reproduce the materials' approaches, and vice versa. Quite the contrary, the strategy seems to coincide more with an "opportunistic" choice of materials: the teachers choose the materials, but then they use only those aspects that at a given moment may suit the tasks that orchestrate the practices. As Boschman et al. (2014) have already stressed, this panorama suggests that when teachers use, adapt or redesign the curricular material, they do so in terms of their specific classroom activity. Indeed, our teachers quite often adapt and redraft these materials, as in most cases each teacher's own profile of practices does not coincide with the proposals made in the materials they use (or in the case of groups of teachers belonging to the same school). In general, these results indicate that the decisions these teachers make regarding the materials are closely linked to their professional duties and are fairly autonomous. This is because there is a significant gap between the circumstances recorded in the real classroom settings and the practices prompted by the materials. In general, the materials focus on more individualised practices than classroom ones, being designed with a prototypic student in mind and also considering generic classroom groups. By contrast, the teacher is responsible for contextualising the practices, with that task being unique in each case. What's more, this gap is also apparent between the recommendations made for initial literacy in the official curriculum for Early Childhood Education and both the data on the real practices and the curricular materials for teaching this same content. We cannot ignore that teaching involves different players, contexts, policies, structures and resources in a process of curriculum building that ranges from the guidelines provided by the education authorities through to classroom practice. The equilibrium in the distribution of tasks among all these components varies, not always being defined according to the same terms, and what's more it is riddled with tensions and ambiguities. It is in the classroom, nonetheless, where all the prior planning ends up being turned into certainties (Sanderson, 2003, Gimeno, 2010).

Secondly, teaching practices appear to focus mainly on *Teaching the code*. The notion of how this literacy process should be undertaken is addressed through different approaches, some of which focus more on the code (Piasta & Wagner, 2010), while others adopt a more functional approach (Barton, 2007), continuing the traditional debate on teaching initial literacy. This issue of what should be worked on is not therefore clearly defined, although this obviously does not mean the goal of mastering the written language is not clear. This may explain the diversity of guidelines teachers use to develop their practices (Rodríguez et al., 2018). Furthermore, it has been stressed that the classroom work on initial literacy is based on the major types of TCAs designed for undertaking more academic tasks. As noted in the results section, our teachers mainly address initial literacy using patterns of activity that involve tasks with a more formal and academic curricular purpose, although they can be managed with sundry organisational models. The more academic patterns of activity are precisely the ones these teachers prefer for the written language;

patterns of language designed to achieve the curricular goals in which teachers and students alike are responsible for organising small individual or group tasks with a more defined content, clearly identified resources, and a specific model of implementation. Other kinds of activity, such as *Reciting poetry*, *Reading pictures* or *Choosing readings for home* have an anecdotic nature and are linked to the teachers' personal profiles.

Teaching the code is the most noteworthy dimension both in the materials and in the teachers' practices, albeit not in official curricular guidelines. Although only a tentative explanation, there are two factors that may influence this discrepancy: on the one hand, the teachers' understanding of the need for students in Early Childhood Education to move on to Primary with skills that will enable them to learn to read in the first term of the following year, and on the other, a degree of social pressure on the need to learn the code as a requirement for entering compulsory Primary education (*Reading* the code is the most obvious fact for families and other social agents that the children know read). This also means that there is shared content regarding the teaching culture in initial literacy at this stage. These premises lead us to the current debate in Europe on the meaning of Early Childhood Education: a stage that prepares children for life or for the next stage of schooling (Bingham & Whitebread, 2018). The data we have discussed have revealed a low correspondence between the curricular guidelines and the dimensions of initial literacy addressed at this stage, and above all, with the development each teacher pursues, as well as what is to be expected of the materials. It may be assumed that in contexts in which neither the curriculum nor the use of textbooks is compulsory, namely, Early Childhood Education in Spain, teachers follow a process of reinterpreting the content involved in initial literacy, which is laden with beliefs, theories, and experiences that are wholly unique and difficult to predict, and which define specific teaching processes (Boschman et al., 2014).

Conclusions

The results obtained enable us to draw certain conclusions. Our findings confirm several prior studies (Smagorinsky et al., 2002; Valencia et al., 2006), and seem to suggest a moderate alignment between practices and materials within a curricular context that guides rather than dictates, albeit with a reasonably consolidated didactic culture regarding the teaching of reading.

As Valencia et al. (2006) contend, the scenario revealed by the data suggests a high degree of complexity, with each teacher's idiosyncrasies having a major influence on the development of the educational resources analysed. Among the factors these authors have reported to explain the teachers' use of classroom resources for initial literacy, namely, the curricular context and the culture of the school at which they teach, and each teacher's understanding of the content or level of learning they seek for their pupils; it is precisely this last one that most suitably explains our teachers' use of resources.

This study is conditioned by several factors that restrict its generalisation and which delimit its scope. On the one hand, the complexity of the teaching situations in Early Childhood Education complicates the data gathering process, and on the other hand, the nature of the ethnographic type of study conducted. Data collection in Early Childhood Education often involves the recording of situations where several groups of pupils simultaneously perform different tasks, several lines of discourse from the teacher to the pupils and vice versa are crossed, which makes it necessary to do a thorough job of reconstructing the sequence in which the teaching actions are carried out. Furthermore, we are aware that some teachers use materials of their own making, many of which contain a homemade and even artistic element, scripts and personal sketches, which we have found almost impossible to access because the teachers do not share them. Taking these factors into account, we are continuing to investigate the topic by including new cases that enrich the body of data.

Despite these limitations, our findings here could help to guide certain content in the training of teachers in Early Childhood Education. On the one hand, the aim would be to provide teachers with models for planning and managing classroom elements that revolve around the activities as a curricular component for designing and developing the practice. On the other hand, the general tasks detected in this study provide guidelines for making curricular sense of the teaching of this kind of content in teachers' professional performance in terms of class time. Finally, it would be pertinent to include certain principles for the design of curricular materials in which the proposed use of the resources contains the wealth of tasks highlighted by the analysis of the practice. This calls for an in-depth reflection on how to bring the format of the resources in line with the nature of the tasks.

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Inés Rodríguez Martín is Associate Professor of Didactics and School Organization at the University of Salamanca in Spain. She is Doctor in Educational Sciences, and she is member of the research group "Curricular Research". Her research involves how teachers teach early literacy in Early Childhood Education and Primary Education, and how help children with learning disabilities in language development.

Jorge Martín-Domínguez is Associate Professor of Didactics and School Organization at the University of Salamanca in Spain. He is Doctor in ICT Education. He is a member of the research group "Curricular research". His line of doctoral research focuses on the use of ICT in classroom practices. In addition, he is currently working on research related to literacy and mathematics in classroom practices.

Maria Clemente Linuesa is Full Professor of Didactics and School Organization at the University of Salamanca, in Spain. She won Maria de Maeztu Award for her research career in 2017. Her research interests include how teachers organizes classroom practices to teach literacy with a view to understanding and reflecting upon the form that initial literacy practices take. She collaborates with various research agencies in Spain.

Elena Ramírez Orellana is Professor of Didactics and School Organization at the University of Salamanca in Spain. She is Doctor in Educational Sciences. She leads the research group "Curricular Research". Her research involves how teachers use ICT resources in the classroom and the impact ICTs may have on the quality of teaching processes in Early Childhood Education, Primary Education and Secondary Education. She collaborates with various research agencies in Spain and Europe.

Chapter 7
Mangling Didactic Models for Use in Didactic Analysis of Classroom Interaction

Karim Hamza and Eva Lundqvist

Introduction

Models for didactic analysis, design and planning of teaching and learning constitute a central part of the discipline of didactics (Jank & Meyer, 2006; Westbury, 2000; Wickman, 2015). Didactic models range from macro theories concerned with the selection of goals, content, and methods to micro level modelling of individual lessons and students' performance, and may take various shapes such as schemata, classification patterns, and rationales for didactic action, i.e., for teaching and learning (Arnold, 2012; Gundem, 2000). A large number of didactic models have been developed in continental Europe (Seel, 1999; Wickman, 2015) but didactic models are also produced in Anglo-American research even though they are not always explicitly labeled as such (Wickman et al., 2018, 2020). In that sense, didactic models have been argued to constitute a potentially unifying concept not only to the varied landscape of European didactics that this book aims to map out, but also between the Anglo-American curriculum tradition and the European Didactics tradition (broadly perceived, cf. Chap. 2 of this book) (Gundem, 2000; Wickman, 2015). The overarching purpose of this chapter is to show how the continuing production and development of didactic models (i.e., the process of didactic modelling, see below) may play a central part in thinking systematically about teaching and learning across specific research traditions both within and outside European didactics.

K. Hamza (✉)
Department of Teaching and Learning, Stockholm University, Stockholm, Sweden
e-mail: karim.hamza@su.se

E. Lundqvist
Department of Education, Uppsala University, Uppsala, Sweden

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Scholars have noted the need to verify existing didactic models empirically, as well as to tie them closer to practice (Gundem, 2000; Seel, 1999; Wickman, 2012). Within the context of Swedish science subject didactics, a research program for empirically generating new as well as for modifying existing models, so called didactic modelling, has emerged during the last 20 years (Wickman et al., 2018). The process of generating and modifying models is commonly referred to as modelling (Thalheim, 2010). Didactic modelling, then, is simply the process of generating and modifying didactic models (Wickman et al., 2020). Didactic modelling consists of three core activities: *extraction*, *mangling*, and *exemplification*. Extraction is the process of building a new tentative model based on didactic analysis of empirical data, such as classroom interaction, interviews, or curricular texts of different kind. Mangling designates a process of successive and deliberate adaptation of didactic models by applying them in didactic analysis and design in new contexts. Exemplification, finally, means that the outcomes of using the model in didactic analysis and design are documented, for instance in the form of teaching sequences.

The purpose of this chapter is to specifically illustrate the idea behind the second core activity in the empirical development of didactic models (i.e., didactic modelling) – namely mangling. The notion of mangling is taken from Andrew Pickering's (1995) treatment of scientific practice as a dialectics between material, human, and social agency. Pickering shows how both scientific knowledge and the very plans and goals leading up to it are "emergent from existing culture and at stake in scientific practice, themselves liable to mangling in dialectics between resistance and accommodation" (p. 146). Pickering calls this pattern of resistance and accommodation between material and human agency "the mangle" (p. 147). The main point is that because of this "dance of agency" (p. 102) there are never any permanent resting places for scientific knowledge, but only "temporary oases of rest in the achievement of captures and framings of agency and of associations between multiple cultural extensions" (p. 146). Translated into the world of educational science and didactics, models and theories are thrown into a constant and never-ending process of modification in response to these different agencies – a process of mangling. The mangling of a model may include actual reshaping or reformulation, but may as well consist in defining its application range or specifying certain conditions for its use. A different context may consist in a slight shift in the kind of data that are analyzed through the model, but also in a more significant transfer of the model, for instance from a research context to a teaching context. In the former case, mangling corresponds to the common research practice of subjecting results and theories to empirical scrutiny, although having a formalized term for this is intended to emphasize that this process needs to be systematic, iterative and continuing. In the latter case, the term emphasizes that didactic models need to be adapted for use not only in research but also in teaching practice, as they constitute the basis for didactic analysis and design by practicing teachers (Jank & Meyer, 2006).

This chapter presents one example of how didactic models may be subjected to such mangling. To this end, we provide an example of mangling of two existing didactic models, *curriculum emphasis* (Roberts, 1982) and *subject focus* (Fensham, 1988; Östman, 1996). The models were initially developed for didactic analysis of textbooks and national curricula. We are interested in extending the application range of, and possibly specifying the conditions for using, these two models in didactic analysis of actual teaching in science classrooms. Both models are related to a central theme in Swedish science didactics research over the past 50 years, namely what kind of worldviews, social meanings, or companion meanings, that are offered to students in school science (Englund, 1998; Östman, 1998). They consist of typologies offering increased resolution of, and reflection on, which discursive meanings that are contained in the texts (Englund, 1998). However, at least in Nordic teacher education, the models are invoked as tools for didactic analysis and design and also of actual teaching in the classroom (see for instance Wickman & Persson, 2008). There are some studies in which the models are employed for analysis of classroom interaction, such as those by Lundqvist et al. (2009, 2012), and Olander (2013). Yet, the fact that the models were initially developed in relation to educational texts rather than from the analysis of classroom situations could be a limiting factor to their range of use, something which has not been explicitly considered when the models have been used in new contexts. In this chapter, we present some empirical evidence of what may be discerned through use of the two models about the meanings offered in science classrooms, and compare the results with the original implications of the models from their use in text analyses. This could be considered a first step in a mangling process through which the two models are successively adapted to new contexts and applied to new kinds of data.

Our research questions are:

- What meanings can be discerned when using two didactic models, subject focus and curriculum emphasis, for analyses of secondary science classroom interaction?
- What are the differences of using the models for didactic analysis of classroom data instead of didactic analysis of educational texts?

Theoretical Background

In this section, we first describe the two didactic models mangled in this study, subject focus (Östman, 1996) and curriculum emphasis (Roberts, 1982). We also describe how the two models relate to each other and to the notion of strong traditions guiding school science practice. Finally, we describe a third didactic model, *organizing purposes* (Johansson & Wickman, 2011, 2018), that was invoked in order to bridge the gap between our classroom data and the two text-based models that we intended to mangle.

Subject Focus and Curriculum Emphasis

Both subject focus and curriculum emphasis constitute empirically based typologies for identifying different meanings emerging in science curricula and textbooks. Such classification patterns are typical for didactic models (Gundem, 2000). Being empirical, the two models do not cover all possible meanings that might ever emerge in a text, nor are they logically exclusive. Rather, they constitute tools for discerning what potential discursive meanings are offered to students through educational texts (Englund, 1997, 1998).

The model subject focus distinguishes between two basic ways for how science is presented in textbooks in relation to humans and to nature: *induction into science* and *learning from science* (Östman, 1996). We may express a subject focus as the primary object, or overarching orientation, of the science presented in the text. If the subject focus is induction into science, the primary object is the subject matter as such, its concepts and methods. To the extent that other areas of knowledge or activity are related to the subject matter, it is as examples or illustrations of a concept or a theory. The possible meaning of science offered within this subject focus may be that science is an activity which is self-contained, in which nature is valued in order to further scientific knowledge for its own sake. If the subject focus is learning from science, the primary object is the application of scientific concepts and theories to accomplish something in society, in day-to-day as well as social or political matters. The possible meaning of science offered within this subject focus may be that science is an activity which primarily serves other purposes than itself, as an instrument to achieve individual, societal, or political goals.

Roberts (1982) found seven different curriculum emphases in Canadian science textbooks: *correct explanation, solid foundation, scientific skills development, structure of science, self as explainer, everyday coping, and science and decisions*. He defined a curriculum emphasis as a coherent set of messages to the student about science, answering the question "why should I learn this science subject matter?" The message is shaped both by what is included in and by what is excluded from the text. For instance, a student encountering science devoid of issues concerning moral and political values may get the message that the only concern of science is with "hard", objective facts. On the question of why s/he is learning science, such a student might answer: "Because I need to know how nature works and that's what science is about". That would be an example of the correct explanation curriculum emphasis. A student encountering school science through a text emphasizing how facts and concepts were historically developed may get the message that science is a human endeavor, containing people of flesh and blood trying their best to describe reality through hypotheses, observations, and experiments. Such a student might say that s/he is learning science "Because science is part of our culture, and science is about a process of exploring and investigating the world which I can be a part of". That would be an example of the self-as-explainer curriculum emphasis. Likewise, a strong focus on the processes of science corresponds to a scientific-skills development emphasis, a focus on how science contributes to solving and understanding

issues in our daily lives gives an everyday-coping emphasis, and a focus on how the role of science in societal and political deliberation corresponds to a science and decisions emphasis.[1] These different messages about science may be considered as contributing to the meaning that a student gives to certain science content, as well as to science as a whole (Östman, 1996).

As indicated by the descriptions of the two frameworks of subject focus and curriculum emphasis, they are closely related to each other. In fact, they are so closely connected, that different combinations of them have been described in terms of strong traditions. Previous analyses of subject focus and curriculum emphases in textbooks, policy documents, and professional development materials in Sweden made by Östman (1996, 1998) show a strong historical continuity in the selection of content and methods. Östman found two distinct patterns (selective traditions): the *academic* and the *moral* tradition. Furthermore, Lidar et al. (2018) and Lidar et al. (2020) developed the understanding and use of these traditions by making surveys and interviews with teachers. The idea was that if a specific pattern of inclusion and exclusion of educational goals and content was made by many teachers over a period of time, a teaching tradition has been formed. In fact, this can be seen a first step in mangling the models, even though the process was never called mangling. The relation between subject focus, curriculum emphasis, and teaching tradition is shown in Table 7.1.

Table 7.1 Relation between subject focus, curriculum emphasis, and teaching tradition. An added emphasis in bold indicates that the emphasis defines the tradition, but still contains the ones from the previous columns (Modified after Lidar et al. 2018)

Teaching tradition	Academic (positivist)	Academic (constructivist)	Applied	Moral
Subject focus	Induction into science	Induction into science	Learning from science	Learning from science
Curriculum emphasis	Correct explanation Solid foundation Structure of science Scientific skills development	Correct explanation Solid foundation Structure of science Scientific skills development **Self as explainer**	Correct explanation Solid foundation Structure of science Scientific skills development Self as explainer **Everyday coping**	Correct explanation Solid foundation Structure of science Scientific skills development Self as explainer Everyday coping **Science and decisions**

[1] Since the two emphases solid foundation and structure of science were not found in our empirical material, they are not described here.

Organizing Purposes

The two didactic models described above were developed from analyses of educational texts. Our interest was to examine how they could be used also for analyzing actual teaching in science classrooms. Examining some of the consequences of such a transfer is what we refer to as the beginning of a mangling process concerning the two models. However, we soon realized that in order to make the move from text to classroom interaction, we needed some kind of mediating analytic framework. For this purpose, we chose the didactic model organizing purposes (Johansson & Wickman, 2011). This model had two advantages: (1) it is developed from analyses of classroom data, and (2) it still has connection to the two didactic models that we wanted to mangle, since its focus is to identify the purposes pursued in a science classroom. Since the purposes pursued in a teaching activity are central parts of what meaning students eventually make of the learning experience (Englund, 1997), we considered this model to be a fruitful tool for mediating between our classroom data and the two models that we wanted to mangle.

Organizing purposes distinguishes between two kinds of purposes in teaching: (1) those that are intelligible to students already before they have begun to learn certain content, and (2) those that students should be able to understand and act through at the end of a given teaching sequence. The former is called *proximate* and the latter *ultimate* purposes (Johansson & Wickman, 2011; Wickman & Ligozat, 2011). This model cannot be used directly for analyzing the discursive meanings offered in the classroom but enabled a close-up analysis of what purposes teacher and students jointly pursued. Having achieved a structured description of our classroom data through the identification of purposes, we were able to analyze what meanings these purposes offered through the two didactic models subject focus and curriculum emphasis.

Setting

This study is part of a larger study investigating teaching traditions and their consequences for learning. We followed six teachers working in alignment with different teaching traditions. The idea was to follow their teaching through a whole unit to get a reasonably fair view concerning their selection of content and methods. For the purposes of this chapter, we present analyses of two of the six teachers who aligned strongly with two different teaching traditions, the applied tradition and the moral tradition. We followed one teaching unit for each teacher. Lisa's unit covered 17 lessons in chemistry in a grade 7-class. It treated gases, solubility, and polar/non-polar molecules. Lisa was working in a K-9 school in a suburb to a large Swedish city. The school has specialized on teaching science through different science projects, in which the students are given an assignment which typically ends in a

physical or theoretical product (such as a moisturizer that smells good), hence her assignment to the applied tradition. Anette's unit lasted for 9 lessons in physics in a grade 6-class. The unit treated energy conversions, forms of energy, fossil and renewable energy sources, electricity, the carbon cycle, and global warming. Anette was working in a K-9 school in a suburb to another large Swedish city. Anette was assigned to the moral tradition in a previous study based on her self-reported views on teaching (Lundqvist & Lidar, 2013).

Data Collection, Processing, and Analysis

We video and audio recorded all teaching in each unit and collected written teaching material that the teachers provided the students with, including written examinations. We watched the lessons several times, and each lesson was finally represented as a condensed narrative of approximately one page. Furthermore, we transcribed parts of the interaction that were of special interest, for example introductions and endings of lessons. In the analysis the three didactic models were then applied to the narrative. Of course, the narrative was checked and sometimes modified even during this final analytic phase, by back checking with the recordings. The analyses of data were also presented to the teachers approximately half-way through the project. The feedback from the teachers led to re-checking and modification of our analyses.

Our analytic focus was to examine what meanings that emerge when using the two didactic models subject focus and curriculum emphasis to analyze classroom data, which corresponded to our first research question. We did this by analyzing which subject foci and curriculum emphases were contained in the purposes identified through the organizing purposes-model. Below we summarize the analytic procedure in terms of two analytic research questions and their sub questions:

1. What purposes emerge within and across lessons in the two science units?
    - What are the students supposed to do during the lesson (what proximate purposes are enacted)? This was done by identifying the different assignments and activities in which the students and the teacher jointly engaged (cf. Appendix 7.1).
    - What are the students supposed to have learnt at the end of the lesson (what ultimate purpose is enacted in the lesson)? This was done by identifying how the lesson was introduced and what content the teacher pointed at in her interaction with the students (cf. Appendix 7.1).
    - What are the students supposed to have learnt at the end of the unit (what ultimate purpose is enacted in the unit)? This analysis was done by looking at how the unit was introduced and assessed (cf. Appendix 7.1).
2. What discursive meanings emerge from these purposes?
    - Which subject focus corresponds to each purpose?

- Which curriculum emphasis corresponds to each purpose? In the analysis, we took into account the relative weight of each curriculum emphasis, which can also be described as a consideration of what content that was foregrounded in the teaching and what was in the background.
- What is the frequency of subject focus and curriculum emphasis within and between lessons, as well as in the unit as a whole?

In the next section, we deal with the first research question on what could be observed concerning the meanings analyzed in the classroom by using the two models. The second research question, comparing how our new use of the two models for analyzing classroom interaction differed from their original use for analyzing educational texts, is dealt with in the discussion.

Findings

Categorizing the purposes emerging in the two teachers' teaching in terms of curriculum emphasis and subject focus revealed one overall finding, namely that there was significant variation in potential meanings offered to students on all levels: the unit as a whole, between lessons, and within individual lessons. Below, this variation is detailed out as two propositions about the variation at the level of the unit as a whole, and one proposition about the variation at the level of lessons.

Variation in Meaning on Unit Level

Proposition 1 *It is perfectly possible to give an entire unit a context within a single subject focus, whereas individual lessons have a different subject focus*. This became especially evident in Lisa's unit. Excerpt 7.1 is from Lisa's introduction of the unit, which clearly displayed a learning from science subject focus.

Excerpt 7.1.

1	Lisa	Well. We're going to start our new project. So now it's chemistry.
2	Student	Mm
3	Lisa	And it's called the moisturizer project. So what are we going to do? We're going to make a moisturizer which will soften and moisturize your skin. And moreover, it has to smell good as well.
4	Student	Oh!

5	Lisa	Oh! Mm. And there's a purpose to this… that there are a lot of good things to learn while you're doing this project. You'll get to practice a lot of useful skills, meanwhile. And the first one, that's what it said already up here, that you're gonna produce a moisturizer. And that you'll be able to explain, which substances it's made of, and why these substances are good to have, in this moisturizer, what part they play. [goes on to explain the next purpose, namely to learn to conduct systematic investigations]
6	Student	Well but people think different things smell good, so…
7	Lisa	Exactly
8	Student	I mean, is that something that is assessed?
9	Lisa	Oh I see, you mean if you like a smell and I don't?
10	Student	Is the scent assessed?
11	Lisa	No. I mean, not in that sense. It's more whether you manage to catch the scent. We'll come to that in a moment. Next question.
12	Student	How much time do we get to do this?
13	Lisa	You'll be doing this project until Christmas. And then, it contains several different parts that are rather short and well-defined. And then everything is put together in the end, and then we end by, when you know all this useful chemistry, then we end by your making this moisturizer. And then you have it when you leave for Christmas holiday. Right, student.
14	Student	So we're not like going to make the moisturizer now?
15	Lisa	You're going to do several laboratory experiments before you make the moisturizer, because you need to know a lot of chemistry in order to make it really nice. If we'd make it now then, you'd have no fragrant to add to it. [Continues to give examples of the chemistry they are going to learn]

Although Lisa was doing most of the talking, it is evident that she and the students together were talking about the content for the project as a whole, and that this content concerned the making of a moisturizer that smells good (Turns 6, 10, 14). The assessment of the unit, moreover, consisted in writing a product sheet for one's moisturizer with information on the substances, their origin and function. Thus, the ultimate purpose for the unit concerned making actual use of chemistry knowledge to produce something potentially valued in students' lives, placing it firmly within the subject focus learning from science (Appendix 7.1).

Yet, only one of the 17 lessons of Lisa's unit had an ultimate purpose corresponding to this subject focus, whereas the remaining ones were assigned to the subject focus induction into science (Appendix 7.1). This is illustrated through the next excerpt (Excerpt 7.2), which is taken from the narrative of Lisa's first lesson, beginning right after Lisa had finished introducing the project to the class (as shown in Excerpt 7.1).

Excerpt 7.2

16	Lisa introduces the "mission" for today's lesson. She bites a whole in an orange, peals it, and walks around the classroom asking the students if they can smell anything. Some students can, some cannot to begin with, but eventually everyone feels the smell.
17	Lisa poses a couple of questions, which the students are supposed to discuss in pairs: "What is smell, actually?", "where is the smell situated?". Then she explains the tricky part of the mission: "You are going to catch this scent, so that you have it in your hand, and are able to add it to your moisturizer".
18	Lisa introduces a new activity: "Brainstorm ideas about what smell is, where it is situated, how we may catch the scent and how we may save it. Write that down. Then, choose one idea that you are going to do as a laboratory experiment on Friday. The laboratory experiment is one hour long. Write down 'material and methods', and hand it in so that I'm able to make a risk assessment in advance".
19	The students set out with the task given to them, in pairs, with one orange slice each. Lisa is walking around, helping the students. She shows a slide on the board, with images and names of different chemistry equipment.
20	After a while Lisa interrupts the students to make a couple of clarifications. "Do you get a new orange for the laboratory experiment? Yes" "Do you need to add orange to you own moisturizer? No, this is just to find good methods to extract the scent". "Are you allowed to save the juice? Yes".
21	Lisa interrupts again when they are almost finished with their plans. She reminds the students that they need to be able to save the scent and add it to a moisturizer. The students get five more minutes to finish their plans.
22	Finally, the students exchange plans and are asked to provide feedback to each other.

The ultimate purpose of this lesson emerges in turn 17 and 18, as Lisa talked with her students about what smell actually is, and that they were going to catch the smell "so that you have it in your hand", and may thus be put as "to learn what a scent is and how to catch and preserve it" (Turns 17 and 18;). This purpose is connected to the two curriculum emphases correct explanation and scientific skills development, and thus falls within the subject focus induction into science. At the same time, the ultimate purpose for the entire unit was indeed invoked as a reminder now and then during the lesson, as in turn 17 ("able to add it to your moisturizer" – which was going to happen at the end of the unit) and turn 21, as she once again reminded the students that they should eventually be able to add the scent to their moisturizer. In fact, the ultimate purpose for the unit was touched upon during virtually every lesson, but it mainly appeared as a sort of constant reminder of why they were doing certain stuff in a particular lesson, not as an actual ultimate purpose for the lesson. "The particular stuff" to be learnt in a specific lesson, on the other hand, was definitely within the subject focus induction into science (except for lesson 14, Appendix 7.1).

Proposition 2 *There is not necessarily a single clear-cut meaning offered for the unit as a whole and expressed as its subject focus.* This became evident in the analysis of Anette's unit, in which the ultimate purpose of the entire unit aligned both with subject focus induction into science and with subject focus learning from science (Appendix 7.1). Anette introduced the new unit by asking the students to write down what they were thinking when they hear the word energy, as shown in Excerpt 7.3.

Excerpt 7.3

23	Anette	We do like this now, if I say the word energy, I know we have done some of this exercise before, but if I say the word energy, what comes to your mind then? You can write on the white board. What comes up on the white board, you write it down in your, both your own thoughts and then we write what comes up on the white board as well.
24	Student	Shall we write it here?
25	Anette	Mm [the students come up to the white board and write their associations to what energy is, this exercise takes 6 minutes]
26	Anette	Is there anyone who wants to, this I just have to write? Are we satisfied now with these associations to energy? Then I put the next question.
27	Student	Who wants to see the experiment!?

28	Anette	[laughter] We'll have a look at it soon. What do we need for this [points at the words the students have written on the white board] what is the foundation for all this? What is needed, it's actually something that is needed for getting all of this to work.
29	Student	The sun
30	Anette	The sun [with an emphasis] [writes a square bracket at the side of the words]. Then I write like this – The foundation for all of this is the sun – So you can see that it's connected. Then you draw a beautiful sun [in your notebooks] the foundation for all energy is the sun, if we didn't have the sun, nothing would exist.

In Anette's introduction of the unit, she built on the students' knowledge about the foundation of energy (Turns 23–25) and on their prior knowledge of photosynthesis (Turns 28–30). This content is closely tied to the curriculum emphasis correct explanation and, thus, falls into the subject focus induction into science. However, directly after Anette's conclusion in Excerpt 7.3, the introduction shifted focus to include not only discussions about the foundations and origin of energy, but also discussion about its application. She then summarized the purpose for the unit with two central questions, as shown in the excerpt from the narrative of Anette's first lessons (turn 31). The first question belongs to the subject focus induction into science, whereas the second one belongs to the subject focus learning from science.

Excerpt 7.4.

31	At the end of the discussion about energy Anette says that when they have worked with this area she wants them to understand how it is possible that a lamp can shine. Then she writes two questions on the white board: "Where does energy come from?" and "How is it possible that a lamp can shine? How do we get electricity?"

Finally, the assessment of the unit also included both subject foci. It consisted of a written test with two parts, one on fossil fuels and the other one on renewable energy sources. The first part corresponded entirely to the subject focus induction into science, as the students had to write a summary on what they knew about fossil fuels, why they are so energy rich, and about their effects on the environment. The second part contained both subject foci. Learning from science was evident in that they were supposed to write what they knew about renewable energy sources and their pros and cons. The induction into science subject focus then reappeared, as they also had to describe the different forms of energy visible in a picture showing a water-powered generator.

Variation in Meaning Between and Within Lessons

Proposition 3 *Several meanings are created both within and across individual lessons in a unit*. The majority of lessons in both units contained more than two purposes that in most cases were connected to different subject foci and curriculum emphases (Appendix 7.1). Anette's lessons generally contained more purposes and, thus, displayed a somewhat larger variation of meanings, in terms of different subject foci and curriculum emphases, than Lisa's lessons. This result was made visible by counting the number of purposes (ultimate and proximate), the distribution and number of curriculum emphases and the distribution and number of subject foci.

Lisa's unit showed the following distribution of purposes. Out of 41 identified purposes in 17 lessons, 32 were identified as scientific skills development, 10 as self as explainer, 7 as everyday coping, 3 as correct explanation, and none as science and decisions. In terms of subject foci, 37 of the purposes belonged to induction into science and 4 to learning from science. Anette's unit showed the following distribution of purposes. Out of 42 identified purposes in 9 lessons, 30 were identified as correct explanation, 11 as science and decisions, 11 as everyday coping, 4 as scientific skills development and 1 as self as explainer. In terms of subject foci, 32 of the purposes belonged to induction into science and 10 to learning from science.

Discussion

Our overall aim in this chapter has been to illustrate the notion of mangling, which is part of the concept of didactic modelling developed in the context of Swedish science didactics research (Wickman et al., 2018). To this end, we have presented findings on what meanings that have been discerned in two secondary science classrooms as analyzed through two didactic models, subject focus and curriculum emphasis, that were originally developed for didactic analysis of the meanings emerging in educational texts. In this section, we first discuss these findings, which correspond to our first research question. Thereafter, we compare our use of the models with their original use and point to some differences, in order to answer our second research question.

Our analyses indicated that students encountered a diversity of purposes, that these purposes varied extensively concerning both subject focus and curriculum emphasis, and that different educational meanings were offered both within a unit and between different classrooms. In other words, not only were certain meanings about science included while others were excluded, as indicated by previous research in which the models have been applied to textbooks, national curricula, and teachers' descriptions of their teaching. In addition, this exclusion/inclusion seems highly contingent and varied and it cannot be summarized in any simple way for a particular teacher or teaching unit. In line with Englund (1998), if we consider teaching as a moral and social act, it is important that the meanings offered to the

students are well reflected and consciously selected. Our results suggest that embedding a unit in an overall everyday context, pointing at a learning from science-focus, does not ensure that the teaching stays within that focus in individual lessons, as shown in Lisa's unit.

Considering the variation in meanings emerging from our analyses, the idea of systematic exclusion or inclusion of content in teaching leading to a certain teaching tradition may need to be modified, and rather be framed as a question of what patterns of meaning that are offered to students in actual classroom interaction. For instance, one pattern in Lisa's unit was a great dominance for the subject focus induction into science, whereas the unit as a whole had the subject focus learning from science (Appendix 7.1). The pattern for Anette's unit was that both subject foci defined the unit as a whole. Similar patterns were possible to discern concerning curriculum emphases. Thus, one might consider the relative frequency of different curriculum emphases that were presented in the findings section as constituting such patterns. For instance, labeling Lisa's teaching according to the order of the most dominant curriculum emphases would yield a "scientific skills development/self as explainer" pattern with elements of everyday coping and correct explanation. Anette's teaching would rather yield a "correct explanation/science and decisions/everyday coping" pattern with elements of scientific skills development and self as explainer.

Considering such patterns of meaning may be important for teachers as they select content and ways of teaching, as part of planning a unit. The models may thus help teachers (and researchers, for that matter) to discern, reflect on, and perhaps even decide what content is put in the foreground and what is put in the background in a teaching sequence. Such reflections transcend the more traditional sense of working entirely within a certain teaching tradition (Lidar et al., 2018), instead affording an awareness of the "patterning" of different meanings in the course of teaching the subject to a group of students over an extended period of time. Although the patterns observed in this particular study are contingent on the specific conditions and choices of these two teachers, their existence suggests possible ways of systematically characterizing different teaching contexts and the meanings that they may offer on the basis of variability rather than regularity.

Turning to our second research question, differences between using the models for didactic analysis of classroom data instead of educational texts, we may begin by stating that using the established frameworks for analysis of classroom interaction was challenging. One difference that became obvious when making this methodological switch in context was an increased range of possible scales on which to apply the models compared to textbooks or policy documents. To analyze many hours of classroom interaction in terms of what purposes and meanings emerge, risks not doing justice to what is happening, both because of overly detailed and of overly summary descriptions of the activities. This requires consideration concerning what level of accuracy is possible to handle and describe, as well as what constitutes the best, or most fair, picture of what is going on in the classroom. We ended up with narratives for the primary analyses, which were then supported with examples from detailed transcripts and complemented with quantitative renderings of the

initial analyses. Another but related difference concerned how to divide the narratives and transcripts into smaller parts in order to apply the two models systematically. Here we ended up with invoking the organizing purposes-model, which allowed us to extract the purposes enacted in the classroom. It was then relatively straightforward to assign subject focus and curriculum emphasis to these purposes. A third difference concerns the rationale for using the models, which became obvious from the actual results from the analyses of our classroom data. Thus, it seems as if the close relation between subject focus, curriculum emphasis, and teaching (or selective) tradition established previously (for instance Lidar et al., 2018) may not apply to actual classroom teaching. Instead of displaying regularity in terms of traditions and systematic inclusion and exclusion of content and methods, then, applying the two models displays different patterns in meanings offered. In other words, there is a difference in expected outcomes of, or purposes for using, the models when they are put to use in these different contexts.

Conclusion

The following three conclusions may be drawn from the study: First, the two models are indeed applicable to classroom data even though they were developed for analyzing text. In other words, they have been mangled in the sense that their application range was extended (Wickman et al., 2020). Second, however, the models cannot be applied to classroom data directly. Instead, because of the complexity of classroom situations, classroom data should be simplified, for instance as narratives, and then analyzed using the organizing purposes-model. The two models may then be used for analyzing the purposes thus extracted. Third, the purpose of applying the models to analyses of teaching is different from when they are applied to analyses of text, viz., to analyze the variation instead of the regularity of meanings offered through teaching. Indeed, this last point is crucial in the mangling of models, since all models need to be specified concerning their application purpose (Thalheim, 2010).

These three points, then, constitute the mangled version of the two models, with respect to their use in a new context and the specifications of this use. At the same time, it is obvious that further work is needed in order to define additional limits to and possibilities for the application of the models in relation to different levels of description of classroom interaction. Teaching is a complex practice and analyses of this practice are even more complex, especially compared to analyses of textbooks and curricula. Didactic models are supposed to help teachers and researchers handle the complexity of teaching (cf. Hudson, 2002), but they also risk oversimplifying the complexity that is actually included in teaching. Striking this balance is something which clearly needs further mangling also together with practicing teachers, in order to make the two models work properly as tools for didactic analysis and design of teaching. To paraphrase Pickering (1995, p. 147), "didactics mangles on" to incessantly re-shape the knowledge that we may have at a certain moment in time.

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Appendix 7.1: Subject Foci (SF) and Curriculum Emphases (CuE) in Lisa's and Anette's Units, Distributed Over Ultimate Purpose for the Unit (UP, Unit), Ultimate Purpose for Each Lesson (UP, Lesson) and Proximate Purposes for Each Lesson (PP). Subject Foci Are Abbreviated as Follows: Induction into Science = IiS, Learning from Science = LfS. Curriculum Emphases Are Abbreviated as Follows: Correct Explanation = CE, Scientific Skills Development = SSD, Self as Explainer = SE, Everyday Coping = EC, Science and Decisions = SD

Lisa's unit

Lesson no.	1	2	3	4 and 5	6	7	8	9
UP, unit, SF	LfS							
UP, lesson SF and CuE	IiS SSD, CE	IiS SSD	IiS SSD	IiS CE	IiS SSD	IiS SSD	IiS SSD	IiS SSD
PP SF and CuE	IiS SSD	IiS SSD	IiS SSD	IiS SE, SSD	IiS SSD	IiS SSD	IiS SSD	IiS SSD
	IiS SSD		IiS SE	IiS CE	IiS SSD			IiS SSD
				IiS SE				IiS SE
				IiS SSD				

Lesson no.	10	11	12	13	14	15	16	17
UP, unit, SF	LfS							
UP, lesson SF and CuE	IiS SE, SSD	IiS SSD	IiS SSD	IiS SSD	LfS SE	IiS SSD		IiS SSD
PP SF and CuE	LfS SE, EC	IiS SSD, SE, EC	IiS SSD	IiS SSD	LfS EC	IiS SSD, EC		IiS SSD, EC
	IiS SSD, SE, EC			IiS SSD	LfS EC, SE			

Anette's unit

Lesson no.	1	2	3	4	5	6	7	8	9
UP, unit, SF	IiS and LfS								
UP, lesson SF and CuE	LfS EC	IiS CE	LfS SD	IiS CE	IiS CE	IiS CE, EC	IiS CE	IiS CE, EC	LfS SD
PP SF and CuE	IiS CE	IiS CE, EC	LfS SD	IiS CE	IiS CE, EC	IiS CE, EC	IiS CE	LfS CE	IiS SD, CE
	LfS EC, CE	IiS CE, EC	LfS SD	IiS CE	IiS SSD	IiS CE, EC	LfS EC, CE	IiS CE, SE	LfS SD
	IiS CE	IiS CE, SSD	LfS SD	LfS SD, CE		IiS CE		IiS CE	
	IiS SSD		LfS SD, CE	IiS CE, SD		IiS CE, EC		LfS SD	
			IiS CE	IiS CE, SD					
				LfS SD					
				IiS SSD					

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Karim Hamza is Associate Professor in Science Education at Stockholm University in Sweden. His research focuses on didactic modelling of a diversity of contents and settings. His modelling work ranges from models for including the risk concept as part of socio-scientific issues in school science, over models for teaching specific concepts in university chemistry education, to models for developing pre-service science teachers' knowledge about planning. He is also involved in the development of methodologies for conducting didactic research in close collaboration between researchers and practicing teachers.

Eva Lundqvist is Associate Professor in Curriculum Studies in the Department of Education, Uppsala University in Sweden. She mainly conducts research on learning and socialization in science education. Besides the research interest in sociocultural studies of classroom interaction, her research focuses on educational reforms and the potential impact on teachers´ practices. In her research, she is focusing on research-based development of teaching, a work that is done in close collaboration with teachers. She is currently convenor of the EERA Network 27 Didactics-Learning and Teaching.

Chapter 8
Issues in "Individualized" Teaching Practice in Germany: An Ethno-Methodological Approach

Georg Breidenstein

Introduction: Individualized Teaching and Learning

In the 1990s and early 2000s a paradigmatic change in the pedagogical thinking can be observed in many European countries. This change is often referred to as *shift from teaching to learning,* prominent not only in higher education (Barr & Tagg, 1995) but on other levels of the educational system as well (Carlgren, 2011). Progressivist thinking promoting a "child-centered" pedagogy contributed to this shift as well as psychological cognitivism and the program of "Self-Regulated Learning" (Zimmerman & Schunk, 2011). A consensus was reached that learning could not be *made* through teaching, but teaching could only *offer* opportunities for learning. At the same time there was a growing knowledge about the variety of learners and the heterogeneity of students. The traditional idea of one setting of teaching addressing a whole group of learners became problematic. The classical principle of *differentiation* in comprehensive schooling was taken further to the *individualization* of teaching (Carlgren et al., 2006). Under this view, classrooms became *learning environments* and teachers became *tutors*. While this shift seems to be quite obvious in theory it is far from clear what it means in practice. How do teaching practices change and what does this mean for learning? How are classrooms organized so that students can learn individually? What does this mean for the work and self-conception of teachers?

The overall move from teaching to learning was shaped differently in different parts of Europe. Especially in the German speaking and in the Northern countries of Europe "individualized" learning has been a wide-spread trend. Carlgren et al. (2006) compare changes in the pedagogical discussion and in the patterns of teaching and learning in five Nordic countries. In Sweden "own work" became popular

G. Breidenstein (✉)
Martin-Luther-Universität Halle-Wittenberg, Halle, Germany
e-mail: georg.breidenstein@paedagogik.uni-halle.de

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when in 1994 a new national curriculum "created a stronger pressure to develop tools for keeping track of every pupil" (Carlgren et al., 2006, p. 307). Within "own work" students have individual timetables, planning and evaluating their own work and monitoring themselves. From Norway, Denmark and Iceland evidences for substantial changes in the patterns of teaching towards work plans and individualized learning are reported as well (Dallan & Klette, 2016). Only in Finland, maybe surprisingly, traditional teacher-centered patterns of classroom discourse were apparently more persistent. Carlgren et al. (2006, p. 319) interpret the trend to individualized teaching and learning as part of a neo-liberal educational agenda and they suspect a "hidden curriculum of late modern schooling" where "self-mobilizing and flexible learners (…) put themselves to work and evaluate their results" and where "the pupils are treated as entrepreneurs".

In the German discourse on primary school teaching, the ideas of progressive education are traditionally rather influential, and they were even strengthened by the constructivist move in didactical theory. Meanwhile there is some controversial debate (Rabenstein & Wischer, 2016); but the mainstream of German pedagogical discourse is characterized by a strong belief that schooling must move away from teacher-centered lessons and move towards an "open education" as well as towards the "individualization" of learning. This is considered to be the best way of acknowledging the heterogeneity of learners: Each student should be able to learn on his or her own pace and follow his or her own way of learning (Klieme & Warwas, 2011; Bohl et al., 2012; Rabenstein et al. 2018). After the "PISA-shock" of 2001 in Germany, standards and national testing were implemented, following the trends developed in Anglophone countries. Learning outcomes are now described in terms of *competencies* instead of *knowledge,* which in effect adds to the described move to the individual learner.

The idea of "individualizing" teaching and learning is additionally supported by the current discussion around "inclusive" schooling and the integration of children with special needs, which is very prevalent in Germany these days. Germany does have a strong tradition of special schools for children with special needs – a tradition which is now heavily debated. In inclusive schools, didactical thinking and didactical practices have to change: It seems obvious that it is no longer possible to teach all members of a school class in a whole group manner, instead it is considered to be necessary to teach in much more differentiated or even individualized ways (Huf & Schnell, 2018). Within this discussion, some schools in Germany provide mixed aged school classes insofar as they seem to be suitable to welcome the heterogeneity of learners, for example, by enabling children of different ages to learn from each other. This is an interesting aspect for international comparison as well (Huf & Raggl, 2016).

German Primary School classrooms these days often look like workshops, since there are students working by themselves on workbooks, as well as an assortment of other materials and learning devices (Reh & Berdelmann, 2012). The students are not actually working on the same tasks but are occupied with different activities. These classrooms rely upon the idea of "self-directed learning" (Wagener, 2010) based on the self-management of the learners. Although these concepts are rather

popular in German pedagogical literature, empirical research is rare. The lack of detailed empirical analysis of individualized teaching practices may be at least partly traced back to the methodological challenge of this kind of research: The complexity and diversity of the ongoing activities within "open classrooms" require methods of observation, which get close to these activities (Breidenstein, 2008a). It is not enough to follow the overall classroom discourse as in established classroom research but the researcher has to sit next to the students and observe them conducting their particular work.

This was the starting point of our research project "individualization and control" (see Breidenstein & Rademacher, 2017). Our research aimed at analyzing on the level of practices and practical demands: What does it mean for teachers as well as for students when school lessons are organized according to the ideas of self-guided and self-regulated activities? How does the "pupils´ job" look like in this setting (Breidenstein & Jergus, 2008)? What is the teacher's work in these lessons? These research questions predominantly refer to the pragmatics and daily routines of teaching and learning, but, as I will show, the analysis as well tells us something about the handling of subject specific contents in the individualized classroom.

The contribution will first give a concise sketch of our field research which was mainly classroom ethnography for more than 20 weeks in three different schools. The main part of the paper then presents two case studies on the micro-level of classroom interaction. The first case study discusses an observation of a student working with a learning device called the "pharmacy", a complex learning tool for divisions developed by Maria Montessori. The second case study refers to the transcript of a teacher-student-interaction on learning to read. The discussion points to the structure of individualized teaching and learning: For "open-classrooms" there seems to be a strong tendency to settle standards and routines when it comes to *organizing* the autonomy and self-reliance of learning.

The Research Project

The theoretical framework of the research is settled by the "studies of work" (Garfinkel, 1986) and the "theory of social practices" (Schatzki et al., 2001) which enable the analysis of situated practices in their own logic and effects. This means, not to ask for intentions or motives of actors, but to look at practices as an object of investigation in itself. Our research methods originate in the tradition of ethnography (Atkinson et al., 2001). The most general ambition of ethnography is the reconstruction of the participants´ perception and handling of their everyday life *from within* – not interpreting and not judging from a point of view from outside.

"Ethnomethodological indifference" (Garfinkel, 1967) is the most important principle of this kind of research. This principle stands in a particular tension to a *didactical* point of view which asks for the conditions and 'quality' of learning. Of course there are different traditions of didactical research in Europe (Klette, 2008; Hudson & Meyer, 2011; Pace et al., Chap. 5 in this book; Ligozat, Chap. 3 in this

book). Especially the German discourse is characterized by a big gap between the tradition of "general" didactics, which was never really connected to classroom research, and subject matter didactics, which are involved in classroom research more or less. But regardless of the differences every form of didactics has a normative and prescriptive bias in observing classroom activities. Didactics, in either version, includes an *idea* of teaching and learning and this idea constitutes the point of view for research which necessarily evaluates from this point of view. The didactic perspective *grosso modo* reveals deficiency when it comes to classroom research; real classroom interactions very seldomly fulfill all the expectations we may have in lessons. With an interest in the 'quality' of teaching and learning we need this kind of evaluative stance – not at least to look for the problems in the factual teaching and learning practices. Ethnomethodology, in contrast, does not evaluate the practices under investigation. It operates with the assumption of "order at all points" (Sacks, 1984) and it asks how this orderliness is built and maintained. In the famous definition of Garfinkel (1967, p. 7): "Ethnomethodological studies analyze everyday activities as members' methods for making those same activities visible-rational-and-reportable-for-all-practical-purposes, i.e. 'accountable', as organizations of commonplace everyday activities."

For classroom activities we must assume that their orderliness, the "interaction order" (Goffman, 1983) and the daily routines may stand in tension to the quality of teaching and learning which need not be a problem for the participants themselves. If we are interested in exploring the nature of this tension, this is the thesis I want to discuss, we need both: the reconstruction of the participants' doings and sayings with ethnomethodological indifference *and* a reflection and evaluation of these doings and sayings with an interest in didactics (Breidenstein, 2008b). I will come back to this discussion at the end of the paper.

Against this theoretical background the research project aimed to analyze the practical demands and practical accomplishments of "individualized" teaching and learning environments on an everyday level. To grasp as much variation as possible in the practices we were interested in, we conducted field research in three contrasting schools. All of them were characterized by mixed-aged grouping of students (first and second grades or first to third grade, typically age 6 to 9 in Germany) and all of them were using "self-regulated" styles of teaching and learning, although in very different ways.

Our first field site was a Montessori-School with "Freiarbeit" (free work) in the core of teaching and learning. "Freiarbeit" where children plan their own learning activities, in consultation and agreement with the teacher, took place every day of the week from 7.30 to 10.00 a.m. This type of learning is mainly based on the learning materials or devices designed by Maria Montessori,[1] which cover aspects of

[1] Maria Montessori was an Italian physician living in the first half of twentieth century who developed a child-centered educational approach based on observations of children. Montessori's methods and especially her idea of a learning environment have been used for about 100 years in many parts of the world.

language learning as well as mathematical learning or sciences. I will present an example from the observation of this kind of learning in the next section.

Secondly, we conducted field research in an "alternative" or "free" school which had been growing out of the anti-authoritarian movement of the 1970s. In this school the teaching style is very much characterized by negotiations: Which child is occupied with which kind of learning activity is debated every single day. Even the timing of the schedule and the breaks are object of negotiation. Most of the time, most of the children are dealing with worksheets or other learning devices on their own, while the teacher is coaching or supervising small groups of students or single students. I will present the transcript of an audio-recorded teaching conversation between one teacher and one student in this paper.

The third school which is not represented by an example in this paper was a regular neighborhood school and not shaped by a special pedagogical program, but instead by a more pragmatic stance in dealing with the standard of mixed aged grouping in the first two years of schooling in this part of Federal Germany. The layout of our research was not so much interested in the differences between the single schools, but in the potential of generalization: Findings which occur in all the three contrasting schools would plausibly be of more general relevance. In this way the examples I present in this paper do not so much stand for specifics of the particular school. It is argued that they do represent more general patterns of the practice of individualized teaching and learning. Montessori-like learning devices were used in all three of our schools and dyadic teacher-student interactions took place in all of the schools as well.

We conducted ethnographic fieldwork with two researchers in at least two groups in each of our schools. Ethnographic fieldwork means in the first place to get as close as possible to the situation of the "participants" (teachers as well as students) in the "field" (the classroom) to be able to retrace and understand *their* way of dealing with *their* situated tasks. "Getting access" in ethnography does not only mean the formal admission to observe but it means, beyond that, gaining the trust of the participants and becoming familiar with their normal course of life (Hammersley & Atkinson, 2007; Breidenstein et al., 2013). We spent several weeks in doing participant observation in each of our field sites. We audio-taped numerous teaching conversations, conducted interviews with the teachers as well as students and collected data from altogether 20 weeks of fieldwork.

With this corpus of data, we were able to explore the practices of child-centered teaching and learning in its variability and to look for overall structures of this kind of organizing classrooms (see Breidenstein & Rademacher, 2017). For the purpose of this paper, I will focus on two case studies, which offer insights into the structures of individualized learning as I want to argue at the end.

Case-Study: Working with the "Pharmacy"

I have chosen, as an example, the observation of an eight-year-old student working with a Montessori learning object, called the "Great Division".[2] The well-known Montessori materials (Fig. 8.1) are paradigmatic in enabling students to work on their own, to solve tasks and control the results by themselves. The "pharmacy", as the "Great Division" is called in everyday terminology, is designed to solve mathematical tasks and is implemented for dividing large numbers.

The functioning of the "pharmacy" is far too complex to explain it in detail. The operating consists of several activities like putting certain numbers of pearls with certain colors into little bowls, distributing pearls to the holes in the wooden boards, changing pearls of one color to another color and counting pearls. In effect, the user is able to divide numbers with seven digits through numbers with four digits by the means of this instrument. Seeing the young student doing this impressed the observer. Yet, the operations of the pharmacy are far too advanced to be understood by the operating students – or the observing ethnographer. The fabrication of the result of the division of big numbers is made possible by a complex algorithm which is built into the "pharmacy" materials. The young students learn how to *handle* it but they don't *know* what they are doing, could be argued. So, in terms of didactics we must ask if pupils really understand the division of numbers or if they simply have the ability to solve impressive looking tasks.

Fig. 8.1 The "pharmacy" Montessori materials

[2] The official name of this learning material is "Great Division" but students as well as teachers call it "pharmacy" – probably because the ensemble of things reminds them of an (old fashioned) pharmacy.

This skepticism (which evolved from my discussions with specialists in didactics of mathematics) is enforced when observing a pupil working with the pharmacy in situ. My field notes are altogether characterized by the admiration of the young student's routine and experience in the handling of an apparatus, which I, as the adult observer, hardly understood. Vincent, as I call the student, did not hesitate or contemplate at any point, but solved the eq. 7,762,929 divided by 3 by using pearls, little bowls, test tubes and holes in wooden boards. To my surprise, having found out the result, he did not even check if it was correct. He did not turn around the task card where the correct result was noted for the purpose of self-control.

What does this indicate? The detail that Vincent did not check his result is clearly due to his lack of interest in the answer. Vincent uses the pharmacy like a calculator: You would not check the results of a calculator either, because you simply trust it. And besides, even if he would have noticed a wrong result, he would not have known *where* he went wrong in the complex procedure. He would have had to try again right from the beginning. Vincent explained to me that he likes to use the "pharmacy", to "play" with it, as he calls it, but reflecting on his practice didactically (in terms of the quality of learning), we cannot be sure about the nature of his mathematical reasoning. And besides from the perspective of mathematics, it should be noted the "pharmacy" represents the task of division as an act of allocation – but not as an act of partitioning which would be as important as representation of division.[3]

In contrast to this legitimate doubt from a didactic perspective the teacher was enthusiastic about Vincent and his handling of the pharmacy. After she noticed me watching Vincent, she praised him as a role model for his self-guided work with the learning material. But, what is it that fascinated the teacher so much about Vincent's work? It seems to be the experienced and independent manner of his handling of the pharmacy. He didn't need any help or assistance and this is the desirable constellation for a classroom where students are occupied by various activities and the teachers are only able to assist one or two of the children. This organization of teaching and learning therefore relies on pupils like Vincent and on the primacy of doing. The *practical demands* of organizing individualized learning prioritize the 'being busy' of the students over the questioning and construction of conceptual knowledge (also see Dalland & Klette, 2016).

Case-Study: Learning to "Read" in a Dyadic Teacher-Student-Interaction

Let us now have a closer look at a situation where a teacher helps a single student in a reading sequence. This kind of interaction occurs regularly within an open classroom. The teacher is asked for help and assistance every now and then by numerous

[3] Without the idea of partitioning you cannot estimate the approximate size of the result e.g. – a competence which is rather important in daily life.

students with different problems. During the time she turns to one student, she has to reject or to put off all of the other requests. But in the long run the teacher has to be fair and divide her assistance equally among the students in the classroom, so every single interaction with a single student has to be valuable.

In the following case the ethnographer observes a teacher, who is called Anja, helping a student named Sören, to "read" his first words. Assisting children when they learn to read is a multi-layered task, as Fisher (1997, p. 194) shows: "teachers were both concerned about children learning to read and did address literacy learning in their interactions with children *while they were working*." As well teachers are "also concerned about affective aspects of the children's development: that children should enjoy reading and that they should feel confident as learners" (ibid., p. 193). How are these complex tasks dealt with in practice? The transcript below (Excerpt 8.1) is an audio-taped dialogue between the teacher and her student.[4]

Excerpt 8.1

```
Anja: Wir lesen jetzt mal. Lies mal. [We will now read. Please
read.]
Sören: Rock. [skirt]
Anja: Nein, das steht hier nicht. [No, that is not written
here.]
Sören: Ich kann eigentlich noch nicht lesen. [Actually I cannot
really read yet.]
Anja: Du kannst noch nicht lesen? [You cannot read by now?]
Sören: Ich kann, ich kann nur „Polizei" oder so was lesen, weil
das Papa mir schon ganz oft gesagt hat, weil ich das schon ganz
genau kenne. [I can, I can only read „police" or things like
that because my father has told me very often that because I
already know it very well.]
Anja: Und wenn man ein Polizeiauto sieht, weiß man, da steht
„Polizei" drauf, ne? Gut. [And when you see a police-car you
know that that there is „police" written on it, right? Well.]
Weißt du auch nicht, was da steht? [And don´t you know what is
written here?]
Sören: Seehund. [seal]
Anja: Aha, weil das auf dem Bild ist, denkste das steht da?
[Aha, because this is on the picture you think it is written
here?]
Sören: Mhm! [agreeing]
Anja: Hmh. [denying] Was ist denn das hier für nen Buchstabe?
[Which letter is this?]
Sören: B.
Anja: Und was ist das? [And what is this?]
Sören: A [For the English translation it would have to be an
E.]
```

[4] This passage is difficult to translate because some of the confusion only works with the German vocabulary and not within English. This is the reason why I keep the German version beside the English translation.

Anja: Okay, und wenn wir das jetzt zusammenziehen? [Okay, and if we now pull this together?]
Sören: B-A [B-E]
Anja: B-A. Ba. (.) Ba (.) [in English: B-E-] Was ist das hier? [What is this?]
Sören: R
Anja: Mhm. Jetzt zieh mal die beiden zusammen. [Now pull them together.]
Sören: B-a-r [b-e-a-r]
Anja: Jaha! Bar-
Sören: Bar-
Anja: Und jetzt lesen wir [and now we read]
Sören: T [D]
Anja: Ja! Jetzt ziehst es alles zusammen! [Yes. Now you pull everything together.]
Sören: Bar- Bart. [bear- beard.]
Anja: Sag‘s noch mal! [Say it again!]
Sören: Bart. [beard]
Anja: Bart, was ist denn `n Bart? [Beard, what is a beard?]
Sören: Haare ämh hier oben [Hair, here above. (showing between nose and lips)]
Anja: Und jetzt erzählst du mir, du kannst nicht lesen? Du hast doch grad `n Wort gelesen! [And you tell me you cannot read? But you have just read a word!] Herzlichen Glückwunsch! [congratulations!]
Sören: Aber nicht so richtige Sachen. [But not so correct things.]
Anja: Ach, das war doch n richtiges Wort. [But that was a correct word.]
Anja shortly deals with other children at the table. Then she spells out together with Sören single words from his reading book. Sören reads with her help another word: „Löwe“ [“lion”]. Anja shouts enthusiastically: Oh Sören! Du kannst lesen! [Oh Sören! You can read!]
She hugs him and replies: Du kannst lesen! Du hast mir eben erzählt, du kannst es nicht. Super! [You can read! You just told me you can´t. Super!]

So, what is going on here? How can a teacher be so excited when a student spells out a few words? She celebrates the result as a great success while Sören himself is still not convinced that he is able to read yet. And he is right: spelling out single words is not “reading”. From a didactical point of view learning to read is a far more complex process which reaches from recognizing singular letters to decoding writing (e.g. Sassenroth, 1991). Compared to this lengthy process Anja makes learning to read to one single event. Sören’s success in reading takes place in this situation but it has been made possible by a very close assistance by the teacher. We come to the presumption that this interaction *has* to be a success. When a teacher invests her valuable time into one single student, this has to result in this particular student’s ‘learning’!

This is a pattern that we observed regularly in the implementation of individualized teaching and learning: When the teacher turns towards *one* student this interaction has to end by the teacher being able to see that *this student* has learned. This is often not that easy. To realize the difficulties it is worth comparing this situation to whole-class-teaching: When a teacher interacts with 20 or 25 students at the same time, there is a very good chance that some of them will understand and be able to demonstrate their understanding of the lesson by giving correct answers. This comprehension demonstrated by some students giving right answers stands for the learning outcome of the whole group. However, when the teaching is directed to one single student it is dependent on the learning achievement of this particular student.

We have another example where Anja tries to facilitate Sören the spelling of "neun" [nine] – an interaction which turns out in a disaster (see Rademacher, 2016). After several tricks and hints, which Anja offers for "finding out", the right spelling of "neun" Sören is completely disturbed and seems even more confused than he was at the beginning. This complementary situation with Anja and Sören, which I cannot present here,[5] shows what can happen if a student does not understand what the teacher wants to explain to him – or if the teacher does not understand what the real problem of the student is. So the risks and uncertainties of an "in-the-moment-teaching" (Griffith et al., 2015) within the dyadic teacher-student interaction may be in the background when Anja celebrates her overwhelming success of "having learned how to read" with Sören. Again we note that the organization of individualized teaching demands to point to a "success" in learning which from a didactical point of view is not very evident.

Discussion: The Structure of Individualized Teaching and Learning

I would like to summarize the above arguments from the empirical observations in some short remarks which may be seen as first attempts to reach conclusions, while I am aware that further research is needed.

Objects and learning "environments" play a crucial role in self-guided learning: Not only Montessori-materials as in our case, but workbooks, worksheets and – to a growing extent – computer-based learning programs as well. These tools facilitate the "self-guided" learning of young children as much as they offer tasks and make it possible to check the solutions. Yet, these tasks often have a fixed linear outcome: there is only *one* way to *one* right solution. The challenge for students dealing with these materials often lies more in the reasonable care and accuracy of the work than in reflecting and finding new ways to solutions. Many of the activities the students

[5] This dialogue is far too complex to include it in this paper and the misunderstanding of the right spelling of the word "neun" cannot be translated into English (but see Breidenstein & Rademacher, 2017, pp. 128–134).

carry out have the character of a routine piece of work. The topic itself may take a backseat within this constellation. The interest of students may lie more in finishing these tasks than in reflecting on the problems – as for example the observation of Vincent showed (also see Huf, 2006).

In the self-guided learning approach, the interaction between teachers and students is characterized by the fact that it is one-to-one interaction within a group of learners who have diverse needs. So the dyadic teacher-student interaction is usually short and standardized, since it consists of giving snippets of advice or controlling some easy-to-check task. Sometimes, as we saw in the example with Anja and Sören, it can be more extensive, but then the teacher is under special pressure to make it result in a success. An observable learning effort for this particular student has to be achieved which may lead to rather trivialized notions of “learning”.

Summarizing the results of our observations it must be assumed that the organization of individualized and self-guided learning tends to standardize and trivialize the contents. The organizational task of providing every student with self-employing engagements seems to neglect the complexities and demands of mathematical or language learning. We have little evidence for creative and open-ended tasks in our empirical data. Tasks have clear-cut solutions which can be controlled easily. Within the “individualization” of teaching and learning there seems to be a strong tendency to settle standards and routines when it comes to organize the autonomy and self-reliance of learning (see Martens, 2018). The most important maxim seems to be that every child in the classroom is busy (see Dalland & Klette, 2016). The pragmatics of organizing the classroom seems to be more important than challenging or thought-provoking tasks.

The latter aspect, of course, is not only true for open classrooms and individualized teaching and learning practices but in many cases for whole-class and instruction-oriented teaching as well. The research on classroom management reports a strong tendency towards routines and avoiding challenging tasks: “relatively simple and routine tasks involving memory or algorithms tend to proceed quite smoothly in class with little hesitation or resistance. (…) In such circumstances a well-managed class would not necessarily be a high achieving class” (Doyle, 2006, p. 111). This tension between pragmatics and pretension with regards to content is displayed in the tension between different methodological prospects as well: To grasp the logic of these findings we do need research from an *ethnomethodological* point of view which is interested in the functioning of daily routines and (classroom) pragmatics (Breidenstein & Tyagunova, 2021). It allows to follow the actors in order to reconstruct their situated and context-specific understandings and doings. But to discuss the problematic of our findings in terms of possibilities and restrictions to learning we need the expertise and perspective of (subject) *didactics* – in our case mathematics and language learning. Relating didactics and ethnomethodology to each other in empirical research on different kinds of situated teaching and learning practices seems to be a challenging but as well promising task.

Above all we should ask, how different traditions of classroom research which have developed apart relate to each other. In this respect it seems promising to discuss how classroom research in the tradition of ethnomethodology communicates

with pragmatist approaches or with the French-speaking didactical approach "Joint Action framework in Didactics (JAD)" (Ligozat et al. 2018). In both perspectives, the pragmatist as well as JAD, the daily routines and habits of classroom activities play a crucial role in conceptualizing "learning". Especially within JAD, the core concept of the "didactic contract" (Brousseau, 1997; Sensevy, 2011) represents the practical cooperation of teachers and students in maintaining the specific norms and expectations which constitute the kind of interaction related to the transaction of knowledge. This contract remains implicit and resembles the concept of the "practical accomplishment" of the specific social order of classroom interaction within ethnomethodology and its taken-for-granted nature (Breidenstein & Tyagunova 2021). But, as far as I see, this tradition of didactic research has not yet turned to individualized teaching and learning practices. So, in the terminology of JAD we would have to explore the *didactic contract* of individualized teaching and learning. We do need to know more about the specific, situated and practical requirements as well as effects of individualized teaching and learning if we want to estimate its benefits and costs – not only in Germany.

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Georg Breidenstein studied at Bielefeld University, and he is Full Professor in Education since 2008 at Martin-Luther University in Halle-Wittenberg, Germany. He is the spokesman of the graduate school "Subject-specific Learning and Interaction in Elementary School" (www.interfach.de). His main interests and areas of research are: the ethnography of schooling and education; the learners´ perspective on lessons; assessment practices; the individualisation of teaching and learning; school choice in Primary education; methodology of qualitative research. He is currently convenor of the EERA Network 27 Didactics – Learning and Teaching.

Chapter 9
Towards Programmatic Research When Studying Classroom Teaching and Learning

Kirsti Klette

Introduction

Classroom observations as lenses for studying and understanding features of teaching and learning processes hold a strong tradition in the educational sciences (see, for example, Brophy & Good, 1974; Callewaert & Nilsson, 1974; Flanders, 1970; Jackson, 1968, and Borgnakke, 1979; Klette, 1998, for Nordic studies). Currently, classroom observation design is a central part of educational researchers' methodological repertoire for understanding instructional practices within and across different subjects and learning sites, thus providing a platform for comparative didactics[1] (Caillot, 2007; Hudson & Meyer, 2011; Ligozat, 2011; Mercier et al., 2002; also see Ligozat, in this volume). The American ethnographer and classroom researcher Erickson (2006) identified the following traditional methods of observation studies targeted towards classroom learning: (i) discourse/interaction analyses, which are micro-analyses of language and communication; (ii) process/product approaches, which emphasize functional classroom interaction and activities; and (iii) teachers' professional knowledge or pedagogic content knowledge, which is mainly on interaction and meaning-making of content. When subdividing this area of research into different school subjects; cultural, regional and linguistic traditions;

[1] The term 'comparative didactics' originates from the French-speaking didactic tradition in the early 2000s. See, for example, the special issue of the *Revue Française de Pédagogie* (unfortunately not translated to English): https://www.persee.fr/issue/rfp_0556- 7807_2002_num_141_1, including the seminal article by Mercier, A., Schubauer-Leoni, M. L., & Sensevy, G. (2002). Vers une didactique comparée. Editorial. *Revue Française de Pédagogie*, *141*(Numéro thématique), 5–16.

K. Klette (✉)
Department of Teacher Education and School Research, University of Oslo, Oslo, Norway
e-mail: kirsti.klette@ils.uio.no

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and theoretical framings, we see a number of designs and frameworks used when aiming at analysing features of classroom teaching and learning. Today, classroom studies serve as the meeting ground for understanding teaching and learning processes from different approaches and perspectives. They diverse approaches capture different aspects of classroom learning such as interaction patterns, teachers' use of scaffolding techniques, subject-specific aspects (i.e., how teachers represent a specific content or the quality of their explanations), and features of a supportive classroom climate. Despite voluminous research on classrooms, our knowledge so far is fragmented due to a multitude of single-case studies, across which it is hard to draw conclusions since the analytical framing and categories of the analyses used, as well as the contextual factors, differ substantially. In this chapter, I argue that efforts are needed to integrate the designs of classroom studies to serve as a platform for systematic investigation of key aspects of classroom teaching and learning. I refer to these integrated research efforts as 'programmatic research'. As such the current chapter discusses methodologies for analysing teaching practices, and in a systematic way, arguing for how recent developments in observation designs—and especially improvements in observation instruments and development in video capture—have paved the way for a new area of comparative didactics.

A current development that is paving the way for programmatic classroom research is the increasing popularity of video observation, thus a new generation of classroom studies is emerging. Video capture is especially suitable for this purpose due to its ability to capture both the teachers' and the students' perspectives (Fischer & Neumann, 2012); its capacity to decompose teaching practices into smaller entities (Blikstad-Balas, 2017; Jewitt, 2012; Klette, 2009; Tiberghien & Malkoun, 2010; Venturini et al., 2014); and to support joint analyses and critical re-analyses (Clarke et al., 2006a, b; Klette, 2022). Small, miniaturized and discrete cameras that support software tools for analysis, together with improvements in methodologies within an integrated methodological design, have enabled the combination of in-depth data from classrooms with large-scale data sets such as student questionnaires and achievement scores (Fischer & Neumann, 2012; Klette, 2022). Thus, nested and integrated designs and new technologies have paved the way for a new wave of classroom studies that range from in-depth, subject-specific studies (Grossman et al., 2013; Lipowsky et al., 2009) to large-scale classroom studies [e.g., the Measuring Effectiveness in Teaching (MET) study (Bill and Melinda Gates Foundation, 2012); the Organisation for Economic Co-operation and Development Global Teaching Insight video study (OECD, 2020); and the Linking Instruction and Achievement study (Klette et al., 2017).

In this chapter, I summarize recent developments in classroom studies in terms of technologies, research design and analytical frameworks used and discuss how these developments pave the way for integrative efforts and more programmatic didactic research within this critical area of education. I focus on how the present spectrum of analytical frameworks and observation manuals targeting classroom teaching and learning point to a high degree of similarities in facets of teaching practices captured, which point to the need to synthesize efforts to take this area of research to the next step. A key argument that I make is how video recordings are

ushering in a new generation of didactical classroom studies that enable systematic investigations of key features of classroom teaching and learning across subject areas, grades, student groups and learning environments. I start by summarizing recent developments in classroom video capture, followed by a summary of improvements in analytical frameworks and especially recent developments in observation manuals and instruments. Then, I look more carefully into some of these manuals and especially how they differ in terms of the facets of teaching practices that they capture, their theoretical underpinning, the degree of their subject specificity and whether they focus on the teacher, the students or both. In the last section, I use this information to discuss how the similarities and differences of the frameworks and manuals can serve as a platform for the integration of the designs of comparative classroom studies, in what I term as 'programmatic research'.

Video Observation: Towards a New Generation of Classroom Studies

Scholars agree that video analysis has multiple and significant advantages in developing our understanding of teaching and learning processes (Fischer & Neumann, 2012; Hiebert et al., 2003; Janík & Seidel, 2009; Tiberghien & Venturini, 2018). Clarke et al. argued that video recordings "… provide a much richer portrayal of classroom practices than would be possible from any single analysis" (2006, p.6). Drawing on video documentations from science classrooms, Fischer and Neumann (2012) claimed that video studies are especially interesting for decomposing teaching qualities because such studies can capture students' and teachers' behaviors' and in one package.

Video captures reveal classroom practices more clearly, facilitate the discovery of new alternatives and stimulate discussions on the pedagogical choices within each classroom, thereby deepening educators' understanding of teaching. Video also facilitates the study of complex processes and the integration of qualitative and quantitative analyses. It enables coding from multiple perspectives and new ways of communicating findings and results. Furthermore, video data can be stored in a form that allows subsequent and novel analyses, fruitful data combinations and collaborative analyses. Video analysis allows the identification of subject-specific patterns of instruction and cultural scripts (Clarke et al., 2006a, b; Stigler & Hiebert, 1999; Tiberghien & Venturini, 2018) and supports in-depth analyses of instructional processes (Borko et al., 2008; Clarke et al., 2006a, b; Klette, 2009).

The growing interest in videos can be traced to the rapid development of technology that allows easy storage and online streaming. Video recording equipment are now miniaturized and portable and can be remotely controlled and operated by individual researchers or teachers themselves, thus making such studies feasible and less intrusive on the everyday life in classrooms (for an overview of reactivity and intrusiveness in video studies, see Lahn & Klette, 2022). New technologies in this

field have been paralleled by major developments in coding and processing instruments, software for analyzing video data (e.g., Studio Code, Interact and Observer XT) and systems and infrastructure that facilitate the sharing of data and targeted and integrative analyses.

One of the benefits of video data capture in classrooms is that it enables analyses that could combine the subject-specific and generic features of teaching and learning, which makes it perfect for achieving programmatic research linked to comparative didactics (Caillot, 2007; Hudson & Meyer, 2011; Ligozat, 2011). Video data also provide opportunities to combine different theoretical and analytical approaches to the same data set. For example, Berge and Ingerman (2016) combined the variation theory and conversation analyses to understand the features of science teaching and learning among college students. Ødegaard and Klette (2012) combined the process and product approaches to teaching and learning (e.g., the instructional format and activity structures) with subject-specific dimensions (conceptual language, quality of explanations, etc.) when they analyzed science teaching in Norwegian secondary school classrooms. Recently, Charalombous and Praetorius et al. (2018) used the same video data set (three elementary math lessons from the video library of the National Center for Teacher Effectiveness at Harvard University) to test different observation manuals, all designed to capture aspects of math instruction. Their purpose was to check for possible synergies and complementarities among such manuals.

Videos further enable testing of how the sequencing of the lessons and the use of time sampling affect the empirical validity of the scoring. Some manuals use 7-min sample segments for scoring; some use 15-min segments sample; and others base their scores on the entire lesson. In addition, frameworks differ in how they identify and parse out teaching practices according to the level of the grain size, such as in how they code off discrete or targeted practices. Finally, how these practices are conceptualized at the level of operationalization and rubrics varies across frameworks (for a more thorough discussion of this point, see Bell et al., 2019; Klette, 2022; Praetorius & Charalambous, 2018). Video capture enriches educators' methodological sensitivity in terms of checking for grain size such as how targeted versus holistic teaching practices are attended as well as the level of subject specificity.

To summarize, the use of video capture has contributed to the strengthening of the methodological rigour, reliability and validity of classroom studies and has enabled productive dialogues between different research traditions and theoretical frameworks.

Classroom Observation Manuals

As proposed, developments in video capture have paved the way for renewed interest in frameworks for analyzing teaching quality. Today, we see a multitude of observation approaches targeting different features of teaching and learning. Table 9.1 summarizes some of the most frequently used observation manuals and

Table 9.1 Overview of Frequently Used Observation Manuals

Name	Main dimensions	Sub-dimensions	Subject-specificity	Scale
CLASS	Emotional support Classroom organisation Instructional support	13 sub-dimensions	Generic	7-point
FFT	(planning and preparation) The classroom environment Instruction (professional responsibilities)	10 sub-dimensions	Generic	4-point
ISTOF	Assessment & evaluation Differentiation & Inclusion Clarity of instruction Instructional skills Promoting active learning Classroom climate Classroom management	14 (28) sub-dimensions	Generic	5-point
ICALT	Safe & stimulating climate Classroom management Quality of instruction Teaching-learning strategies Learning environment Adaptive teaching	32 sub-dimensions	Generic	4-point
TBD	Student support Cognitive activation Classroom management	21 sub-dimensions	Generic	4-point
IQA	Academic rigor - Quality of the task Accountable talk - Participation - Student linking - Teacher linking	11 sub-dimensions	Subject-specific (math/LA)	4-point
PLATO	Instructional scaffolding Disciplinary demand Representation of content Classroom environment	12 sub-dimensions	Subject-specific (language arts)	4-point

(continued)

Table 9.1 (continued)

Name	Main dimensions	Sub-dimensions	Subject-specificity	Scale
MQI	Richness of mathematics Errors and imprecision Working with student math Common Core aligned practices	20 sub-dimensions (overall score for each dimension added)	Subject-specific (math)	4-point 5-point
TRU math	The content Cognitive demand Equitable access to content Agency, ownership, identity Formative assessment	15 sub-dimensions (focusing on all class activities) 11 sub-dimensions Focusing on students	Subject-specific (math)	

Note. CLASS Classroom Assessment Scoring System, *FFT* Framework for Teaching, *ISTOF* International System for Teacher Observation and Feedback, *ICALT* International Comparative Analysis of Learning and Teaching, *TBD* Three Basic Dimensions system, *IQA* Instructional Quality Assessment, *PLATO* Protocol for Language Arts Teaching Observation, *MQI* Mathematical Quality Instruction, *TRU Math* Teaching for Robust Understanding (math framework)

instruments. Contrary to earlier observation schemes and instruments that were limited to mapping surface structures (Seidel & Prenzel, 2006) and trivial aspects of classroom teaching and learning (Ko & Sammons, 2010; Scheerens, 2014), recent classroom observation manuals and frameworks are more focused, capturing either generic aspects of teaching (e.g., the Classroom Assessment Scoring System (CLASS) of Pianta et al., 2008) or subject-specific aspects of teaching (e.g., the Mathematical Quality of Instruction (MQI) manual by Hill et al., 2008). They have also been thoroughly validated in large-scale empirical studies (e.g., Kane & Staiger, 2012; Klette et al., 2017), and their rigour and reliability have been strengthened by the elaboration of procedures for scoring and coding that meet specific training and certification requirements.

The different analytical frameworks and manuals may further vary in terms of their theoretical underpinning and units of analysis, as well as whether they focus on the teacher or the students. They may also vary in grain size and sampling specifications, such as segments of scoring (every 7 min, every 15 min, or for the entire lesson) and number of scale points assigned (e.g., 1–4-point scale, 1–7-point scale, or present/absent). Bell et al. (2019) suggested differentiating frameworks based on the following eight dimensions: (i) teaching practices; (ii) views of teaching and learning; (iii) subject specificity; (iv) grain size; (v) focus on actions of teachers versus students; (vi) scoring specifications and requirements; (vii) empirical validity; and (viii) development continuum (e.g., how the framework has developed). Praetorius and Charalambous (2018) systematically assessed 11 frameworks for math teaching according to the following aspects: (i) purpose; (ii) theoretical basis; (iii) conceptual framework, operationalisation and technical vocabulary; (iv)

measurement methods decisions; and (v) evidence of validity and reliability. While there is increasing interest in using standardised observation manuals, the majority of classroom observation studies use non-standardised and informal instruments (Bostic et al., 2019; Stuhlman et al., 2010), often in the form of field notes or 'home-made' codes and categories, as it is argued that the instrument should be sensitive to the specific research questions and interests. These approaches may be described as "bottom-up,", as they define the teaching quality either from the data (Praetorius et al., 2019) or from their specific theoretical basis (e.g., the TRU Math framework in Schoenfeld, 2014 or the Joint Action in Didactics (JAD) framework in Ligozat, 2011 and in this book). However, non-standardized and local measurements may make it difficult to systematically capture and analyze patterns of instruction across studies (Praetorius et al., 2019). Recent developments in comparative didactics (Ligozat et al., 2015) applying, for example, the JAD framework to new content areas and research contexts represent promising pathways in this respect (see also Hudson & Meyer, 2011 for this argument). Thus, to move the field forward, I argue in this chapter that we should build on existing analytical frameworks and observation manuals rather than design our own local instruments for analyzing features of teaching and learning.

In the following section, I resume and assess three frequently used classroom observation manuals: the Classroom Assessment Scoring System (CLASS), the Protocol for Language Arts Teaching Observations (PLATO), and the Three Basic Dimensions (TBD) manual. While CLASS and TBD may be described as generic manuals, PLATO is an example of a subject-specific (Language Arts) manual. They further differ in terms of training specifications and requirements, theoretical underpinning and conceptual language used. Thus, these three manuals cover a spectrum of key issues relevant when assessing existing manuals. Before I do so, however, I will briefly describe each manual.

A Short Introduction to the CLASS, TBD and PLATO Manuals

CLASS was initially developed to capture the social aspect of Pre-K classrooms in the U.S. but has since been developed to cover learning situations for the entire K–12 span. It was developed as a generic observation instrument with a special focus on the social and relational climate in the classroom (Pianta et al., 2008). CLASS covers three main domains: Emotional Support, Classroom Organisation and Instructional Support. These domains are further divided into 13 sub-dimensions (see Table 9.2). The use of CLASS requires formal training and annual certification.

The TBD manual was developed and has been used in Germany since 2001 (Klieme et al., 2009; Praetorius et al., 2018). It was based on a set of classroom studies that targeted features of classroom instruction. Originally developed for use in

Table 9.2 Key Aspects of the Three Observation Manuals: CLASS, TBD and PLATO

Manual	Coverage	Main domain	Sub-dimension (example)	Scoring system	Certification
CLASS	K-12 CLASS versions, cover Infant Toddler Pre-K K-3 Elementary Secondary	1. Emotional support	13 subcategories (CLASS secondary) Positive climate Negative climate Teacher sensitivity	15-min cycles of instruction are scored on all 13 sub-dimensions of instruction, using a 1–7 scale based on how much evidence there is of teaching practices related to the given sub-dimension.	Requires certification (online certification is possible) and recertifi-cation every year
		2. Classroom organisation	Regards for student perspectives Behaviour management Productivity Instructional learning formats		
		3. Instructional support	Concept development Quality of feedback Language modelling		
TBD	Primary level	1. Classroom management	20 subcategories (2018 version) Disruptions/disciplinary problems Monitoring/'withitness' Clear rules and routines	20-min cycles of instruction on all 20 sub-dimensions, using a 1–4 scale based on how much evidence there is of teaching practices related to the given sub-dimension.	Requires no formal certification but a reliability workshop is offered
	Secondary level	2. Student support	Differentiation and adaptive support Pace of instruction Constructive approach to errors Factual constructive feedback Support for autonomy/relevance Performance pressure/competition Individual choice options Support for social relatedness: (t-s) (s-t) (s-s)		
	Vocational training	3. Cognitive activation	Challenging tasks and questions Activating prior knowledge Eliciting student thinking Transmissive teaching (neg.) Discursive, co-constructive learning Socratic teaching Supporting metacognition		

PLATO	Developed specifically for English language arts, but is also used in other subjects	1. Instructional scaffolding	12 subcategories (version 5.0) Modelling Strategy use and instruction Feedback Accommodations for language learning	15-min cycles of instruction are scored on all 13 elements of instruction, using a 1–4 scale based on how much evidence there is of teaching practices related to the given element.	Requires certification (online certification is possible.)
		2. Disciplinary demand	Intellectual challenge Classroom discourse Text-based instruction		
		3. Representation and use of content	Purpose Representation of content Connections to prior knowledge		
		4. Classroom environment	Behavioural management Time management		

math classrooms, it has since been used for different subject areas such as reading, foreign language and science, in addition to math. TBD focuses on three overall domains: Classroom Management, Student Support and Cognitive Activation. These are further divided into 20 sub-dimensions (3 under Classroom Management, 10 under Student Support and 7 under Cognitive Activation). The TBD manual requires no formal certification and training, but researchers who want to use it need to ensure their reliability through a training workshop.

The Protocol for Language Arts Teaching Observations (PLATO), another US-initiated manual, was originally developed to capture qualities of English and Language Arts Instruction (Grossman et al., 2013). Thus, it was designed as a subject-specific manual.[2] It observes four domains of (English) Language Arts teaching: Instructional Scaffolding, Disciplinary Demand, Representation and Use of Content and Classroom Environment. These four domains are further divided into 12 sub-dimensions (see Table 9.2). The use of PLATO requires formal training and certification.

In the next section, inspired by Bell et al. (2019), I resume my assessment of these three frequently used observation manuals with respect to teaching practices captured and conceptual language and terminology used. Then, I discuss the theoretical underpinning and views of learning of the different manuals as well as their subject specificity and whether they focus on teachers' actions, students' actions or both. When discussing issues of views of learning, subject specificity and whether to focus on teachers or students, I also refer to other observation manuals when relevant.

Comparison of Manuals

In this section, I first discuss challenges across manuals with regard to (i) teaching practices observed, and terminology used; (ii) views of learning upheld; (iii) subject specificity and (iv) whether they target teachers' actions, students' actions or both. If warranted, I will also refer to other manuals.

Teaching Practices Observed, Dimensions of Teaching Captured and Terminology Used

Different frameworks use different dimensions of teaching as indicators of teaching quality. The assumption is that the higher a teacher scores for these indicators and constructs, the better the teaching and the better the student learning are. However,

[2] PLATO has also been used in other subject areas such as math (Cohen, 2013; Stovner & Klette, 2022), science (Kloser, 2014) and English as a Foreign Language (Brevik & Rindal, 2020).

looking across the different frameworks and manuals, they have both similarities and differences; and, as underscored by Berlin and Cohen (2018), it may be difficult for researchers and practitioners to decide on which framework would suit their purposes best. However, although they are often developed for specific purposes or for a specific project, scholars argue that there are more similarities than differences when looking across manuals (Gill et al., 2016; Klette & Blikstad-Balas, 2018; Schlesinger & Jentsch, 2016). For example, studies have suggested that there are strong commonalities across different observation manuals when it comes to teaching practices captured (Bell et al., 2019; Praetorius & Charalambous, 2018), and most manuals use creation of a Supportive Climate, addressing of Cognitive Challenges and Classroom Management as key indicators of teaching quality. Thus, there seems to be a consensus that some key domains (e.g., constructs) are essential when measuring aspects of teaching and instruction (see, for example, Klette, 2015; Kunter et al., 2007; Nilsen & Gustafsson, 2016). These domains include *instructional clarity* (clear goals and explicit instruction), *cognitive activation* (cognitive challenge, quality of the task and content coverage), *discourse features* (teacher-student interaction and student participation in content-related talk) and a *supportive climate* (managing classrooms and creating an environment of respect and rapport). Most of the manuals have three or all four of such domains (Bell et al., 2019). However, although the manuals focus on the same overall domains (i.e. instructional clarity, cognitive activation, classroom discourse and supportive climate), they vary in terms of their grouping of the domains, their level of operationalisation of the domains into dimensions/sub-dimensions and the terminology they use.

Klieme et al. (2009), in their TBD manual, focused on three domains (or 'dimensions' in their vocabulary) as the overall key areas of their analysis of teaching quality (divided into 21 sub-dimensions): Classroom Management, Cognitive Activation and Student Support. In their manual, the quality of the Classroom Discourse, for example, is subsumed under the overall domain Cognitive Activation, while aspects of teacher-student and student-student interaction (e.g., trust and tolerance) are treated as a sub-dimension under the domain Student Support (Praetorius et al., 2018, p. 414).

In the PLATO manual (Grossman et al., 2013), Classroom Discourse is, as in the TBD manual, treated as part of the overall domain Cognitive Demand (Intellectual Demand in the PLATO terminology) and refers to students' opportunity to engage in content-related discussions with their peers and teacher. In the CLASS manual, Classroom Discourse refers to students' opportunities to express themselves and is treated as a sub-dimension under the overall domain Classroom Organisation.

Thus, despite the strong similarities in the thematic domains and teaching practices observed in the manuals, the way the different domains and sub-dimensions are conceptualized, grouped and listed have huge implications on the empirical validity of the observation results and the possible findings that can be drawn from the different manuals. When the findings are represented as aggregated scores for the overall domain (not for the individual sub-dimension), it is difficult to draw conclusions on the role of, for example, classroom discourse, as this might capture

different things across the different manuals. (e.g., the student's content-related talk in the TBD and PLATO manuals but general opportunities to talk in the CLASS manual). A related but slightly different problem is the question of terminology and how the different domains and dimensions are named in the manuals. For example, across the manuals (see Table 9.1), similar domains and sub-dimensions are named differently (e.g., classroom environment, classroom climate, classroom management and classroom organisation), but they capture more or less the same facets of teaching quality. Praetorius and Charalambous (2018) pointed to this problem and showed how the same domains (constructs) are defined using different terms, and the other way around—similar terms seem to capture different dimensions. Thus, we argue with Praetorius and Charalombos that, without disregarding cultural nuances and contextual differences, "…agreeing on some common terminology would be one first and basic step to ensure that our research field build upon each other" (Praetorius & Charalambous, 2018, p. 545). This is especially relevant for the dimensions of which there seems to be a common understanding, as, for example, the dimension Classroom Management.

Also, the number of aspects observed differs across manuals. Some manuals are comprehensive and include a long list of sub-dimensions, such as the International Comparative Analyses of Learning (ICALT[3]) manual (Van de Grift, 2007), while others focus on some key dimensions of teaching (e.g., CLASS and PLATO). However, across the manuals, it is not perfectly clear why certain dimensions/sub-dimensions are included or not. Moreover, the motivation or the rationale behind the grouping of the different dimensions/sub-dimensions is not made explicit. The grouping of the sub-dimension Classroom Discourse—either as a part of Cognitive Demand, as in PLATO and TBD, or as a part of the domain Classroom Organisation, as in CLASS, as discussed above—is an interesting illustration of this 'lack of explicitness' of the grouping of dimensions. Thus, it would be useful for instrument developers to make these groupings more explicit and to clarify the rationale for listing a sub-dimension under a specific domain.

Again, making the rationale behind these groupings explicit would help actors in the field to build upon each other's experiences, accumulate common knowledge and constructs and move away from fragmentation and idiosyncratic approaches when analyzing teaching.

Views on Teaching and Learning

Observation systems also embody the view, by a community of practice, of high-quality teaching and learning. A community of practice here could refer to a view of teaching and learning linked to different theoretical traditions such as cognitive

[3] The ICALT manual includes six domains (scales) divided into 32/35 sub-dimensions (items). For a full description of the ICALT manual, see Van de Grift, 2007. A short overview is available in Bell et al., 2019.

approaches to learning, socio-constructivist theories of learning, behaviour learning theories and the like, but also country-specific standards (national curricula and a country's national teaching standards). Praetorius and Charalambous (2018) identified 11 theoretical underpinning and research traditions when reviewing math frameworks, which span educational effectiveness research, learning and teaching theories, subject-specific theories, didactic theories, and motivation theories. Luoto (2021) distinguished between cognitive theories, motivational theories, behavioral theories, socio-constructivist theories, and subject-specific theories, along with national standards and frameworks, in the assessment of the theoretical underpinning of different observation systems. Of course, communities' views of which aspects of teaching and learning to emphasise will vary. Cognitive activation may be a core aspect of high-quality teaching across communities, but the degree to which teachers facilitate classroom discourse and student participation may vary depending on the country's cultural views of teaching and learning (Clarke et al., 2006a, b). Communities' views necessarily reflect cultural differences in valued practices in different contexts. For example, in Nordic countries, an observation instrument may consider a high degree of student engagement as critical for high-quality instruction, while in the U.S., an observation instrument may pay more attention to the explicitness of instruction (Luoto et al., 2022).

Thus, communities' perspectives of teaching quality can differ from a behaviourist view of teaching and learning to a more cognitive view, to a more socio-constructive or situated view. Such perspectives often blur the boundaries across this continuum, and, depending on how thoroughly the rationale of an instrument is documented, the view(s) that underlie a specific manual may be difficult to determine. Moreover, dichotomizing or oversimplifying views of instruction may not be helpful (Grossman & McDonald, 2008; Oser & Baeriswyl, 2001) as it can lead to underscoring of differences in how communities define and label teaching instead of focusing on how teaching and learning activities are nested and related.[4] The analyses within a tradition, while drawing on the same theoretical underpinning and references, may differ radically in their level of conceptualization, terminology and key concepts, which would make it hard for outsiders to recognize the (a) parts of the theoretical framework that are considered and (b) how these considerations are used and implemented. The Classroom Discourse domain can again serve as an example here. As argued, such dimension appears in several manuals, including in CLASS, PLATO and TBD. While PLATO and CLASS are based on socio-constructivist theories (Grossman et al., 2013) and developmental theories (Pianta et al., 2008) of learning, TBD originated from cognitive approaches to learning (Praetorius et al., 2018). However, learning theories are seldom operationalized as teaching theories (Oser & Baeriswyl, 2001), and users/readers of the manuals may find it hard to see how a specific concept or item arises from a distinct theoretical

[4] The French didactic tradition (Brousseau, 1997; Chevallard, 1992) and supporting analytical tools developed within the Joint Action in Didactics (JAD) framework is a distinguished example of a nested framework that captures teachers' and students' actions in an integrated conceptual design (Sensevy & Mercier, 2007; Ligozat in this book).

tradition. This becomes even more problematic when the same dimensions/subdimension (e.g., Classroom Discourse) is listed and used to capture rather different aspects of teaching (in CLASS, students' opportunities to talk in general; and in PLATO and TBD, content-specific student talk). However, we can also argue the other way around—that despite the differences in the theoretical underpinning of manuals, the domain Classroom Management, which originated from behavioural theories, appears in almost all manuals.

Two points are hereby made. First, similar studies with similar theoretical perspectives do not necessarily share a conceptual framework, which is at the level of operationalization, terminology and grouping. Thus, categories at the empirical level may differ substantially between frameworks belonging to the same traditions and pursuing similar theoretical goals. Second, because of these discrepancies and inconsistencies in terminology and in the grouping and listing of concepts (items) between the theoretical framework and the empirical definitions of categories, it may be wise to look more closely at the actual use of dimensions and categories (e.g., what Hammersley (2012) terms 'language games' used) when referring to theoretical frameworks or when attempting to theorize. A conceptual level that is closer to the actual dimensions and items (e.g., the language game used) may provide the template for exploring how different items and categories delineate similar or different phenomena and how they process outcomes, as well as the extent to which these are consistent with higher-order theoretical domains and dimensions.

Generic Versus Subject-Specific Manuals

Scholars agree on the importance of subject matter specificity when measuring teaching quality (Baumert et al., 2010; Seidel & Shavelson, 2007;). However, they agree less on how to best capture this aspect of teaching quality. Several observation manuals have been developed to evaluate subject-specific practices, such as the PLATO manual, as presented in this chapter, but also the MQI (math) manual and the Quality of Science Teaching (QST) manual (Schultz & Pecheone, 2015). The MQI manual (Hill et al., 2008), for example, focuses on the 'richness of math,' student participation in mathematical reasoning and the clarity and correctness of the math presented in the class. Other manuals are what can be described as generic, designed to capture key aspects of teaching held to be critical for student learning across subjects and classes (e.g., instructional clarity, cognitive demand and classroom management). The CLASS manual (Pianta et al., 2008) is an example of such a manual, as well as the Framework for Teaching (FFT) manual (Danielson, 2013), the International System for Teacher Observation and Feedback (ISTOF) manual (Teddlie et al., 2006) and the ICALT manual (Van de Grift, 2007). Internationally, several scholars have argued for the need for subject specificity when analyzing the qualities of classroom teaching and learning. Hill and Grossman (2013) argued that for classroom analyses to achieve the goal of supporting teachers in improving their teaching, they must be subject-specific and require content expertise (see also the

French didactic tradition and the JAD framework for similar arguments; Ligozat, 2011; Sensevy, 2011, 2012). This will enable teachers to provide information that is relevant for situation-specific teaching objectives, be they student engagement, group problem solving or algebra learning. Blömeke et al. (2015) showed how a combination of generic factors and subject-specific factors (in their case, math-specific factors) is required to produce valid knowledge on how different teaching factors contribute to student learning. Klette et al. (2017) used the PLATO framework (targeted for Language Arts education) to capture both subject-specific and generic aspects to analyse the features of Norwegian language arts and math instruction. However, looking across generic versus subject-specific manuals, I again would like to underscore that there are more similarities than differences across these manuals (Bell et al., 2019; Kane et al., 2012; Martin et al., 2021). After systematically examining 11 different manuals [four generic manuals (CLASS, TBD, ISTOF and DMEE[5]), three subject-specific manuals (IQA, MQI and M-Scan[6]) and four 'hybrid' (both generic and subject-specific) manuals (TEDS-Instruct, TRU Math, UTOP and MECORS[7]), Praetorius and Charalambous (2018) claimed that these manuals have more similarities than differences. They seriously questioned the fruitfulness of the distinction between generic and subject-specific frameworks and discussed whether they could be replaced by thoroughly validated and comprehensive generic frameworks, supplemented with targeted subject-specific frameworks. Hill and Grossman (2013) argued differently that subject-specific manuals are needed for analysing teaching quality due to their strength in level of precision and details. The MET study (Kane et al., 2012) found no significant differ in the measurement of teaching quality in 3000 US classrooms using five different manuals—three subject-specific manuals (PLATO, MQI and QST) and two generic manuals (CLASS and FFT). There is probably no one right solution to the question of whether to use generic or subject-specific observation manuals. Instead, the answer to this question will depend on the purpose of the study—strengthening student engagement and participation, deepening classroom discussion or content-specific teaching. For the latter, however, I maintain that a content- or subject-specific manual is critical.

[5] DMEE, the Dynamic Model of Educational Effectiveness (Kyriakides et al., 2018).

[6] IQA, Instructional Quality Assessment (Boston & Candela, 2018); M-Scan, The Mathematics Scan (M-Scan) (Walkowiak et al., 2018).

[7] TEDS-Instruct, (Schlesinger et al., 2018); UTOP, the UTeach Observation Protocol (Walkington & Marder, 2018); MECORS, the Mathematics Enhancement Classroom Observation Recording System (Schaffer et al., 1998 (see also Lindorff & Sammons, 2018)).

Analysis of Teachers' Actions, Students' Actions or Both

Depending on the focus of the scoring procedures, observation instruments may require raters (e.g., those who score the lessons) to pay attention to teachers' or to students' words and behaviours, or both. Most frameworks focus on teachers' actions while often simultaneously paying attention to student activities. For example, for the domain Classroom Discourse on the PLATO manual, raters will give a high score (4), only if they have evidence of the students' active engagement, that is, that 'the majority of the students participate by speaking and/or actively listening'. For the Feedback element, raters need to see 'that the feedback helps students in their activity' (Grossman et al., 2013). Purely 'teacher-centred instruction' would not be given high scores in the PLATO, CLASS and TBD manuals. The ICALT manual (Van de Grift, 2007) may be the one manual that will especially rate teacher behaviour.

As teachers or students seldom engage in stand-alone activities but take part in a chain of interactions and interlinked relationships, scholars conducting classroom research need to situate their analyses in a larger landscape that often includes all aspects of the didactic triangle (the teachers, students and content). To analyze learning from the students' perspective, one most often needs to consider the teacher's activities and utterances, as well as those of the other students. Similarly, as content cannot be analyzed alone but must be considered together with the students and the teachers, manuals need to include the focal content in their analyses. However, the danger of privileging analyses of activities and the potentially high cost of targeted analyses of the content limit content analysis to the aspect of interaction and communication patterns (Klette, 2007). Looking across manuals and frameworks, however, we argue that the field may profit from designing manuals and instruments with an explicit focus on student actions, either as a related (student) manual or instrument or as a separate part of the teacher manual.

Towards Programmatic Research: Conclusive Discussion

Despite a multitude of case studies on classroom instruction, our knowledge so far in the field is fragmented due to a multitude of single-case studies, from which it is hard to draw conclusions across studies since the analytical framing, categories, manuals of analyses, contextual factors and content involved differ substantially. To achieve robust and sustainable findings from analyses of critical components of classroom teaching and learning, 'programmatic research' may be required. This approach underlines the need for researchers in the field to: (i) use standardized manuals rather than 'home-made' frameworks; (ii) agree on some key dimensions that should be systematically investigated; and (iii) pursue, conceptualize and operationalize the analysis in a manner that supports and facilitates aggregation and accumulation of findings and knowledge across studies. As I have argued, drawing

on Klette (2007), the relational dynamics between the different aspects of classroom teaching and learning are not well understood, and there is a need for integrated frameworks "… that link instructional activities and procedures (the *how*) with thematic patterns (the *what*) and modes of interaction (the *who*)" (p. 148). One promising way to move the field of didactical classroom studies forward is to go beyond single-case studies (Grossman & McDonald, 2008) to a more programmatic approach, whereby researchers in a shared tradition, view of learning or subject expertise answer a set of critical questions over time and in different settings and with different subjects. To this end, we need integrative and synthesizing maneuvers that can summarize how different frameworks and manuals might produce patterns and findings that vary across contexts, subjects, groups of students, school environments, and other factors. We further need common analytical frameworks and manuals that can discern the possible impacts and implications of these findings across actors, content areas and settings. One possible way to do this is to combine different frameworks that target classroom discourse (e.g., PLATO versus CLASS but also other frameworks aimed at capturing aspects of classroom discourse such as Conversation Analyses (CA) approaches and interaction analyses) so as to systematically investigate the role of classroom discussions across grade levels, subject areas, groups of students and classroom environments. Another way could be to use the different analytical frameworks and conceptual framings to analyse features and challenges in a specific subject area—for example, algebra. Yet a third approach could be to apply the same analytical framework to different topics and subjects in order to deepen understanding of the potential power of specific features of classroom learning, such as classroom discussion. Reviews of research on the impact of classroom discourse revealed mixed and inconsistent findings (Howe & Abedin, 2013), and it is critical to discern when classroom discourse is productive and when it is not.

To demonstrate the viability of my proposed approach, I present our current large-scale classroom study "Linking Instruction and Student Achievement," where we are investigating how aspects of classroom teaching contribute to student learning (Klette et al., 2017). To understand how instructional practices contribute to learning in different subject areas (math, Language Arts and social science), we are using a common analytical framework for our first level of analysis. Based on this framework, we are capturing teachers' scaffolding techniques and representation of content, students' cognitive demand, and the discourse features and classroom climate across 150 classrooms and almost 500 lessons. This gives us a possibility to look for common features and challenges linked to the role of classroom discourse across different subject areas such as math, social science and Norwegian language arts.

Classrooms and students vary, and to make this research useful for teachers, subject-specific and targeted analyses are required. We further need information on how features of classroom teaching and learning may work for different types of students, groups and learning goals, be they be cognitive, social motivation, etc. To such end, multiple frameworks, manuals and instruments are needed. Thus, a next phase for didactical classroom research can be what I have described as a more

programmatic approach to classroom studies. To operationalize such approach, key features of classroom teaching and learning must be systematically investigated across grades, content areas, and types and groups of students.

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Kirsti Klette is a distinguished professor at the Department of Teacher Education and School Research, University of Oslo. Her research interests include research on teaching and learning, teaching quality, classroom studies and comparative studies. She has been the principal investigator for several international and comparative projects targeted classroom learning including the large-scale video study "Linking Instruction and Student Achievement" (LISA) analyzing how instructional practices in mathematics and language arts impact student learning, and the "Synthesizing Research on Teaching Quality" (SYNTEQ) summarizing how classroom video documentation develop our understanding of teaching quality. She is also the Director of the newly funded Nordic Center of Excellence "Quality in Nordic Teaching" (QUINT) drawing on comparative classroom video data from all Nordic countries. She is one of the founder of the EERA Network 27 Didactics—Learning and Teaching, and she acts as convenor of this network since 2005.

Part III
Didactics Meets Societal Challenges

Chapter 10
Addressing Gender in French Research on Subject Didactics: A New Line of Investigation in Physical Education

Chantal Amade-Escot and Ingrid Verscheure

Introduction

This chapter is about a French *didactique* research program that explores how institutionalized teaching and learning processes, which are fundamental if people are to live together and act as citizens, can participate in the societal challenge of gender justice at school. It presents a recent theoretical development that addresses gender perspectives in subject didactics. More particularly, it focuses on how gendered contents take shape, or might be challenged, through teacher and students' interactions in the class. The chapter begins by pointing out the late emergence of gender as a research question in European didactics and gives an insight into recent perspectives in German, Nordic and French didactics research. The core of the chapter, in two sections, develops the way gender is addressed within a French *didactique* research program of the early 2000s that emerged to investigate gender issues at the micro level of didactical transactions. The first section sketches out the conceptual framework and key concepts that form the background against which the studies are conducted. The second gives two examples in physical education that illustrate the unique twofold contribution of this research program in terms of (i) investigating didactical interactions through a non-binary gender analytical lens and (ii) implementing emancipatory didactical strategies that foster non-gendered learning. The first example underscores the extent to which the program sheds new light on gendered knowledge constructions and the second gives a glimpse of how collaboration between teachers and researchers can enhance directions to increase gender equity from early schooling onwards. The conclusion stresses the need to increase didactic research on gender in all school subjects.

C. Amade-Escot (✉) · I. Verscheure
UMR EFTS, Université de Toulouse - Jean Jaurès, Toulouse, France
e-mail: chantal.amade-escot@univ-tlse2.fr

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Gender in European Didactics

Since the late 1970s, an increasing volume of research within educational sociology, educational psychology and curriculum studies has shown that pedagogical practices reproduce gendered aspects of the cultural heritage of societies. In the Anglo-American areas, early works on gender and school subjects questioned the gendered knowledge-producing processes in schools. An overview was provided in the third part of the 'Handbook on Gender and Education' (Skelton et al., 2006) with chapters covering the theme in particular school subjects, such as literacy, mathematics, science, sex education, and technology. Recently, national curricula or national standards over Europe have encouraged teachers to consider girls and boys equally in day-to-day practices to promote a more inclusive pedagogy. Despite a dramatic increase of gender studies in the various fields of educational research and some recommendations given by educational policy makers, European didactics research (understood as studying the teaching and the learning of subject-specific knowledge) did not pay much attention to gender before the last decade (Danielsson, 2010; Schneuwly, 2015). However, related works on-going since 2014 were presented in EERA Network 27 (Didactics – Learning and Teaching) through symposia and workshops. They gave exposure to research on gender in learning and teaching, from which a book, 'Gender in Learning and Teaching: Feminist Dialogues Across International Boundaries', has been published recently, providing a collection of international research (Taylor et al., 2019). The emergence of a focus on gender in European didactics is thus recent. In the late 2000s, initial works concentrated on differences between female and male students' achievement, attitude and motivation, etc., while shedding little light on the social interactional processes underpinning the differences observed in students' gendered relations to the subject being taught and learned. Gender is considered in these first studies as a characteristic of the individual student and, more often than not, related to an a-theoretical approach taking gender as synonymous with sex (Danielsson, 2010). These approaches to gender are still vivid in the landscape of European didactic research.

More recent works concentrate on gender as a social construction within academic disciplines and their cultural anchorage. They are studies providing gendered analysis of textbooks, of students' voices, of teachers' attitudes and knowledge, etc. Innovative designs and intervention projects intended to enhance students' achievement have been tested, particularly in subject disciplines marked by inequalities of gender performance, such as literacy, mathematics, physical education (PE), technology, and sciences. Notwithstanding, over the 2000s, gender focus has still remained marginal among the incredible amount of literature in didactics research. The last decade was characterized by new didactical approaches going far beyond the taken-for-granted traditional binary gender distinction and more attention has recently been paid to how the contents of lessons impact students' gendered learning (Amade-Escot, 2019a; Danielsson et al., 2018; Goetschel, 2010) as outlined in the next section.

Contemporaneous Gender Research Approaches Within the Three Core Strands of European Didactics

Didactics research within continental Europe is multi-faceted and the kind of focus given to learning and teaching differs according to national contexts. Three core strands are classically distinguished: German-speaking didactics, Nordic didactics, French-speaking didactics (see contributions in Hudson & Meyer, 2011). In this landscape, the study of gender issues in subject-didactics research still has strong connections with the theoretical frameworks used in each didactical research tradition. The types of present-day non-binary didactical research on gender are briefly summarized and illustrated below:

– Aligned with the historical and philosophical German *Didaktik* tradition of *Bildung,* researchers put forward feminist critiques of the gendered culture of knowledge production at school, its impact on teaching and the risk and danger of reifying traditional gender roles through teaching, particularly in STEM (Scholand, 2011; Jehle & Blessing, 2014; for a discussion, Taylor, 2019). Questioning the Enlightenments origin of didactics, the new approaches integrate post-modernist, post-structuralist and/or queer theories to breach the binary perspective that underpins 'mainstream' research in German *Didaktik* (Goetschel, 2010; Kraus, 2019).
– In Nordic didactics, contemporary studies investigate gender, knowledge and power together within the Foucaldian framework of governance using post-structural discourse analysis to explore teaching and learning (Eriksson Barajas, 2010; Larsson et al., 2009). Within a pragmatist standpoint focus on how teacher-student interactions contribute to knowledge construction and meaning making, some works underscore how vivid relations between knowledge and power are in classrooms (Danielsson et al., 2018). Teachers communicate what counts as (ir) relevant knowledge or (ir)relevant ways of acquiring knowledge and thus contribute to the exclusion of certain knowledge and gendered ways of knowing, as well as the normalization of gendered power relations and hetero-normativity (Danielsson, 2014; Larsson et al., 2014).
– The hallmark of Francophone *didactique* research is to focus on how subject-specific knowledge gets transposed as it moves, through curriculum choices and teachers' practice, from society to the classroom where learners confront it (Caillot, 2007; Ligozat, in this volume). Within the perspective of didactical transposition, the first interest in gender started with studies focusing on sex-stereotyped contents, teaching practices, and assessment, mainly in the subjects of PE, science education and French literature (Verscheure, 2020a). Using the Joint Action framework in Didactics (JAD), an innovative line of research in PE emerged in the early 2000s at the *University of Toulouse*, in France. Based on detailed analysis of classroom events, this body of research (for a review, see Amade-Escot, 2017) sheds light on how gendered contents are co-constructed by teacher and students as a by-product of the differential didactic contract (definition will be provided in a coming section). Drawing attention to the fact that

participants continuously interpret and define both the context and the meanings, this approach underlined the extent to which didactical transactions affect the doing/undoing of gender in the class far beyond the traditional sex categories.

A common characteristic of contemporary studies across the three strands of European didactic research is to provide fine-grained, descriptive accounts of classroom interactions, relations, and transactions with a particular focus on how gender impacts knowledge construction, meaning-making, and subject contents. All these works are rooted in non-binary theoretical gender perspectives (Taylor et al., 2019). All are related to the very specificity of knowledge embedded in learning environments, including its gendered aspects. Their conceptual frameworks may differ but they have common purposes: (i) to consider that students are differently literate, physically and discursively, according to the various school-subjects; (ii) to delve into how subject specific knowledge impacts, through teaching practices, gendered students' knowledge construction; (iii) to investigate how teaching and learning implies gendered power relations. This research, while rooted in the various didactical frameworks of individual European traditions, also finds stimulating sources of inspiration in post-structural feminist theories, critical pedagogies, queer theory and intersectional approaches. The purpose of the next sections is to look into a French *didactique* research program in depth.

Investigating Gender in Teaching and Learning: The Distinctive Approach of the French Research Program on 'Gender and *Didactique*'

Broadly speaking, research in didactics relies on the idea that all students, whatever their differences, should be entitled to knowledge because knowledge has a potential power to move individuals towards emancipation. Thus, when investigating gender in the classroom, subject-didactics researchers aim to study the possibility and the constraints of gender sensitive pedagogies, identifying the critical role of knowledge in the promotion of gender justice in education. As far as the 'Gender and *didactique'* research program is concerned, the aim is twofold: (i) to describe the unequal dynamics of gendered learning related to each individual piece of knowledge content; and (ii) to create didactical conditions that allow girls and boys to acquire empowering knowledge and know-how while deconstructing traditional gender norms. Two tenets are at the core of this research program (Amade-Escot, 2019a; Verscheure, 2020a):

– Gender is theoretically understood as a relational concept, a fluid, multiple and shifting category beyond the traditional male and female binary,
– Gendered or non-gendered learning of any particular knowledge is co-constructed through didactical joint action.

Gender as a Relational Concept

Drawing on authors who criticized the blind, binary gender perspective in social sciences and who theorized the important distinctions among sex, sex-category, and gender (Butler, 1990; Chabaud-Rychter et al., 2010; West & Zimmerman, 1987), we consider gender as a relational and social construct to be understood far beyond the traditional male and female distinction. According to West and Zimmerman (1987) gender is 'an emergent feature of social situations: both as an outcome of and a rationale for various social arrangements and as a means of legitimating one of the most fundamental divisions of society' (p. 126). For the two authors, doing gender is 'the activity of managing situated conduct in light of normative conceptions of attitudes and activities appropriate for one's sex category' (p. 127). Gender is thus performed depending on the social context through day-to-day practices and cannot be reduced to the notion of identity (Butler, 1990). In that theoretical perspective, we contend that 'doing gender' involves socially guided perceptual and interactional processes in all areas of activities, and ultimately in institutional arenas like schools. School activities often reproduce gender binary norms of behaviors and marginalize individuals who are not clearly identified as acting according to those traditional norms. In our research, the concept of gender is conceptualized and investigated in terms of the subject's fluid, shifting and, sometimes fragmented, experiences that regulate, rather than determine, the enactment of unequal learning trajectories. Investigating gender in classroom practices to examine how girls and boys construct their knowledge differently through academic expectations requires focusing on the tiny and detailed ways knowledge contents are brought into play at the micro level of didactical transactions between students and teacher and/or among peers.

A Research Program Rooted in the Joint Action Framework in Didactics (JAD)

The French research program named 'Gender and *didactique*' (Amade-Escot, 2019a; Verscheure, 2020a) investigates gendered knowledge construction against the background of the JAD theoretical framework (Amade-Escot & Venturini, 2015; Ligozat, in this volume; Ligozat et al., 2018; Ligozat & Schubauer-Leoni, 2010). The purpose of this descriptive framework is to account for the situated dimensions of the intertwined process of teaching and learning. It draws on the idea that teachers' and students' practices are best theorized as 'joint action'. However, joint action does not mean that participants have the same goals or agendas. Therefore, transactions about the knowledge at stake continuously occur in classroom settings. Tackling gender issues in didactic research requires attention to be given to the several facets of each individual piece of knowledge, particularly the gendered ones. Within a pragmatist view of classroom practices, the research program focuses on

the teacher and students' didactical joint action to account for gendered learning experiences and meaning-making through these experiences (Amade-Escot, 2019a; Verscheure, 2020a). It was first conducted in PE at different school levels (Amade-Escot et al., 2004, 2015; Verscheure, 2005, 2009; Verscheure & Amade-Escot, 2007). Then, studies were extended to other school subjects like science education (Pautal & Vinson, 2017) and philosophical debates at primary school (Verscheure et al., 2019), recently integrating an intersectional approach (Verscheure & Debars, 2019).

Over time, three analytical key concepts have appeared as relevant to address the critical question of gender in teaching and learning school subjects: 'differential didactic contract', 'epistemic gender positioning' and 'teacher and student practical epistemologies'. Their compatibility with the didactical joint action framework is discussed in Amade-Escot (2019a) and Verscheure (2020a).

Differential Didactic Contract

The concept of didactic contract accounts for teacher and student joint action with regard to a particular piece of knowledge. It refers to the transactional dynamics of the teaching and learning semiotic processes: how individuals engage with and interpret the knowledge content at stake and its epistemological, social and cultural dimensions. According to Schubauer-Leoni:

> The 'didactic contract is not implicitly negotiated with all the students of the classroom but with some groups of students having various levels of standing. These standings are themselves related to diverse hierarchies of excellence and are partially attributable to students' social backgrounds' (Schubauer-Leoni, 1996, p. 160, our translation).

Among these social backgrounds, gender as a social and cultural construction of habits, plays a major role in the differential evolution of the didactic contract in a class and, in consequence, in students' learning. This was clearly stated in the seminal doctoral thesis of Verscheure (2005).

Epistemic Gender Positioning

Over the course of the first studies, the need for the second key concept appeared for investigating gender in didactical transactions. Epistemic gender positioning is a knowledge specific concept (Amade-Escot, 2019a; Verscheure, 2020a; Verscheure et al., 2020). It expresses what teacher and students privilege when interacting about the piece of knowledge embedded in any didactic *milieu* (i.e. a specific learning environment that encompasses conceptual and material components as well as social and semiotic aspects that provide the context of teacher and students' didactical joint action, Amade-Escot & Venturini, 2009). We borrowed the term

'positioning' from the work of Davies and Harré (1990) and Harré and van Langenhove (1999). For these authors, human behavior is constrained by group norms and is a product of the history of each individual's interactions with other people. Drawing on the social, symbolic and interactional dimensions of human action, the importance of context and language, these authors demonstrate that individual 'positions' are not fixed but fluid and can change from one moment to the next, depending on the context through which the various participants take meaning from the interaction. Extending the 'positioning theory' to teacher and students' gendered participation in teaching and learning, we claim that the concept of epistemic gender positioning: (i) resonates with Butler's idea of gender performativity (1990); (ii) allows us to grasp the various and differential ways gender is done or undone in the class; (iii) accounts for the transactional dynamics of the construction of gender inequities; and (iv) explains how gendered contents are enacted through didactical transactions. Actually, it is the various forms of gender positioning and repositioning that teacher and students enact during didactical transactions that play a major role in the differential evolution of the didactic contract. Among them, are some noteworthy forms of gender positioning in the classroom that are 'linked with each participant's practical epistemology', in the sense that teacher and students, who are embedded and act within an implicit and differential didactic contract, value or privilege different facets of knowledge depending on context, meanings and interactions' (Amade-Escot, 2019a, p. 35). This point marks the dialectic relation between epistemic gender positioning and the teacher's and students' respective practical epistemologies, the third key concept used in our approach.

Teacher and Student Practical Epistemologies

The notion of an individual's practical epistemology is mainly conceptualized by two pragmatist research approaches in European didactics (Amade-Escot, 2019b; Ligozat et al., 2018). Broadly speaking, French didactics primarily studies the teacher's practical epistemology and how it influences the didactical transactions, while Swedish didactics focuses on that of each student. In our works, we pay attention to participants' practical epistemologies, understood as what the teacher's and students' actions privilege in the various facets of the knowledge taught and learned, to document the gendered patterns of expectation and perception the participants have of the subject.

To conclude, within the didactical joint action theoretical framework, the interrelations of the three concepts (differential didactic contract, epistemic gender positioning, and teacher and students' practical epistemologies) allow us to interpret how gendered contents are developed through transactions, and the extent to which they impact student gendered learning trajectories.

Two Examples of Empirical Contributions in Physical Education

In this third section, we illustrate the twofold purpose of the research program through two examples of empirical works. The first one, extracted from a volleyball lesson at a middle school during ordinary teaching, exemplifies the relevance of the three key concepts delineated in the section above to describe the very subtle dynamics of unequal gendered learning that occurs unbeknownst to the participants. The second example, borrowed from a collaborative research design in rugby at primary school, points out how a gender sensitive pedagogy creates conditions in which girls and boys acquire empowering knowledge and know-how while deconstructing traditional gender norms. Both account for the evolution of didactical transactions and how gender is done or undone in the class.

Method

This section presents a brief overview of the observational method used in both studies, and sketches the principles that undergird the collaboration between teachers and researcher in the second one.

Overview of the Observational Research Design

Data collection in both studies was based on the observation of didactical practices to provide fine-grained accounts of classroom events related to the specificities of the knowledge taught and learned. It used videotaping and participants' interviews over a succession of lessons, even though we only present one lesson in each setting here. The focus of observation (including verbal and non-verbal transactions) was on documenting: (i) the gendered forms of knowing valued by the teacher, (ii) the gendered forms of achieving the tasks valued by the students, and (iii) the diverse ways girls and boys interact with the teacher in relation with the gendered dimension of the knowledge content at stake. The purpose of the method was to provide a description and an analysis of the dynamics of the differential didactic contract.

Principles Guiding the Collaborative Research

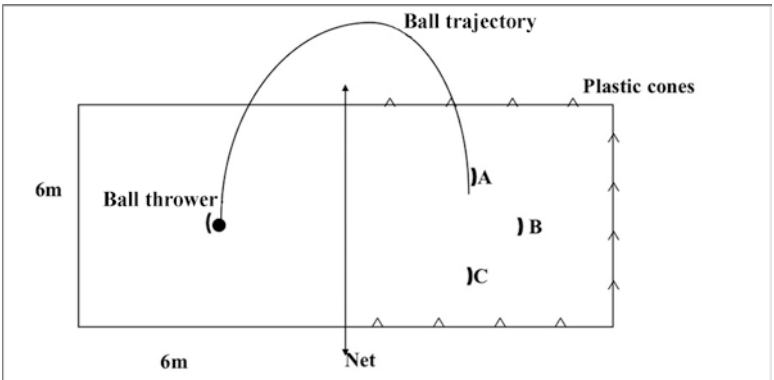
In the second study (rugby at primary school), the collaborative research was driven by the idea that changes in teaching can no longer rely on only teachers' awareness of gender inequalities but need an 'activist approach' as discussed by Oliver and Kirk (2015). Specific didactical strategies were co-elaborated by the teachers and the researcher: (i) all lessons were co-designed, (ii) the teaching was conducted by

the teacher of the class and all lessons were videotaped; (iii) the debriefings after each lesson co-analyzed the lesson with the aim of providing guidelines for the next one. During the debriefings, videos of lessons helped the scrutiny of the teacher's and students' actions but they may also be used with students for reflective practice. At each step of the collaboration, the teacher's and researcher's deliberations focused on the functioning of the didactic contract and its potential/actual differential evolution among students.

Effects of Participant's Epistemic Gender Positioning on Gendered Learning in Ordinary Volleyball Teaching at Middle-School

This first excerpt is from a volleyball unit conducted by an experienced female teacher. It concerns the principal task of the tenth lesson of 14, which opposed a ball-thrower (as a facilitating high serve) and three players (A, B, C) who had to cooperate to maintain the ball overhead in their court (see Fig. 10.1).

The knowledge at stake is related to the continuity and the cooperation between the three players (A, B, and C) to maintain the ball alive overhead in their own court 'as long as possible'. The 'need for cooperation in the team was highlighted during the previous lessons based on easy serves initiated from the back of the court, at approximately six meters' (Teacher's pre-lesson interview). Furthermore, the teacher indicated that she privileged 'the two-hand set' over the lessons: 'I never forbid the two-hand bump but, at any time I see a student using the two-hand bump and losing the ball [most often because the ball is deviated or kicked down]



The teacher told the students: 'On each throw, players A, B, C, should keep the ball in play in their court as long as possible; you have to count the number of ball-touches. After each hit of the ball, the player has to go to the nearest plastic cone to touch it, and so on' (instruction from the videotape of the lesson).

Fig. 10.1 Volleyball Learning task as provided by the teacher

I mention that it is not the best way to play collectively'. In line with these aims, to increase collective cooperation in the task, each player has to initiate high ball trajectories, the only condition giving time to her/his partner to move under the ball with good balance and to hit it (continuity of the collective cooperation). At the same time, performing high trajectories helps to give the ball-player time to move sideways, to touch a plastic cone and then to return. Moreover, giving high trajectories to the ball forces the players to reorient the contact-surfaces upward when engaging bodily under the ball to perform a nice two-hand set. To summarize, the immediate targeted knowledge contents of the task are: (i) for the ball-player, to coordonate height and direction when hitting the ball; (ii) for the partners, to read the ball trajectory and decide who is going to play it next and, (iii) for the one who is in charge of the ball, to move under it to make a high trajectory pass.

At this stage, the knowledge and know-how at stake in the didactic *milieu* set by this teacher neither priviledge stereotypical masculine gendered norms of volleyball practices such as spikes and powerfull attacks (Verscheure, 2009), nor is benevolent toward girls in terms of demand of exacting content (Larsson et al., 2009). It may be said that this female teacher's pratical epistemology is not really gendered.

Observation of Didactical Transactions

The class was organized into six groups of students with heterogeneous volleyball skill levels. Three of the six groups were single-sex (two groups of boys, one group of girls); the three others were mixed. The six work groups of the class engaged in the task consistently:

– A group of four male students having the highest skill level in the class succeeded in keeping the ball flying during four to five successive hits but none of them moved sideways to touch the plastic cones during the task. They played in a very reduced space. The continuity of the volleyball rally was thus gained at the expense of high trajectories. These boys never risked losing their balance and they acted in ways that did not allow them to progress. Through their actions, we can interpret the meaning they gave to the task: they privileged a form of cooperation that fulfilled the overt part of the didactic contract (counting the number of ball hits). However, the implicit one (to perform ball high trajectories), which is at the core of cooperation, was left out of their work. Actually, these four boys did not increase their learning; they just repeated what they already knew. Surprisingly, the teacher never monitored them or reminded them to touch the plastic cone. At the end of the lesson, she mentioned to the researcher:

Excerpt 10.1

'well ... it's... it's difficult ... I saw groups playing differently: some try to hit the ball high, others target the partner ... and *I also saw some students that played together with exchanges of tiny amplitude, in a small space, without any risk of losing their balance'* (post-lesson interview, italics our emphasis).

Playing like this often characterizes forms of beginners' practical epistemologies but, in this group of more highly skilled boys, it can be interpreted in terms of epistemic gender positioning: these four boys favor their male self-esteem, exhibiting a kind of success in the task while remaining at the margin of the didactic contract.

– Two other groups of mixed students having an intermediate level of volleyball skills organized their work by placing one receiver in the middle of the volleyball court and the two other players near plastic cones. The receiver (most often a boy) deviated the ball to target one or the other partner. We observed very few successive hits of the ball (one or two) before the ball fell. All actions were explosive. The height of the ball trajectories never exceeded the net line. In these groups, students privileged the instruction to 'touch the plastic cone' at the expense of the other dimension of the work, which was the cooperation in the team. The teacher consistently monitored these two groups: 'do not stay stuck to the cone, move, move'. She invited them to reflect: 'how can you keep the ball alive?' Some students (boys as well girls) maintained their place in ways that might be interpreted as avoiding the responsibility of taking charge of any action on the ball, letting the skilled boy in charge or the receiver manage the game. In terms of epistemic gender positioning, we can interpret these actions as a feminine way of being a 'competent bystander'. Competent bystanders are students who are particularly competent for 'the avoidance of participation without misbehaving' (Tousignant & Siedentop, 1983, p. 49), often described as ways of practicing games that girls privilege to protect their selves during PE lessons valuing masculinity (Davisse, 2010; Griffin, 1984).
– Finally the students of the other three groups (in the majority girls) who encountered the greatest difficulties at the beginning of this volleyball unit (Teacher's pre-unit interview) tried to apply the instruction. Each student who hit the ball moved sideways to touch the nearest plastic cone and return. The ball trajectories were of limited amplitude and thus did not allow a second touch of the ball. The teacher concentrated her monitoring in the direction of these three groups. She first invited the students to reflect: 'how can you keep the ball alive?' Then she reminded them 'go go go and touch the cone'. She particularly supported the single-sex group of girls, who applied themselves strongly to the game, and said loudly: 'high, high … need to send it [the ball] high', even though they did not really succeed in doing so. The teacher gave support: 'yes good idea, it's a good job'! Interestingly, during the 32 min of the task development, we observed the early stage of new know-how, some clumsy adjustments with the premises of an upward reorientation of the two-hand contact-surfaces, and better body engagement under the ball. In these three groups, students' actions expressed a certain sensitivity to the implicit part of the didactic contract: the meaning they built in the situation at hand was compatible with the knowledge and know-how targeted by the teacher. Through didactical joint action, emerged relevant volleyball forms of knowing. In terms of boys' and girls' epistemic gender positioning, we also point out a greater independence with respect to traditional gender norms (Davisse, 2010).

To conclude on this first research excerpt, the analysis revealed the diversity of student learning and how gender epistemic positioning impacted the functioning of the differential didactic contract. It also underscored the uncertainty of the didactical process to address gender in an ordinary setting, even when knowledge contents and the teaching did not pay tribute to masculinity as is often the case in PE (Davisse, 2010; Fagrell et al., 2012; Griffin, 1984; Larsson et al., 2009; Verscheure, 2009).

Raising Teachers' Gender Didactical Judgment Through Collaborative Research in Rugby at Primary School

This second research excerpt is borrowed from a collaborative longitudinal study aiming to combat school construction of gender differences (Verscheure, 2020b). As pointed out above, the research design followed 'an activist approach' (Oliver & Kirk, 2015) to increase gender justice in teaching and learning, notably in raising teachers' didactical judgment (Almqvist et al., 2019). Moreover, consistently with the 'Gender and *didactique'* research program, which emphasizes that gender order in the class is a by-product of teacher and students' didactical joint action, the collaborative project also fostered young children's awareness of gender issues in their learning (Verscheure, 2020a, b; Verscheure et al., 2019). In that vein, during all PE lessons and in continuity with other activities in the class, any gendered exchange, remark, or form of bullying expressed or suggested by any child (boy or girl) related (or not) with the subject was brought forward to the class to increase awareness about gender stereotyping.

The excerpt selected here is related to a rugby unit (8 lessons on the field, 3 on videos) at elementary school (age 6–7 years) during the second year of the research. The choice of rugby, a sport activity having a strong social male connotation, makes the recognition of gender stereotypes more salient. In rugby, they are often expressed as: (i) girls and timorous boys systematically avoid contact with the opponent and get rid of the ball as soon as received without any tactical intention, and (ii) more confident boys happily engage in bodily struggle and, whatever the opponent context, often perform (un)successful individual runs to score a try. Of course, these descriptions are not only binary but also reductionist and gender biased.

The educational project during the rugby unit aimed at fighting these stereotypical social gender norms by implementing relevant non-gendered learning environments where the management of the balance between power and strategy in the game was at the heart of the teaching. Its ambition was to maintain strong vigilance so that girls, but also certain boys, did not become confined (or confine themselves) in bystander roles; and that not only the most highly skilled boys could feel authorized to score tries. In other words, the collaboration between the teacher and the researcher over the unit aimed at undoing gender.

Within the above purpose, the broad didactical strategy was to involve students in a play-practice of school rugby based on a game where two teams of two players

played against each other. This reduced game format (noted below as 2*vs*2) is considered as the 'simplest unit of a complex game' that maintains the logic of rugby as a social sport practice (Bouthier, 2007). In our research, the 2*vs*2 was used to develop both tactical and technical rugby skills that contributed to a non-gendered rugby play-practice. Another standard to promote gender cooperation between children over the unit was that all learning tasks involved teams systematically composed of one girl and one boy, both of almost identical size. Moreover, approximately every two lessons, a short video session was dedicated to students' analysis of their own game. The overarching learning purpose for the unit was collaboratively defined in terms of increasing '*students' sense and know-how to achieve an accurate collective attack and score a try*' within the 2*vs*2 game.

The task is multivalent in its conception: there are several ways to achieve it, making various students' actions possible according to their own practical epistemology. The knowledge contents at stake respect the logic of a rugby game. During the attack: (i) each ball-carrier has to coordinate her/his action with her/his partner using two types of tactical alternative: she/he may strike the defender or she/he may skirt around the defender, before passing the ball to her/his partner; (ii) for the partner, she/he may adjust her/his move to support the ball-carrier and/or to be available to receive the ball and go forward in the direction of the in-goal area; (iii) both players have to cooperate consistently during the ball progression whatever the choice of alternatives. As in any rugby game, no intentional throwing or passing the ball forward is allowed. All these actions are equally relevant ways to perform an accurate collective attack and score a try without privileging only strength and power to succeed. An important aspect of the didactic milieu thus concerns the dimensions of the playing area. The ground must be neither too broad nor too restricted to increase various forms of tactical cooperation between students The length (6 m) and width (3 m) of the field (see Fig. 10.2) were designed to facilitate cooperation between children through tactical choices that did not privilege traditional gendered rugby practice only (i.e. if the ground is too wide the ball-carrier will most often skirt around the defender, avoiding body contact; if the ground is to long it becomes hazardous to maintain cooperation over the field as it favors fast, strong children and an individualistic attitude in the game).

To sum up, the knowledge at stake in this task offers the students various tactical choices in relation with the context at hand, allowing diverse epistemic gender positioning and repositioning throughout the game. During its completion, great vigilance must be exercised by the teacher over time in order to attach equal value to all ways of performing, notably students' actions that increase cooperation in the team and not only a hand-to-hand struggle.

Observation of Didactical Transactions: The Case of Nina and Mathieu

In this section we describe the case of Nina and Mathieu during the 5th lesson of the unit, which illustrates how students, girls and boys, progressively undo gender over the unit. At the very start of the 1st lesson, Mathieu said loudly that 'rugby is for

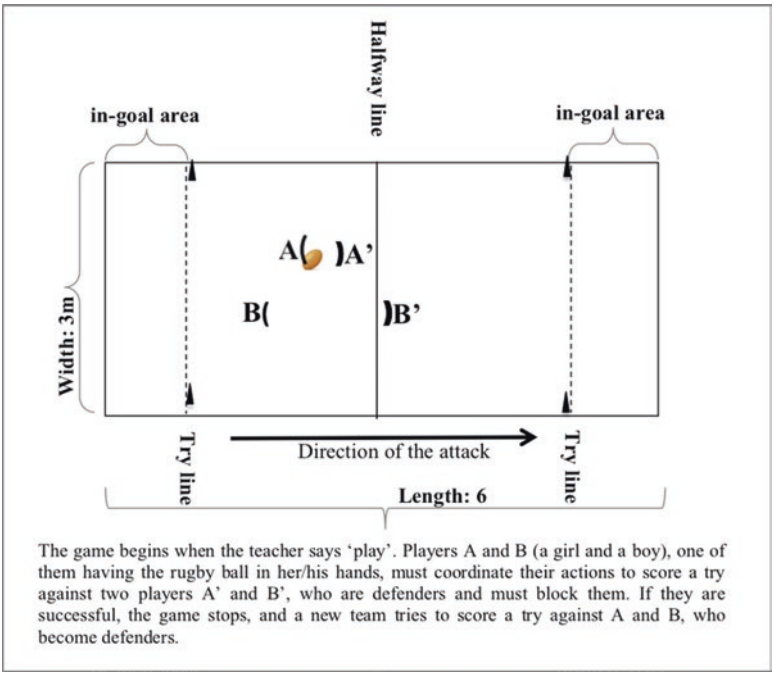


Fig. 10.2 Rugby 2vs2 play practice co-constructed by the teacher and the researcher

boys'. This gave the experienced female teacher the opportunity to bring forward a debate in the class on what sports are appropriate (or not) for girls and for boys: a first step to address sex-stereotyping! Thanks to children's inputs during the debate, the teacher concluded: 'Hey Mathieu: what we think is not always the reality!' and for the class: 'we will see at the end of the unit if Mathieu has made a mistake'.

During the 2*vs*2 play-practice, all children consistently engaged in the game. For example, the team of Nina and Mathieu scored a few tries. Nina initiated the first one, choosing to go with the ball and engage with the defenders. The video recordings of the previous lessons show that she did not do this at the beginning of the unit, where she privileged skirting around defenders to avoid bodily confrontation. In her successful effort, the two defenders came to her and attempted to capture the ball from her hands. Nina, surrounded by the defenders, turned her body backward and looked around to find the support of Mathieu. The boy was waiting for the ball behind Nina, at some distance from the defenders. Nina's strategic choice of carrying the ball close to the defenders gave her the opportunity to pass to her partner, who was free from opponents at this time. The pass was effective and Mathieu progressed forward. He concluded the collective action by scoring a try. In this attempt, the two students demonstrated great understanding of collective basic rules of rugby: fixing the defenders, making a backward-pass. After this attempt, and in line with the didactical strategy of the whole unit, the teacher called the four players to reflect on what happened. The teacher then summarized the relevant key-point of

their discussion for all the class: 'Thanks to Nina's choice of fixing the defense, Mathieu found an open space to carry the ball to the in-goal area'. Later, in another attempt, Nina was the one of the team who carried the ball into the in-goal, after a good backward pass from Mathieu.

All these actions and reflections did not appear suddenly. During the previous four lessons, the teaching had emphasized the tactical notion of how to collectively carry the ball forward without ever throwing or passing it forward. It also provided the children with learning experiences of performing the backward-pass skill. Moreover, during a video session, a debate was implemented within the class to focus students' attention on collective strategies rather than on individualistic actions.

This short extract exemplifies the interest of using multivalent tasks as a didactical tool to undo gender at school. There is no one best way or single approach! Learning environments (or didactic *milieux*) should offer several legitimated and equally recognized ways of achievement. This didactical strategy allows children to express their own epistemic gender positioning in the course of the collective actions. But, in itself, this condition is not sufficient to open new learning paths. A permanent focus on students' gender positioning and repositioning is also needed. This was another target of the collaboration during the research because such gender focus helps teachers, when monitoring students' actions, to manage the didactical uncertainty of the differential didactic contract: an additional condition to envision relevant evolution of students' practical epistemology, as exemplified by Nina and Mathieu.

This second research excerpt illustrates some didactical conditions under which collaborative research allows gender justice to be increased in terms of students' achievement and in terms of the teacher's didactical judgment:

- Over this PE unit, children (boys and girls together) progressively learned several things: (i) ambitious knowledge content related to how to play rugby tactically; (ii) new rugby experience breaking away from traditional teaching which, too often, pays tribute to masculinity; (iii) mutual gender respect including the sense of fair play through cooperation between students. All of this is in contrast with PE teaching that endorses benevolence towards girls and ostracism toward boys who are not clearly identified as acting according to their assigned sex (Larsson et al., 2009).
- Over the collaboration (co-construction of learning environments, post lesson debriefings, video co-analyses, etc.), this female teacher enhanced her teaching skills in rugby, a sport she had not taught much before. She gained a deeper cognizance of the logic of rugby that helped her to increasingly use more gender sensitive monitoring during didactical transactions. For example, as a co-author, she has reported that, over the course of collaborative research, she 'expanded vigilance about sex-stereotyping whenever it appeared in student discourse or, more implicitly, in PE practices' (Verscheure & Barale, 2017).

Conclusion: Gains of Addressing Gender at the Micro-Level of Didactical Transactions

The twofold purpose of this chapter was to draw attention to: (i) the subtle gendered didactic phenomena that, unbeknownst to anyone, are co-constructed in class through teacher and student transactions within a specific learning environment where stereotypical masculine and/or feminine forms of action can be valued (or not) by participants, and (ii) how a collaborative emancipatory research project can provide directions to increase gender justice and equity in PE.

Within the JAD Francophone theoretical framework, the research program on 'Gender and *Didactique'* highlights the specific forms of gendered embodiments, discourses, values and cultural experiences that undergird knowledge construction in everyday classroom life. It shows how all of these constitute a 'material force' (Taylor, 2013) at the roots of gender inequalities that are enacted through tacit and implicit transactions in relation to the gendered nature of the knowledge at stake. The specific contribution of this line of research is to feature the effects of didactical transactions on gendered learning and how it evolves differently (or not) between students.

The volleyball case demonstrates the subtle process at the base of the production of gender order in the classroom even when the teaching and the contents are not gender biased, as is traditionally the case in PE. In creating the concept of epistemic gender positioning, the program gave rise to an analytical tool that expressed how individuals engaged themselves in the situated teaching and learning processes with regard to the piece of knowledge at stake (Amade-Escot, 2019a; Verscheure, 2020a; Verscheure et al., 2020). This concept, which is very specific to the knowledge intended to be taught, and then really taught, provides new research perspectives to describe how gender order and its subsequent inequalities are enacted in the classroom but can also be defied. This research program, coherent with previous research, underscores that the teacher's experience and goodwill are not sufficient and suggests that a better understanding of the didactical phenomena at the core of doing/undoing gender in the class can open new directions to foster emancipatory projects.

Then the rugby case at elementary school comes to the fore, illustrating the didactical conditions a collaborative research design is able to implement in raising teachers' gender sensitivity and didactical judgment. It shows the extent to which learning environments – understood as the evolving dialectic genesis of a didactic milieu and a didactic contract monitored by a teacher – can envision undoing gender in the class without sacrificing the quality of the content.

In that sense, the 'Gender and *didactique'* research program supports the idea that gendered learning can be challenged even if it cannot be totally eradicated. Teaching and learning are not neutral processes and gender emancipation can be contested as it is bound up in power relations. That is why the collaborative didactical strategy adopted is to consider that gender justice in teaching and learning may remain something of a holy grail if the teacher's mediation is not strongly attentive

to power relations in the class, to the implicit hierarchy of the activities related to the knowledge at stake, and to the need for critical reflexivity during the exchanges between students. It also suggests that greater attention should be paid to teacher and students' joint action related to knowledge during classroom events and how the differential didactic contract is functioning.

In terms of research perspectives and with the purpose of addressing the issue of gender to meet educational and societal challenges, we believe that future research on subject didactics has to delve more deeply into: (i) the study of knowledge content and its gendered role in teaching and learning; (ii) the extent to which participants' epistemic gender positioning impacts learning and students' developmental processes; and (iii) the implementation of didactical conditions that support changes in teaching and learning. Important themes still waiting to be investigated!

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Chantal Amade-Escot is Professor of Educational Sciences at the University of Toulouse – Jean Jaurès, in France. Her research focuses on Didactics of physical education and Comparative didactics. She investigates the situated processes of teaching and learning subject-specific knowledge. This includes the studying of teacher and student(s) joint action in didactics (JAD theoretical framework) with a focus on gender and participants' practical epistemologies. Another of her interest lies in the studying of epistemological issues related to the conceptual constructions developed within subject didactics research. She is co-editor of the French journal *Education & Didactique* and member of the editorial board of *Gender and Education.*

Ingrid Verscheure is Professor of Educational Sciences at the University of Toulouse – Jean Jaurès, in France. She leads the scientific board of the multidisciplinary research center: UMR *Education, Formation, Travail, Savoirs* (http://efts.univ-tlse2.fr/). Her research interests focus on gender equality in education, and didactics of physical education. Her research, from pre-school to the end of compulsory school, draw on longitudinal participatory research with the purpose of facilitating changes in teaching and learning practices to increase justice among students. She is member of the scientific committee of the French-language journal *Genre Éducation Formation.*

Chapter 11
A Gender-Balanced Approach to Teaching Visual Literacy in the Czech Republic

Zuzana Svatošová and Marie Fulková

Introduction

This chapter illustrates the current philosophy behind the realm of art education didactics in the Czech Republic. It presents the contemporary direction of art education goals in a cultural-historical context. The following chapter emphasizes the development of *productive teaching culture* and possible educator approaches that help develop them in students. To understand the complexity of the educational process and the teacher's role, it seems more than appropriate to invariably think about it in the widest possible range of perspectives. We offer an overview in a historical, theoretical (poststructuralist), pedagogical (constructivist) and subject-specific didactic context. Our research has led to a notion that gender has become a useful theoretical construct that can help teachers to better comprehend their own didactic procedures and methods in order to effectively pursue educational goals that they set for their students. The model of a *gender-balanced approach* is a (visual) example of a theoretical scope and reflection on the teaching based on a discursive analysis of teachers' statements. Personal theoretical concepts of teaching then become part of the practice of teachers (Hooks, 1994; Fulková & Svatošová, 2021a) and thus the theoretical diversity of *subject-specific didactics* comes into developement.

Art education is often underestimated both in the public debate and in the educational policy internationally as well as in the Czech Republic (hereafter CR). The objectives of art education do not allow easy measurement of learning outcomes or mutual comparison of learning outcomes of individual students. Compared to other educational subjects, art education (hereafter AE) is considered by most people to

Z. Svatošová (✉) · M. Fulková
Department of Art Education, Faculty of Education, Charles University, Prague, Czech Republic
e-mail: zuzanasvatosova@seznam.cz

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be a fun and relaxing subject with no significant impact on the further personal and professional growth of individuals. Grades in art education have a different weight in society than grades in mathematics, languages and science subjects, such as geography, biology, physics etc. Experts in their profession, art teachers themselves often fail to explain the essence and goals of their discipline in a way that their colleagues, students, and the general public can understand. Research studies focusing on the educational process of art education CR show that teachers have tacit knowledge of the process even when the best teachers are unable to describe it efficiently in the context of educational goals (Šobáňová, 2011; Fišerová, 2015; Svatošová, 2017).

Although the subject focusing on art creation has been a part of the educational programs of Czech education almost from the beginning of compulsory school attendance, the name art education was not used until 1960. Around the same time, interest in children's artistic development was growing. (Kitzbergerová et al., 2019). In Czech, the term for Art Education is "výtvarná výchova." The word vý**tvar**ná/art has a common basis (root of word) with the word **tvar** /shape, to give a shape, to create and **tvoř**ivost/creativity. From the 1960s to 1989, AE was under the strong influence of late Modernism and also under strong communist ideological pressure (Šobáňová, 2019). The main educational goal of art education was systematic technical training in drawing and painting and the requirement to develop students' creative abilities (Curriculum AE, 1968 in Fišerová, 2015). The year 1989 brought the liberation of society, the expected democracy and with it the postmodern approach to challenging old truths and universal aesthetic ideals. The current goal of art education is not only to strive to create aesthetically and technically correct works, but to teach students, using the specifics of the art field, to be active participants in this dynamic and experimental process. Thus, the aim of art education as stipulated by the valid curriculum of the General Educational Program for Basic Education[1] is to actively facilitate collaborative creativity of students, to take into account their own interest, to use visually pictorial means, to develop their sensory perception, to release their imagination and to expand their communication skills.

Despite these modern approaches used in theory and policy, the term creativity is still often associated with historicising romantic notions of man's natural creative power, the ability of self-expression, or the notion of a brilliant artist (mostly male) as a creative individual in CR. In a pedagogical context, this term is associated only with child-oriented pedagogical approaches, in which students spontaneously express their emotions through artistic means and become artists themselves. However, the current didactic theory of AE offers ´visual literacy´ as a new substitute term (Kitzbergerová et al., 2019). This term refers to a complex, culturally situated skill allowing for unrestricted study and creation of visual images. This skill is developed by specific tasks that are not structured, scaffolded or escalated from simple to complex, but rather throw the students into a problematic situation where they are forced to solve it themselves. By its essence, Art Education is

[1] Rámcový vzdělávací program pro základní vzdělávání [Framework educational program for basic education] (2017) [online]. Prague: Ministry of Education, Youth and Sports. Available from: http://www.nuv.cz/uploads/RVP_ZV_2017.pdf

problem-based education working with problems of the visual world, where the students have to orient themselves to the problem, imagine various solutions, be selective and try to create possible solutions. The productive process itself brings several other problems that students then have to reflect on and solve. Although the current Czech curriculum develops literacy terminology in many areas (reading, language, mathematics, science, social and media literacy), visual literacy is absent. The new concept of the educational goal of visual literacy has been included in the undergraduate training of future teachers for two decades, but research on school practice shows that the concept is absent while focus on the evaluation of the final aesthetic product persists. In the space of theory and practice of art education, this presents a certain contradiction, which is based on the paradigmatic transformation of the theoretical background of contemporary didactics and its difficult introduction into the practice of teaching. Moree (2020) describes the current Czech school culture as transitional, because it still contains the signs and ideals of the old socialist and at the same time the new democratic culture. In many participants in the education system, some attitudes of the previous regime persist and are difficult to change. The task of the current Czech theory of AE didactics is to create ways or tools that will make it easier for teachers to understand the current curriculum and use more liberal postmodern didactic approaches. Our study is one such attempt to create a helpful tool based on the metaphor of gender differentiation of teaching approaches deeply rooted in our culture as *dominant fiction* (Silverman, 1996). However, with the help of specific postmodern theories, we give the metaphors new meanings that will help teachers to move to more open ways of teaching.

Conceptual Background

Post-structuralism

The theoretical framework of our thinking is formed by post-structural approaches that appreciate openness and uncertainty. These approaches include issues of gender, culture, visual and psychoanalytic studies, all of which undermine established cultural values and force people to establish their own attitude to these values or to create new values. These theoretical perspectives cast doubt on fixed human identity and analyse the processes by which identity is constructed. The human subject and its identity is, from a post-structural perspective, the result of discursive practices (Foucault, 1972). The human as a subject is rather an ideal or social norm that shapes us through discursive practices. However, we as human beings are more than closed human subjects. The terms of subjectivity imply this opening up of the subject to the process of becoming a subject, or also revealing its other hidden layers of non-identity. These hidden horizons of human subjectivity are dealt with in psychoanalytic studies. Jean Lacan's subjectivity theory seems appropriate for our

purposes because it combines Freud's theory of mind (Freud et al., 1974) with linguistics (de Saussure, 1995) and semiotics theory (Peirce, 1958).

Lacan (2016) distinguishes three spaces of subjectivity that are closely intertwined. Although these spaces gradually establish themselves in a person (in a child), they all exist in the finished subject at the same time and do not disappear anywhere, even if we are unaware of them. Lacan called the first psychic space *real*. *Real* (le réel) is an unidentified state of fullness that we experience in our development as indistinguishable from the mother's body. The term *real* refers to what is unrepresentable and unimaginable. *Real* is something we, as cultural individuals possessing a tool of symbolisation - speech, do not have access to. *Real* is the original "zero" (Mitchell, 1974). This zero is gradually being displaced from the developmental point of view. The mother's body is not always at our disposal and we experience a feeling of lack and a desire for original indistinguishability. We will gradually learn to replace this desire for original indistinguishability with at least an image. This replacement is, according to Lacan, the second region he calls *imaginary*. However, image is not a satisfactory replacement over time. The child needs to replace its desire with something more enduring and certain - a symbol that makes the child able to delay its satisfaction for later. The *symbolic* is what Lacan considers the symbolisation of the third region of subjectivity. By acquiring this ability, a human subject able to mark itself as *myself* and others as *others* is established.

Lacan's theory of gender subjectivity is important for our study. According to Fulka (2002), Lacan defines masculinity and femininity based on how they relate to the *symbolic* order. Subjects with a masculine psychic structure are those that have closed themselves into a *symbolic* region in their development. They are separated from the other two regions, the *real* and the *imaginary*, but they are left with the desire for them (the desire for symbiotic unity with the mother). They can fulfill this desire only in the *symbolic* form of pleasure. This desire is never satisfactory and only flashes momentarily, but the masculine subject can only relate it to the objects of the *symbolic* world. Satisfaction is continually postponed by creating other possible ways/means by further symbolic fulfillment (in the form of ownership, consumerism of things and experience, the exercise of one's own power, the multiplication of knowledge, etc.). Subjects with a feminine psychic structure are not entirely subordinate to the symbolic region and have the ability to cross the boundaries established by the language and transcend into an area outside the language and signifying mode (creating signs). The feminine structure is specific in its relation to something that is radically different – *Other*- to the symbolic order, and must remain unchanged. This *Other* is located in the *real* region. Thus feminine desire is an expression of "extra something" in contrast to a masculine desire that is an expression of lack (Fulka, 2002, p. 36–37).

Pedagogical Constructivism

Another framework of our research is the theory of the educational process. We study and develop the theory of educational constructivism, which is important to us in its radical (individual) and postmodern social form. We complement the autopoietic system of self-formation (Maturana & Varela, 1991, Piaget, 1972) and its didactic aspects, focusing on individual knowledge construction with a socio-interactionist perspective (Vygotsky, 1986; Soukupová, 2012; Vygotsky & Průcha, 2017), showing us that everything *human* is introduced to us from the outside world based on common interactions. Learning is seen as a socio-cultural process of creating (linguistic) meanings, as a process in which the socio-cultural environment plays an essential role. There is no doubt that educational institutions are an immanent, important and effective part of this environment. From a social-constructivist point of view, their primary role is to reproduce those cultural patterns and common myths that help maintain social cohesion and conformity. However, school does not transmit these patterns through official educational content but rather in its way of functioning, in its form that expresses and fulfils the communal symbolic meaning of the term school. The socially required forms of behaviour are purposefully integrated into the internal life of the school institution in the form of diverse habits, internal rules, myths and ideas of how it should work, function, and how it should be organised. Basic behaviours ensuring social cohesion are not part of official education programs and documents; they are not explicitly defined and therefore are not part of the process of intentional delivery of knowledge and experience. Therefore, the traditional content analysis of the educational process did not reflect it either. Content analysis of the transferred curriculum is completely insufficient to understand the hidden learning process (Kaščák, 2002). Theorists and researchers are becoming interested in these unintentional, unintended formative consequences of educational interactions. These consequences are the subject of the interests of contemporary Czech didactic theorists (Janík, 2013; Kitzbergerová et al., 2019) who necessarily deal with the current preparation of the new Czech curriculum.[2] Although the curriculum was very progressively set up against an earlier rigid and transmissive curriculum, based on ideological principles, it did not bring the expected progress of teaching outcomes. According to Janík (2013), all curricular changes were only formal and did not manifest themselves in the form of the educational process itself. As Fig. 11.1 illustrates, Janík and Reusser propose to complement the classical didactic triangle with the cultural dimension of the relation between its individual elements – teacher, student and curriculum. According to Janík, the productive culture of teaching and learning is, in contrast to the classical receptive culture, mainly given by: challenging and motivating learning tasks, cognitive activation of students, constructive work with errors, cumulative learning processes, transfer of knowledge, developing students' metacognition, etc. (Janík, 2013, p. 657).

[2] The Czech curriculum that was established in 2004 is currently being revised.

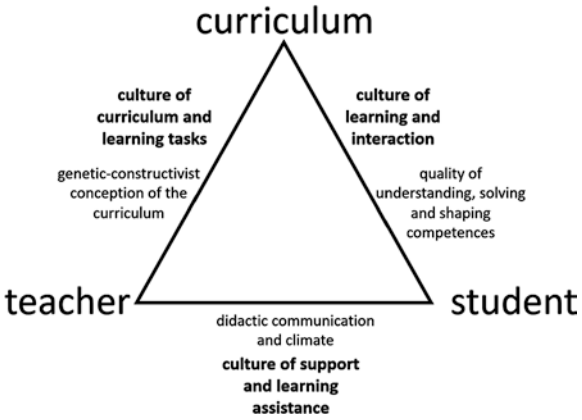

Fig. 11.1 Articulation of constructivist culture of teaching and learning (Reusser in Janik, 2013, p. 655). (The English translation was done by the authors of this chapter)

Janík (2013) recommends that the state curriculum should be conceived as a framework defining space for the implementation of efforts to promote a productive learning culture. According to him, it is necessary to accurately define general and specific objectives for individual educational areas and disciplines. Basic education should be aimed at providing and consolidating basic knowledge and skills that can be included under the term literacy in the sense of the German term 'Grundbildung', an educational basis referring to the ability to participate in certain areas (fields) of human activities at all.

Visual Literacy

The term visual literacy is essential for art education (Freedmann, 2019; Fulková, 2002, 2008, 2019; Fulková et al., 2009; Přikrylová, 2010; Raney, 1999; Wagner & Schönau, 2016; Vermeersch et al., 2019; Zálešák & Vančát, 2009). This term has functional character and resonates with the Unesco definition of a functionally literate person who can be involved in all activities where literacy is required for effective functioning in his or her group and community while also enabling him/her to continue reading, writing and counting for their own and community development (in Rabušicová, 2002). Visual literacy defines the collection of skills required for free dealing with visual images/pictures/signs. There are more definitions of visual literacy, but we will focus on the definition developed by Raney (1999) based on different modalities of overall approaches or skills.

The skills are the following:

1. Perceptive sensitivity – the ability to distinguish and to see or feel a difference.
2. Orientation in visual culture – the ability to communicate visually, think critically, and recognize differences and connections.
3. Openness – the ability to perceive and accept new incentives, relations, processes and otherness.
4. Visual expressivity/convincingness –the ability to express decisions, emotions, experiences and perceptions.

The term visual literacy by Raney (1999) goes beyond symbolic discourses and can therefore be accepted as a well-defined current goal of art education. It overlaps with Lacan's (2016) *imaginary* space that presupposes encountering the *real* and is related to the state of insecurity. Unfortunately, this objective does not correspond to the political requirement of measurability and verifiability of educational objectives. However, the objectives have a non-normative function to verify learning outcomes. In particular, these objectives have a directed function. Thus, it is not clear whether students achieve the desired and ideal outcome or are making progress towards the goal. It is not realistic that all students will achieve the highest benchmark and be equally visually literate. We are aware that not everyone is likely to become artists, although we as teachers would aspire for it and strive for it by all possible methods.

Raney (1999) distinguishes two models of visual literacy – autonomous and ideological. An autonomous model is made up of a set of certain skills that, through correct analysis, will reveal the hidden structure of meaning. The ideological model speaks of visual literacy in the plural as *literacies*, which are kinds of social practices more than an autonomous system of skills. This model thinks of reading, writing and speaking as acts linked to the institutions and social structures in which they are taught. It is essential to be aware of the reasons we should want to read, write and speak in concrete situations and what values and meanings we believe are behind this desire. We use language differently based on different domains or roles, and the meaning of a word depends on the context of its use. Different *literacies* can be linked to the goals of certain institutions such as advertising, art or religion. This model does not deny technical or cognitive aspects of language; it contains them. It seeks an understanding of how these aspects are embedded in cultures and activated in the structures of power. The meaning here is open, fluid, unstable, ambiguous, and still in formation.

Art education becomes a subcategory of visual education and art becomes a subcategory of visual culture. Visual literacy is what needs to be developed around this. Visual literacy suggests that viewing is active and needs time. Objects and images need to be created as well as understood and analysed.

We agree with Raney (1999), that

> in Western culture, vision is associated with reason, logic, knowledge and control, on the one hand, and on the other hand with the mobilisation of fantasies, primitive desires and unconscious forces beyond our control. Thus the visual representation has a double identity: it is both rational and amenable to analysis, irrational and resistant to analysis. Images and objects are both words and like holy relics. One face or the other may be emphasised at any time, depending on what is perceived to be at stake. Art and design education needs to acknowledge and to celebrate these two faces of the visuals - or rather the two faces of our interaction with the visual world: the ordered, deliberate and systematic and the chaotic, instinctive and unpredictable. The tension between them is the basis of creativity. (pp. 46–47)

Study Design

The study is based on previous quantitative research (Svatošová, 2017) reflecting the topic of gender stereotypes in assigned creative tasks. This research showed that gender issues are often present in teaching, but not always explicitly in tasks. When

the question was asked: “Do you include the topic of gender stereotypes in teaching?”, more than half of the participating teachers (116 out of 220) replied, “Maybe so.” The uncertain responses intrigued us and we wanted to analyse them more in-depth by asking how they teach this topic. Thus, the present study reports from qualitative interviews with teachers‘perspectives on AE.

Participants

This study includes data collected from ten teachers from general schools teaching art education to students aged 12–15. All participants were women.[3] Except for one who was just finishing her studies, they were all qualified teachers in AE. Their teaching experience ranged from 1 to 20 years. All of them participated in the previous questionnaire survey and had a personal interest in participating in an in-depth research interview.

Data Collection

All interviews took place in 2016–2017. Although the central topic of the interview was gender issues as the theme of a creative task, respondents were also asked more general questions about their teaching practice. For this reason, a semi-structured type of interview was used, with several open questions, which were further developed through a joint dialogue between the researcher and the respondent. In an interview, we were looking for answers to the following main questions: How do you bring the topic of gender issues into art lessons? What is the core of the content of the discussed topic? What are the subtopics? What didactic methods and art techniques do you use for that? What do you consider to be the goal of teaching this topic? Are pupils critically and creatively reflecting on gender issues? Could you describe your personal concept of art education? What does gender personally mean to you? Each interview took 60–150 min to complete. All the interviews were digitally recorded and transcribed into text files by one of the researchers.

[3] Unfortunately, we were unable to involve any man in the research. However, male teachers are still in the minority in the Czech education system.

Analysis

More than 150 pages of interview transcripts were analysed by the grounded theory method (Charmaz in Smith, 2015). We used the qualitative data analysis software MAXQDA. First, the data were coded line by line; focused coding was applied for more significant or frequent codes, and conceptual categories were established. We identified the relationships between established categories and divided them into two different sets of meaning. Based on the analysis of the relationships between the concept categories, we created a map that shows the implicit space of the educational process. Significant theoretical teaching approaches were drawn into the map. However, these theoretical concepts are used by teachers in the real education process rather as manoeuvring tactics to guide them to the expected educational goal.

Results and Interpretation

As mentioned above, our research was based on the finding that teachers unconsciously perform gender roles in their teaching. Although the interviews were explicitly more focused on teachers'work on gender issues, the most interesting data came from parts of the interview relating with the general concept of teaching. Teachers described their concept of teaching art education in broad terms with various levels of details. They spoke about their personal experiences, their own families, specific students and their socio-cultural background and current problems; student cohorts and dynamics of relationships among students, other cohorts and other teachers; and, of course, concrete teaching experiences. Teachers mentioned a wide range of definitions of general and partial educational objectives and teaching methods they have applied in their educational intentions.

Specific Conditions

In their statements, teachers pointed to specific conditions that did not allow them to accelerate the creative process in the student's learning. The creative process is often associated with a feeling of joy and well-being, which they did not find in pupils. They often described the process as being terminated, lacking continuity, and that they had to react sensitively to it.

Excerpt 11.1

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But you know, art education is about being relaxed…and
when I get the cohort in sixth grade I have a lot of
trouble with them.
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The teacher comments (Excerpt 11.1) are based on the situation after she taught sixth-grade students (first year at the secondary school) and they are not used to a

free creative process and self-expression methods. The teacher experienced the situation very strenuously, as she had to fundamentally change their attitude towards their creation. Students have not acquired any creative habits and are not used to dealing with basic artistic means (drawing, painting, 3D work/spatial creation). They want to know exactly what visual result the teacher expects of them and they do not feel comfortable when the teacher gives them the responsibility for the result of their creative process.

Teachers perceive the educational space of art education as inseparable from the rest of the world, and with their attitude, they have to react and adapt to the current situation. Teachers do not perceive the creative process of students as a natural part of the teaching process. They are well aware that it cannot be enforced, but only create specific conditions for it, and they perceive this as their role as a teacher (Excerpt 11.2).

Excerpt 11.2

RESPONDENT: Art education can never be evaluated very strictly, so… I give a big A (grade), slightly smaller A, and B when they are not working. That's when they sabotage it. These are the lessons, yes, and the types of students I already know. A bad day! E from a maths paper, E from a english and at that moment there is no mood for creating art and as if I'm just scribbling something … So, we have an agreement, if it's not the rule, so there are adepts where I let them be. And how many times does it happen that they start to create something themselves…

Teachers choose specific methods according to the solved problems and also according to the current climate in the classroom. On the one hand, the class climate is most often influenced by fatigue, demotivation, an overload of stimuli from other subjects, disputes between pupils or pupils' personal problems, but on the contrary, joyful expectations, attunement and openness were also experienced.

In the following example (Excerpt 11.3), it is evident how the teacher describes her decision-making for teaching methods that she adapts to the class climate.

Excerpt 11.3

INTERVIEWER: Given your experience when you know what you didn't enjoy or what didn't work, how would you ideally teach?...

RESPONDENT: Well, it works when you have kids that are perceptive. And then it's a real pleasure when the reflection works out, when it's reciprocal and you see that…so I think that totally giving up, that's also kind of stupid. …..You sort of often need to direct it based on the dynamics in the group and sometimes you do need to almost let it go…

The teacher is aware that the success of her pedagogical activities depends on certain conditions that she herself cannot fully influence. Students come to the lesson in a certain setting, which is not always ideal for developing the creative process. Students often come to the class tired, oversaturated with knowledge from other educational subjects, and lack sufficient time and space to rest and refresh the mental strength necessary for creation. The teacher must respond to these student expressions and adapt the teaching.

Respondents often question the conditions of teaching and adherence to general educational principles in their answers. They are often in a situation where their teaching intervention, the assignment of the task, are in conflict with some principles (for example: taking into account the educational needs of the individual – mutual respect, solidarity and dignity of all participants in education). This contradiction does not allow them to enable active participation in the creative process.

Specific Approaches

The teacher also describes two specific approaches that she likes to combine. And she describes her ideal of teaching in a pair – a man and a woman as a teacher (Excerpt 11.4).

Excerpt 11.4

RESPONDENT: In this sense, I may be on both sides, I like the social group things, and I provided support to cohorts with social therapists, and I also brought in art and art therapy, so that's something I enjoy. Actually, it would be ideal to co-teach in pairs, that would be great. And what's really great is when the pair is a man and a woman. That's really great.

This functional difference in the educational approach was so important in the analysis that it became essential for our research. A man and woman, as representatives of a specific way of acting, have become the starting point for our findings. In relation to our post-structural background, we consider these representations only as signs that lead us to perceive a certain way of acting regardless of the identity of specific individuals. Each person, male or female, may combine feminine or masculine forms of action based on the perpetual situation and conscious or unconscious intention.

Our interpretation of coded data takes the form of a spatial map. Concept clusters are formed by the participants' own words which were obtained by in-vivo coding of the transcripts (Fig. 11.2). This is the space in which the creative process takes place. This process is marked in space by a double- curved vertical curve. The curve indicates movement in space, which is divided by circles into two spaces (imaginary and symbolic in Lacanian sense) and educational approaches (feminine and

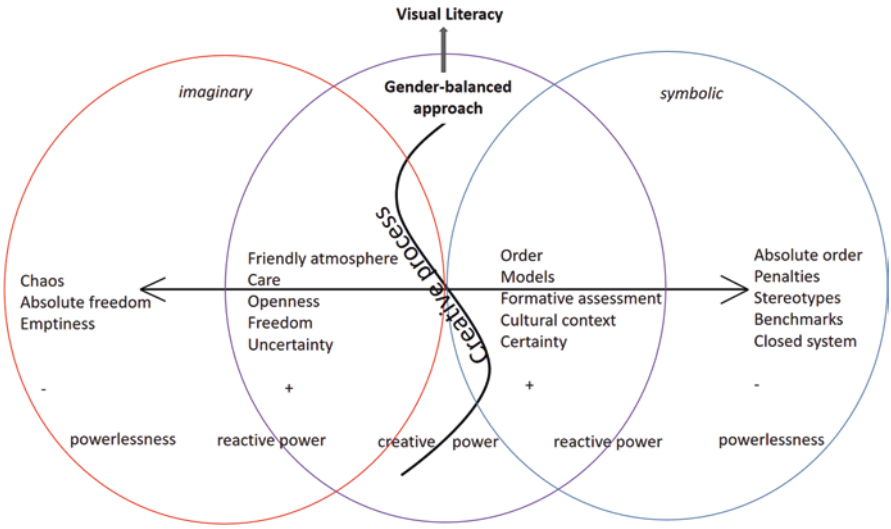

Fig. 11.2 Visual interpretation of gender-balanced approach to teaching visual literacy

masculine), which support and develop these spaces of creative process. This process can arise in art education only when the teacher supports both differentiated spaces, so that they are in a dynamic balance. The horizontal line that intersects the curve of the creative process in the center indicates a differentiating scale. This scale radicalises its approach away from its center. The more we move from the center to the pole on the horizontal axis, the more dominated the feminine or masculine approach becomes. A polarized approach never leads to a creative process. It needs a gentle movement around the center, which is marked in the creative, a gender-balanced, approach area on the map.

The interview below (Excerpt 11.5) shows the negative connotation of the masculine approach in its polarized form. The teacher complains that the teaching of the previous teacher was too closed to a predetermined form of the expected outcome of art.

Excerpt 11.5

RESPONDENT: When I start from the very beginning, in preschool they paint and they paint however they can. Then they come to first grade and that's where it stops and the teacher starts pulling out the templates.

INTERVIEWER: And tells them how to do it.

RESPONDENT:Exactly….you take the pen and move it in this direction so that all the carp are green and as soon as there is a boy or a girl who has a blue carp, or a pink or red one….whatever else, then it's a problem and she gets an F for the task because she doesn't have the same thing as everyone else.

The analysis of the masculine approach has brought several general categories that define it. Positive masculine categories that develop the creative process include: Order, Models, Certainty, Formative assessment, Cultural context. Negative, polarized categories of the masculine approach include: Absolute order, Penalties, Stereotypes, Benchmarks, Closed system.

The stronger the masculine approach is, the less the student's creative power is. Rather than creating, the student responds to the teacher's authority, which can lead to complete demotivation and powerlessness.

According to Lacan (2016), the feminine approach is specific in that it is not completely enclosed in a *symbolic* order. Rather, it is open to a new, unknown *imaginary* space and a radically different Other in touch with *real* space.

The analysis of the feminine approach has brought several general categories that define it. Positive feminine categories that develop the creative process include: Friendly atmosphere, Care, Openness, Freedom, Uncertainty. Negative, polarized categories of the feminine approach include: Chaos, Absolute freedom, Emptiness, which can lead the student to lose active power and move into powerlessness.

In the following example (Excerpt 11.6), the teacher describes her experience when she wanted to give the students as much freedom as possible and found that it did not work.

Excerpt 11.6

RESPONDENT:…I was thinking about that recently. Look, I think I would have learned a lesson from that year and a half and I would be a little different now. I was trying to give freedom to my students. But since I was teaching for the first time, I didn't really know whether to fight against the system or accept it. So it was a compromise after all. Sometimes I gave them complete freedom, which did not seem to work. They were little confused …

As a gender-balanced approach, developing a creative process is described by teachers as a combination of both, masculine and feminine, approaches. The students need to receive some of the freedom and support to accept uncertainty and at the same time insight into the already existing symbolic culture, with order and rules, models and certainty.

Excerpt 11.7

RESPONDENT: I always think back to Mrs. XY who used to say: kids are precious material and I won't let it go spoilt for them. And often think that when the kids can't catch on, maybe it's your fault. Maybe you don't explain things in the right way. You know it, but they may not be able to transfer it into their minds. So these are some things, not to interfere with their artwork under any circumstances because you will mess it up for them, if they don't want it that way, they will stop working.

And that's true. Because as soon as I, for instance ask "Can I?" And they would reply: "just tell me how." Or they would say: "sure, show me how to do it". So I usually take a separate paper and mix colors separately to demonstrate that they can, or I sketch it out to show something they could understand and think whether something can be done or can't be done differently.

The example below (Excerpt 11.7) demonstrates the experience of a teacher who knows that the strategy is needed. The teacher carefully offers model support that develops students' visual and symbolic communication skills. At the same time, she respects the autonomy and openness of her students' creative processes.

Discussion and Conclusion

From Lacan's (in Fulka, 2002) point of view, the creative process that is a pleasure and that can create something really new needs *something extra* that we find in an imaginary space. The emergence and development of the creative process is dependent on specific conditions, and it can only arise when the individual's creative power is in excess. As the main hurdles of this process, teachers perceive students' oversaturation with the *symbolic* impulses they don't engage in a problem-solving way. As a result, the students come to the art education lesson fatigued and demotivated. Teachers have no choice but to give them a place to relax and regain energy. However, lessons are too short to revitalise them and to trigger their creative process. To non-participating observers, art education may then seem as a relaxing/fun subject without higher educational goals (Fulková & Svatošová, 2021b).

The results of our survey point to an unbalanced setting of the conditions of the educational process, for which a specific school climate is essential. Art teachers can use innovative educational methods and interesting topics. However, they do not do so for various reasons. Art educators are often not sufficiently trained and they tend to work according to their own childhood experiences, as they were taught at the time. A selection of teachers were often educated under the previous socialist regime and find it difficult to adopt new practices and paradigms in AE. Some of the teachers do not feel that they receive sufficient support from colleagues and school management. The socialist regime was built on a clearly defined educational goal of an ideal socialist citizen, learned to live according to the totalitarian social principles of absolute order and power authority using the means of penalties, benchmarks, and supported ideological stereotypes. These principles do not support a *productive learning culture*, which, according to Janík (2013), is still mostly missing in our educational system. We find it beneficial to distinguish between the above teaching approaches without stereotypical identity connotations. The characteristics of the *gender-balanced approach* can help teachers to reflect on their teaching practice and better teaching culture in the classroom. Based on our study we think that

teachers can intentionally use all approaches (feminine, masculine and gender-balanced) according to the situation, so that learning is generally balanced and productive.

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Zuzana Svatošová is Ph.D. student and lecturer in the Department of Art Education, at Charles University in Prague, Czech Republic. Her research focuses on exploring the intersection between educational and cultural studies discourses especially on the application of poststructuralist theories in the didactics of art education. She is also interested in the definition of visual literacy and its development through contemporary art. In addition to the theoretical research, she deals with clothing design and textile art.

Marie Fulková is Associate Professor and Deputy Head of the Department of Art Education, at Charles University in Prague, Czech Republic. Her research focuses on exploring ways in which the cultural artefacts function as a polysemy across different social domains. Her activities cover visual literacy and modalities of perception of visual arts in children and youths, transpositions between artistic, cultural and pedagogical domains and creative interactions between education and visual arts.

Chapter 12
Didactic Transposition and Learning Game Design. Towards a *Ludicization* Model for School Visits in Museums

Catherine Bonnat, Eric Sanchez, Elsa Paukovics, and Nicolas Kramar

Introduction

These last decades, the integration of digital technologies in educational contexts has opened a wide field of research, particularly for the design of digital learning games. Indeed, game-based learning is becoming more and more popular. In addition, it is considered to offer interesting perspectives to foster students' engagement. However, due to the complexity of these educational resources, the design of such games is a challenge. Indeed, the design of learning games is not limited to adding "game elements" such as rewards or leaderboards to a traditional learning situation as suggested by the term "gamification". This is a matter of contextualizing knowledge in a playful learning game.

Knowledge contextualization consists of linking abstract concepts with problems that make sense for learners. For the design of learning games, knowledge contextualization takes the form *ludicization* (Genvo, 2013; Sanchez er al., 2015), which consists of the integration of a specific learning content into a game so that it provides an epistemic dimension to playing and enables students to develop their knowledge from the gaming experience.

This chapter elaborates on contextualization of knowledge and a model of *ludicization* as an alternative to the didactic transposition framework (Chevallard, 1985/1991), by considering the game-based learning context. This generic model aims at describing the processing of the scholarly knowledge to make it suitable for its use as learning objects within a game-based learning situation. According to this model, the contextualization of knowledge into a specific learning situation consists

C. Bonnat (✉) · E. Sanchez · E. Paukovics
LIP/TECFA Université de Genève, Genève, Switzerland
e-mail: Catherine.bonnat@unige.ch

N. Kramar
Musée de la Nature, Sion, Switzerland

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of its metaphorization, i.e. building a metaphor of the knowledge to be learnt by capturing the essence of the knowledge to be taught. Indeed, according to the interactional theories, metaphor is an instrument of knowledge. This instrument allows for the projection of a better-known conceptual domain (the source domains) onto a lesser-known conceptual domain (the target domain), this movement being from the more concrete to the more abstract (Botet, 2008).

This model is discussed from the lessons that we have learned for the design of *Geome,* a game dedicated to the *ludicization* of school visits in a natural history museum (Canton of Wallis, Switzerland). The museum aims at educating visitors about the many impacts of the Anthropocene Era, one of the main and complex challenges faced by mankind in the twenty-first century. Regarding this specific context *i.e,* the use of a game in a museum school visit and the complexity of the Anthropocene concept, we discuss the process dedicated to the contextualization of the knowledge to be learned.

We first describe the museum and Anthropocene as a specific learning context, the rationales for the contextualization of knowledge and the design of a learning experience. In the second part of this chapter, we present the didactic transposition framework and the *ludicization* model as an alternative to the knowledge contextualization. The third part is dedicated to the presentation of the methodology of this empirical work. The model is discussed in the fourth part based on lessons learned during the design of the game.

Research Context

We first present the Anthropocene as multidisciplinary, complex and controversial. These characteristics require the design of contextualized learning situations. In the second part, we support this approach by presenting a short state of the art on knowledge contextualization for science education.

Anthropocene, a New Complex Problem

Coined in the early 2000s by Nobel Prize winner Paul Crutzen, the Anthropocene concept refers to a new geological epoch characterized by the massive and lasting impact of human activities on the Earth (Crutzen & Stoermer, 2000). Since 2009, a working group has been trying to define the Anthropocene as a new subdivision of the geological time scale, in which humanity has become the main driven geological force on a planetary scale.

The Earth system parameters have undergone an unprecedented evolution since 1950, during a period called the “Great Acceleration” (McNeill & Engelke, 2016) which shows a correlation between the human activities growth and their impacts on the environment. A consensus on a stratigraphic marker (the use of radioactive

isotopes associated with nuclear testing in the mid-twentieth century) has been found (Subramanian, 2019). While the Anthropocene, as a new subdivision of the geological time scale, is still under debate and has not yet stabilized stratigraphically, there is a consensus on the reality of anthropogenic impacts on a global scale.

Anthropocene study requires a systemic vision involving natural sciences and humanities in order to understand the complex interactions between mankind and its environment. It provides a framework for multidisciplinary approaches dedicated to addressing the ongoing global environmental changes. It invites us to rethink this classic opposition between nature and society, or nature and culture. In addition, Anthropocene is a complex concept due to the interrelation and the multiplicity of the needed knowledge to deal with current issues. Its recent and unstable nature, due to a gap among researchers' views, makes it a particular scientific concept that is evolving with new research contributions. These features raise the question of the current science status of scientific knowledge, which has long been considered by the general public as strong, stable, thus denying any possibility of debate. Moreover, the understanding of the Anthropocene depends on the cultural history of societies and culturally embedded ways of thinking should also be considered. Those dimensions give the Anthropocene a high level of abstraction that raises the question of its understanding by young learners. Thus, teaching Anthropocene is a significant educational stake, which challenges science education. These features make this concept a good candidate to address knowledge contextualization.

Knowledge Contextualization

Contextualization of knowledge emerged from the idea of "inert knowledge" (Whitehead, 1929) disconnected from the real world. Contextualization of knowledge is still addressed by many studies because it raises educational issues at different levels (school, class, learner). For example, taking into account students' engagement and motivation has contributed to the evolution of the school status in our societies (Mouraz et al., 2012) and to the way education is provided. This issue is extremely important for science education within a context of loss of interest and popularity over the last few decades.

Contextualization of knowledge has been studied according to different but complementary approaches. Studies have shown that knowledge contextualization enables students to link well-stabilised scientific concepts to address real-world problems (Bulte et al., 2006; Gilbert, 2006). This idea is based on the students' need to make sense of scholastic content for its use, out of school (Giamellaro, 2014). Nikitina (2006) goes further by writing that "learning becomes personally meaningful and highly motivated by a desire to resolve an important social concern" (p. 266). Knowledge contextualization changes the students' perception of science (King & Ritchie, 2012) and enables for a longer integration of the scientific content (Giamellaro, 2014).

Knowledge contextualization is also a strategy dedicated to teach how to deal with multidisciplinary issues. According to Nikitina (2006) it allows to use disciplinary "tools and methods with precision and rigor rather than in a generalized and abstractly way" (p. 266). According to these authors, knowledge contextualization consists of giving meaning to scientific knowledge by linking abstract concepts with real life problems. Knowledge contextualization also means integrating the knowledge to be learned into a meaningful learning context, that is a set of elements with which a student interacts, and in which a specific content can be relevantly applied for problem solving.

Our approach of the contextualization of knowledge consists of designing a game-based school visit in a museum enabling the students to interact with a mixed environment (tangible and digital). Studies have shown the relevance of such a context for the involvement of school visitors in problem solving (Bakken & Pierroux, 2015). The implementation of collaborative quests (Klopfer et al., 2005) reinforces participants' feeling of having contributed significantly to problem solving. More specifically in science museums, the integration of a playful dimension helps to develop student engagement compared to a visit led by a mediator. Nevertheless, this approach of knowledge contextualization raises issues and is still being debated, because learners rarely discover the content to be learnt entirely on their own (Giamellaro, 2014). The design of such a learning situation consists of a specific transformation of the targeted knowledge for its integration into specific tasks. The didactic transposition of knowledge framework offers different tools for understanding this process.

Theoretical Framework and Research Questions

We first present the didactic transposition framework as a model dedicated to conceptualizing knowledge contextualization and we discuss its limitations regarding the context of a game-based school visit about Anthropocene in a museum. Based on these limitations, we present an alternative model integrating *ludicization*.

Didactic Transposition and Its Evolution in an Informal Educational Context

The didactic transposition framework (Chevallard, 1985/1991) has been displayed outside the French-speaking community, and applied for the teaching of many disciplines. This framework emerged from sociological studies (Verret, 1975) and the need to understand what is being taught at school. Indeed, knowledge is produced out of any social need for education and dissemination and later on, transposed into the school context. As a result, "knowledge has to be selected, delimited,

reorganized, and redefined until reaching the classroom" (Bosch & Gascón, 2006, p. 55). The didactic transposition results from the transfer of knowledge from one institution to another and describes a process of "de-construction and rebuilding of the different elements of the knowledge, with the aim of making it teachable" (Bosch & Gascón, 2006, p. 53). This process includes two main steps, with multiple actors and temporalities. The first step (external transposition) describes how the *scholarly knowledge* (produced by scientific institutions) becomes knowledge *to be taught* (school curriculum, textbook, prescriptions, etc.). Selection, delimitation, reorganization and redefinition are legitimized by the noosphere (Chevallard, 1985/1991), a community which could include politicians, researchers and managers of the teaching system. External transposition highlights the conditions and constraints under which the knowledge to be taught is constituted and evolves (or remains fixed) among time. The second step named, internal transposition, is under the responsibility of the teacher who contextualizes the knowledge to be taught into learning situations. Then, the knowledge *to be taught* becomes *taught knowledge*. This process depends on the constraints faced by the teacher such as time, students' age, available resources, etc.

The use of a museum as informal context might play a specific influence on the didactic transposition. Indeed, the *museographic transposition* concept describes the adaptations of a scientific discourse to an outreach discourse ('knowledge taught') in museum exhibitions (Simonneaux & Jacobi, 1997). The term "museography" refers to the form of visual representation specific to the museum which results from this transposition. Different models have been proposed for this process (Mortensen, 2010) and the more complex one includes epistemological, sociological and semiotic dimensions that influence the museum's discourse. In comparison with the didactic transposition, the social dimension takes precedence over the academic dimension (school, teachers, community, parents) developed by Chevallard. Moreover, the whole transposition process (external and internal) is "regulated by roughly the same group of actors within the same institution" (Mortensen, 2010, p. 19).

Ludicization: Proposal of a Model Adapted to Game-Based School Visits in a Museum

The knowledge contextualization in a learning game played in a museum questions the didactic transposition framework, both because of the museum context in which the game situation is designed, but also because of the game situation specificities. The knowledge transformation is then not approached as such, but it is considered from the point of view of the player's experience. Games are made with metaphors and narratives. Above all, it aims to set up a context, a situation enabling the visitor to live an epistemic experience. Moreover, this experience must also lead the visitor to discuss the nature of the knowledge at stake (its complexity, its evolutionary

character) as well as its mode of production and criteria of validity. Finally, the experience should be playful. The visitor becomes a player because the visit takes the form of a narrative in which the player plays a role by getting personally involved to take up a challenge. We call *ludicization* this conversion of meaning.

Thus, this model is an alternative to the classical model of didactic transposition. It is inspired by the work of Hofstadter and Sander (2013) who postulate that learning is the result of a process which allows the learner to identify analogical relations between different situations rather than thinking logically. Indeed, according to these authors, concepts are built from analogies. This dynamic process allows the development of concepts and also their transfer. Within a learning situation, analogies are used to describe complex and abstract concepts because they provide concrete situations with no disciplinary boundaries (Soto-Andrade, 2006). According to this author, analogy refers to a link between two already constructed concepts, while metaphor considers the use of an already existing concept to build a new one. A metaphor is an implicit analogy and operates a transfer of meaning from a transparent source domain (in the sense of a situation targeted by learning) to an opaque target domain (in the sense of a situation targeted by learning). In other words, it allows a target domain to be understood from a source domain (Soto-Andrade, 2006). According to this point of view, the *ludicization* corresponds to a conversion of a target situation into a source situation (Fig. 12.1).

– The target situation includes complex and multidisciplinary knowledge. This knowledge is interlinked and organized in a conceptual network that constitutes a second level of complexity. The concepts involved are, for most of them, very recent. They are not yet stabilized and are subject to controversy.
– The source situation takes the form of a playful experience. This experience consists of a metaphor. The term metaphor refers to the idea that the game captures the essence of a specific situation, that there is a hidden meaning behind the

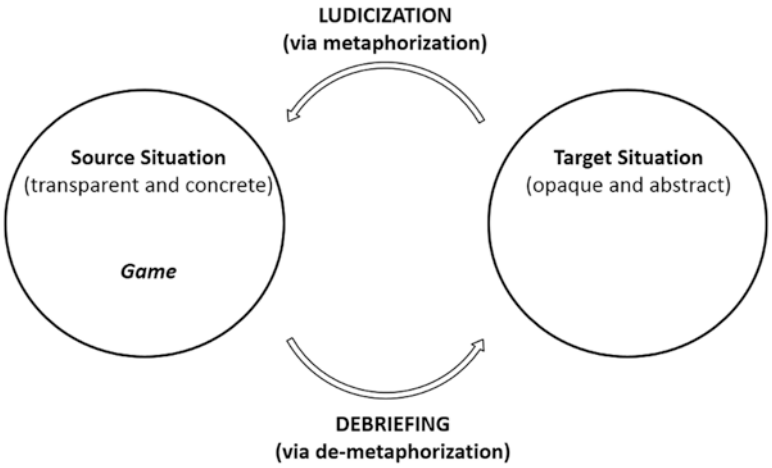

Fig. 12.1 Model of *ludicization*

game, and that this second level of meaning gives the game its power and ontological significance (Sanchez & Pierroux, 2015). Thus, the player is expected to leverage knowledge in context.

The process of *ludicization* enabling the source situation to be conceived from the target situation consists of:

– The playfulness of the situation. The narrative allows the player to be cognitively and emotionally engaged. This narrative includes challenges that, if successful, result in point gains and advances through the game levels. The game also allows the player to play a character. This character constitutes a projective identity (Gee, 2003). On the one hand, it allows the player to experience himself, to assess the consequences of his choices within the game.
– The metaphorization of the target situation. Indeed, the game constitutes a discursive form qualified by Bogost (2007) as "procedural rhetoric". The player learns through her experience, not from texts or images, but from the consequences of her choices. As a metaphor, this discursive form allows us to understand something, to experience it, in terms of something else (Bordas, 2003). The metaphor is primarily a physical and affective experience. It constitutes the figurative meaning of the domain studied and is likely to facilitate a cognitive engagement. There is therefore an isotopy between the metaphor (source situation) and the domain studied (target situation). Nevertheless, the two terms are distant from each other and, in order for the learner to re-establish the isotopy, he must follow an interpretative path that will allow him to deconstruct the metaphor. This de-metaphorization takes place during debriefing.

This way of considering didactic transposition is in line with the idea of "intrinsic metaphor" proposed by Fabricatore (2000) for the design of learning games. The playful and epistemic dimensions of the game set up for learning are not distinct. The expression labels a successful combination between educational contents and playful aspects.

Research Questions

The aim of this chapter is to discuss *ludicization* against the background of previous models of didactic transposition. We want to describe how the knowledge is processed when it is contextualized within a game. It means that we need to characterize the target and source situations.

As a first step of our work we define the target situation. Starting from the knowledge characterization relating to the Anthropocene concept described above, our study aims firstly to question the way in which this evolving, complex, multidisciplinary, and unstable concept is dealt with in Western-Swiss educational institutions. What pieces of knowledge are selected, how are they reconstructed in order to make them teachable? Based on these elements, and in relation to the museum context, what are the choices made for the design of the target situation?

The second step of our work aims at analyzing a learning situation which proposes a specific contextualization based on the design of a digital game in the context of a school visit in a museum. In the same way, within the didactic transposition framework, we discuss how the targeted knowledge is modified, reconstructed in the game as a source situation. We also discuss the reasons for these choices by relying on the *ludicization* framework. How does this specific process influence the knowledge processing? What specific constraints should be taken into account?

Methodology

Our work is based on mixed methodology. First, we first carry out an ecological analysis of the school curriculum by describing how the scholarly knowledge is taken into account within the school curriculum (to be taught) and selected for the design of the source situation (the game). The second one consists of a design-based research methodology (Design-Based Research Collective, 2003; Sanchez & Monod-Ansaldi, 2015). It enables the description of the decisions made in terms of game design and thus, to analyze how the knowledge is processed and contextualized.

An Ecological Analysis of the School Curriculum

In relation to the research questions described above, we carried out an analysis of the secondary school (students aged 12–15) Western-Swiss curriculum (CIIP, 2010[1]). For this purpose, we conducted a textual analysis. This textual analysis consists of describing the external transposition process carried out to make the knowledge teachable. Our objective is to measure the distance between the school curriculum and the scholarly knowledge. This was done through an *ecological analysis* of the school curriculum. This analysis refers to the Anthropological Theory of the Didactics (Chevallard, 1992) and considers the school curriculum as a set of interconnected *knowledge objects*. According to this theory, the Anthropocene is a knowledge object living in association with others in the school curriculum. Thus, the ecological analysis consists of examining the different places where Anthropocene is found in the school curriculum and its relationships with related objects (Artaud, 1997). These places are called *habitat*. Indeed, a same *knowledge object* might be located in several *habitats*, and might be connected to different other *knowledge objects*. Then for each *habitat* we describe the ecological *niche* it occupies, that is, in a way, its function in terms of problems addressed. The whole interrelations between knowledge objects are comparable to an ecosystemic network.

[1] Conférence Intercantonale de l'Instruction Publique de la Suisse romande et du Tessin.

Although the whole analysis is not described in this paper, it is a starting point for the description of the target situation. Indeed, the characterization of the target situation is not limited to the results of the external transposition. In a museum context, it also takes into account how the museum deals with the Anthropocene. The results of the *museographic transposition* also influences the knowledge selection for the target situation.

Method for the Analysis of the Game Design

The project is grounded on a design-based research methodology (Wang & Hannafin, 2005). Design-based research (DBR) consists of conducting an iterative process dedicated to the game design, and in our context, taking benefit from the museums as educational resources. This design process is carried out by researchers and practitioners (teachers, trainers, museum director and mediator, researchers, computer specialists). The DBR methodology has the following characteristics:

Contributive and collaborative. It means that researchers and practitioners collaborate for the design of the game and, by doing so, they also discuss and refine the theoretical foundations of the design process (the *ludicization* model).

Tested in naturalistic context. Depending on the results of the tests carried out in the museum, the game and its theoretical foundations are revised.

Iterative. The process includes different cycles for the design and the implementation of the game. In parallel, for each cycle, the theoretical model is also modified.

The model described above results from the work carried out during eight workshops. Regular workshops have been driven by pre-defined objectives to ensure progress through the various stages of the game design. These workshops brought together members of each institution in order to take advantage of each member's expertise. The discussions were recorded, and the decisions were collected in the minutes of the meetings. The decisions taken during workshops enable us to answer the research question related to the process for knowledge contextualization and the different decisions taken by the participants to the workshops. We also identified the constraints that led to these choices and those that are specific to the *ludicization* process.

Knowledge Contextualization for a Game-Based School Visit in a Museum

First, we present the features of the target situation based on the school curriculum analysis and the *museographic transposition*. Then, we present the choices made by the participants to the workshops (the game as a source situation) and we discuss, according to the theoretical model, how the *ludicization* process influences the knowledge contextualization.

A Complex and Abstract Target Situation

Anthropocene in the School Curriculum: A Wealth of Knowledge Objects for Solving Real-World Problems

The Western-Swiss school curriculum[2] is divided into three domains: disciplines (e.g, Natural Science, Humanities), general education and soft skills. Although the Anthropocene is never explicitly mentioned, numerous related knowledge objects are displayed in the school curriculum and located in several *habitats*. The main ones are presented in Fig. 12.2. They are evenly distributed between the two disciplinary domains *i.e.,* natural sciences and humanities.

These knowledge objects are organized, whatever the considered discipline, according to different scales of study (biological, time, space, societal) except for the geological time scale which is not mentioned although this is one of the main characteristics of the Anthropocene. The *habitats* of these objects are linked to each other. Potential links are made explicit but without being further described.

All these knowledge objects belong to *niches* that describe their roles. For example, in the natural sciences part, the study of "species" is addressed in different ways such as "level of organization of life" "transmission of information" "origin of biodiversity", which constitutes different *niches.* This ecological analysis highlights a significant gap with scholarly knowledge, which is the absence of the stratigraphic dimension (the geological time scale). This observation reflects the position taken by the noosphere (school authorities). On the contrary, the stabilized knowledge object explicitly finds its functions in different *niches*.

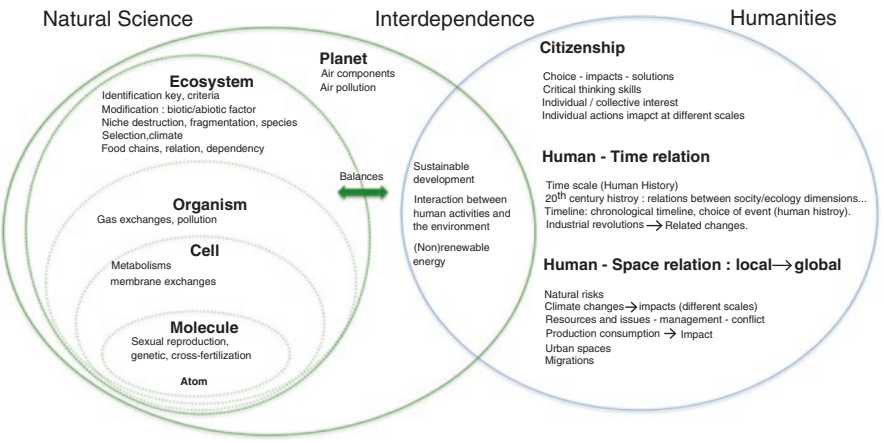

Fig. 12.2 Identification and organization of main knowledge objects for the school curriculum

[2] Plan d'étude romand (PER 2010) https://www.plandetudes.ch/

A significant feature of the curriculum is that learning is focused on the knowledge objects functions. The teachers can freely "create links between disciplinary contributions, in particular by addressing a problem" (PER 2010, General Education, p. 23). Through the use of disciplinary knowledge objects, one of the curriculum objectives consists of addressing the social, political and environmental interdependence. According to the ecological analysis, we characterize as an *ecosystem* the part called "interdependence" of the general training in the curriculum (Fig. 12.2) whose objectives are "to introduce students to the complexity of the world" (PER 2010, General Education, p. 14). For the different topics, a choice list is proposed (ex. "ecological footprint"; "global warming"), however teachers are responsible for addressing the curriculum objectives with a relevant knowledge contextualization.

Another point highlighted by the *ecological analysis* is that student's personal development is the main objective. The general training aims to develop the "relationship to oneself… to others… and to the world". As a result, the entire acquisition of the related knowledge objects, their function and their interrelationship are expected to contribute to the student's personal development. Indeed, the acquired knowledge is necessary to understand how to address "issues related to the relationship between people and the environment" (PER 2010, General Education, p. 23) and to be able to understand the consequences of the choices made by people.

Although the reasons for the decisions taken by the noosphere are not explained, the curriculum offers a framework for dealing with real-world problems from a multidisciplinary perspective. This framework encourages the diversification of teaching strategies. This is in line with the opinion expressed by Mouraz et al. (2012): "The curriculum should no longer be conceived in a normative and prescriptive perspective but should be integrated into a project logic" (p. 33). The contextualization of knowledge with concrete problems addressed by students also gives meaning to the concepts for their usage outside school (Nikitina, 2006; Giamellaro, 2014) and contributes to citizenship education.

This ecological analysis of the school curriculum is a starting point for the contextualization of the related knowledge into the target situation. However, due to the context of a game-based museum school visit, specific constraints have to be considered.

A Target Situation Constrained by the *Museographic Transposition*

The target situation depends on the noosphere choices for the writing of the school curriculum, but also by the choices made for the design of the museum exhibition. The contextualization of the knowledge in a specific exhibition is called *museographic transposition*. According to Mortensen (2010), the *museographic transposition* reflects the choices constrained by epistemic, semiotic and sociological dimensions. These constraints are specific to the museum and to different actors who designed the exhibition and they impact the target situation.

The "Nature Museum" based in Sion (Wallis Canton, Switzerland) offers a representative collection of the fauna, flora and geology of the canton and invites visitors to discuss their relationship with nature. Indeed, the exhibition discourse focuses on the historical evolution of the relationship between human beings and the environment. Its progressive hold on the territory is illustrated throughout the scenography with barriers that become more and more present, evoking the distance (physical and symbolic) that gradually separates human beings from the natural environment. As a result, the target situation focuses on the human relationship with his environment, using a reflexive and systemic approach to deal with current issues. It is expected that the museum visitors will understand the stakes and the impacts of individual and collective actions on the environment.

Moreover, the target situation includes complex and multidisciplinary knowledge. This knowledge is interlinked and organized in a conceptual network that constitutes a second level of complexity. The Anthropocene is a recent concept, subject to controversy. It is therefore not simply a question of mastering it, but also of understanding the arguments on which it is based (the methods for scientific validation) and understanding the way it is produced (the scientific procedure). In the present case, beyond the understanding of a complex phenomenon, the learning process concerns the development of the learner's personal epistemology.

Lessons Learned from the Design of a Game-Based Museum School Visit

In this section, we present the lessons learned from the design of *Geome*, a learning game designed as a source situation which is the result of the *ludicization* process.

The *Geome* Game, a Concrete Source Situation Dealing with the Relationship Between Human and Nature

Geome is a two-part game played by teams of students with digital tablets in the Museum of Nature in Sion. The school visit takes approximately 90 minutes. It includes an introduction, the game and a debriefing.

The students play the role of a nature expert who lives and works in an isolated chalet in a valley. For the first part of the game, the players face bad weather conditions. Then, they are led to use the resources of the valley to survive. The students gather these resources by scanning the naturalized specimens or another object from the exhibition with a digital tablet. The players are expected to select one of the four options: hunt, capture, protect or escape. Depending on the chosen action, they collect animals and resources that can be exchanged with other players at any time. As the players interact with the environment and collect resources, an individual progress bar increases while a collective progress bar decreases. The collective one

corresponds to the natural environment's health state. The first part of the game is designed in such a way that players collectively lose the game.

For the second part of the game, the nature expert is now considered to be released from the bad winter conditions and he is expected to do his job. His job consists of problematic situations or solving puzzles relating to the natural environment. The game offers three types of investigations based on a rumor, a fake news or a scientific controversy. Then, the role of the players shifts from predators of natural resources to researchers involved in a mission. Through the quest, the player draws a "systemic map" based on the relationships of the scanned objects in the museum. They earn points for each performed action. Finally, at the end of the mission the players complete a post-investigation questionnaire. Solving the puzzles does not necessarily lead to a unique answer. Rather, it aims to encourage thinking and argumentation about the quest and its significance.

Geome offers to the students a concrete situation where the knowledge is contextualized through quests performed in the museum. However, the knowledge remains implicit. Indeed, for the first part of the game, the players deal with the impact of individual and collective actions on the availability of natural resources. These actions are mainly based on a single predation link, which does not reflect the complexity of the whole ecosystem. Complexity is addressed in the second part of the game. By performing a quest, the players face complexity and ill-structured problems. Players are expected to develop a reflective mind about their relationship with knowledge. This aspect refers to the complex and non-deterministic dimension of the Anthropocene. Indeed, the quests aim to enable the players to understand the complexity of the ecosystem considered as a whole. Finally, the quests deal with a diverse range of issues (rumors, fake news, controversies) and complexity levels (the number of relationships at play). The nature of the quests aims to encourage the emergence of different points of view and the confrontation of ideas between students. The students are expected to defend their ideas and strengthen their argumentation using evidence based on the information displayed by the museography and the game. They are also expected to assess the relevance and veracity of the information supporting their argumentation.

This description of the game-based school visit highlights the choices made based on the target situation for the design of a concrete source situation. These choices are the result of the *ludicization* process described by an alternative model of the didactic transposition. In the following, we discuss how this process influences knowledge processing.

Ludicization and Knowledge Contextualization

The *ludicization* process is based on the use of a metaphor that reflects the object of learning, which remains implicit within the game. *Geome* offers a metaphor that represents a change in the relationship between human and nature, first hunter and then researcher. This metaphor is enhanced through the choice of a realistic universe consistent with the museum. These elements promote the game coherence and thus

the player's involvement. Besides, as soon as the player starts the game, he plays a role. More precisely, as a hunter during the first part of the game, the players can freely realize the challenge and visualize the consequences of his actions in the progress bar. Thus, he adopts the way of being and thinking of his character, which is one of the specificities of the learning situation.

Nevertheless, strategies offered to the players in the first part game are constrained by the number of actions proposed by the game. Indeed, a set of four actions (hunt, capture, protect, escape) have been chosen for a quicker handling and understanding of the game and its objectives. Besides, the second part of the game takes into account the museum's tangible elements but also their location within the museum in order to limit the player's mobility and then the game time. The design of a mixed-reality game (digital and tangible) adds constraints in terms of time and space which influence the knowledge processing. Thus, the experience lived by the players reflects a simplified aspect of a much more complex target situation, which is the essence of the metaphorization.

As a result, the *ludicization* framework offers new perspectives for the contextualization of knowledge. On the one hand, this framework is specific to game-based learning. Indeed, it is anchored on metaphors, narratives and the playful experience of the learner/player. The game is expected to provide a procedural rhetoric enabling the player to learn through the authorship of the game rules. On the other hand, the ludicization framework goes a step beyond the traditional perspective about didactic transposition. Indeed, *ludicization* does not only consider the didactic transposition of concepts but instead the transposition of a target situation, including relationship between concepts, digital and tangible artefacts, rules, actors and their postures, into an analogical and metaphorized source situation.

The *ludicization* consists of a knowledge contextualization process which involves specific constraints. Through a concrete and transparent situation, the player lives a unique experience that modifies his/her relationship to knowledge. However, learning from a game occurs only after reflection and debriefing which is an integral part of a game-based learning experience (Garris et al., 2002). The metaphor has to be deconstructed during the debriefing, in order to decontextualize this knowledge. Then, the implicit knowledge in the game becomes explicit and transferable in other situations. Studies have been carried out on debriefing in a gaming context and particularly on its formalization (Plumettaz-Sieber et al., 2019).

Conclusion

The aim of this chapter was to introduce the *ludicization* model as an alternative to the didactic transposition framework in a game-based learning situation. This process is often used for game design but without being described and formalized. For example, the game of 5 lines, a strategic game close to backgammon, played in Greek antiquity or, more recently, the game of chess are metaphors of war. They have been used to develop the strategic mind. The contextualization of knowledge

into this specific kind of learning situation is based on the metaphorization of a target situation and involves specific constraints.

This model describes the knowledge contextualization from a target situation to a source situation. It allows taking into account both the complexity of the learning object, the need to also contextualize the relationship to knowledge and the specificity of the game-based learning context. This alternative model was experienced for the design of a school visit including *Geome*, a game dealing with the Anthropocene. In relation to this game-based school visit and to the features of the scholarly knowledge at stake, we designed a source situation from a target situation by taking into account the school curriculum (as the result of the external transposition) and the museum constraints (framed by the *museographic transposition*. The model of *ludicization* appeared to be efficient for designing learning situations where learning through play is not just about playing but about reflecting on one's play experience. As a result, this model offers new perspectives for the contextualization of knowledge, however, the scope of this approach is still limited regarding the specific context addressed by our study. Indeed, metaphorization of educational content is difficult to carry out because it requires expertise on the content itself, on game design and on pedagogical aspects. Furthermore, it is not clear that all educational content lends itself to this type of approach.

Another limitation of this work consists of methodological issues. The corpus analyzed for this study is limited to the minutes of the meetings with all participants (teachers, trainers, museum director and mediator, researchers, computer specialists), which doesn't totally reflect what is negotiated between them during the time dedicated to the game design. Further investigations are needed to explain the reasons for the choices made by the participants.

In addition, due to the iterative process of the design-based research methodology used, the learning situations described in this study are still evolving. The designed scenario including the game will continue to be tested. The analysis of the data collected during the game and the debriefing phases will probably contribute to the evolution of the source situation and the contextualization of knowledge (the redesign of the game), and thus, to improve the model of *ludicization*.

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Catherine Bonnat is Senior researcher at the University of Geneva in Switzerland. She holds a PhD in Educational Sciences from the Grenoble-Alpes University (France). Her thesis and post-doctoral research are in the field of science education, didactics and technology enhanced learning. Her research involves the design of learning environments by integrating digital technologies to support students' science learning activities, with a focus on the use of game-based learning for school visits in museums. She currently leads the French-speaking Switzerland Master and Doctoral programs in Subject Didactics.

Eric Sanchez is Professor in Educational Technologies at the University of Geneva. He currently leads the Pedagogical Innovation Lab (LIP) within the TECFA Unit. He holds a PhD in Science Didactics obtained at the University of Lyon (France). His research interests focus on technology enhanced learning, distant learning and he currently develops research on the use of game-based learning for formal (school and university) and informal (museum) learning. He has a sound experience in design-based research and learning analytics. He leads the Master program in Learning and Teaching Technologies.

Elsa Paukovics is PhD student and research assistant at the university of Geneva in Switzerland. She holds a Master degree in Educational sciences (pedagogical innovation, educational technologies and adult's education) from the University of Fribourg (Switzerland). Her PhD focuses on the teachers' and researchers' collaboration and knowledge production by practitioners involved in design- based research. She is also involved in research on game-based learning and learning labs in higher education.

Nicolas Kramar is Director of the Musée de la Nature du Valais (Nature Museum in Wallis) in Switzerland, where he prompted the World's First Exhibition on the Anthropocene awarded the 2016 Expo Prize of the Swiss Academy of Sciences. He holds a Master's degree in History, Philosophy and Didactics of sciences from both the University Lyon 1 and Ecole Normale Supérieure de Lyon (France), and a PhD in Sciences (radiochronology, geochemistry) obtained at both the University of Lausanne and Ecole Polytechnique de Lausanne (Switzerland). Since 2013, he has been the Chair of the ICOM-NATHIST Anthropocene Working Group, member of the Committee for Museum Definition, Prospects and Potentials (ICOM Define) and he is associate researcher at the LIP-TECFA, University of Geneva.

Chapter 13
ICT in the Classroom – Didactical Challenges for Practitioners and Researchers

Marte Blikstad-Balas

Introduction

How teachers implement information and communications technology (ICT) in the classroom is a topic that has gained substantial and increasing attention around the world over the last two decades. Digital competence is a crucial aspect of education, which schools should systematically develop (Ferrari, 2013; Griffin et al., 2012). For a long time, the discourse around digital technologies in education has been very optimistic, and full of promises of more and better learning (Elstad, 2016; Klausen, 2020; Selwyn, 2016), and there has been an emphasis across countries to ensure that relevant digital equipment is available, preferable one-to-one access, that is one device per student (Blikstad-Balas & Davies, 2017; Ditzler et al., 2016). In general, the international discourse around technology in education has been more about the wide-ranging need for digitalization to ensure that all students are "ready for the future", than about the actual use of the tools.

This is the case despite the fact that research has repeatedly shown that the digital tools—including devices, such as smartboards, tablets, computers, or mobile phones, or software, such as PowerPoint, Google Docs, or Kahoot—are less important for students' learning than the ways teachers are able to use these tools across subjects (Baker et al., 2018; Jewitt et al., 2007; Lei & Zhao, 2007). Future research questions to be asked about digital devices in the classroom, then, should not concern only access itself or the political ambitions to digitalize schooling – they should also concern the didactical choices teachers make when trying to integrate technology in their everyday classroom practices, that is choices relating to teaching, learning and subject content (Ligozat & Almqvist, 2018).

M. Blikstad-Balas (✉)
Department of Teacher Education and School Research, University of Oslo, Oslo, Norway
e-mail: marte.blikstad-balas@ils.uio.no

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In this chapter, I will discuss why access to technology alone it not enough to digitalize education, and what kind of knowledge specific educational research we need to address digitalization in the classroom. This adds to the overall ambition of this book by addressing a didactic topic that is relevant across European curricula, and by shedding light on how contents, in this case digital technologies in general, take shape in the interaction between teachers and students. I will draw on empirical data from two different projects to shed light on these questions: the large scale video study Linking Instruction and Student Achievement (LISA), led by professor Kirsti Klette (Klette et al., 2017; also see Klette, Chap. 9 in this volume) and a national survey to parents in Norway about what characterized teaching when schools went 100% digital overnight in March 2020, due to the global outbreak of COVID-19 (Blikstad-Balas et al., 2021).

Why Is Norway Relevant in an International Discussion About ICT Implementation?

Norway is a very interesting case when it comes to technology and education, for two interrelated reasons. First of all, Norwegian educational policies and national curricula have made digital competence an explicit aim for decades, and teachers are supposed to draw on digital technology across grades and subjects (Erstad, 2006). In the compulsory and secondary education reform of 2006, known as the *Knowledge Promotion*, five skills were defined as basic to learning in school, work and social life. These skills are basic in the sense that they are considered fundamental to learning across all school subjects as well as a prerequisite for students to show their competence and qualifications within and across subjects. One of these skills are digital skills, which should permeate all subjects and be used when relevant. In Norway, digital skills involve being able to use digital tools, media and resources, efficiently and responsibly, to solve practical tasks, find and process information, design digital products and communicate content. Further, digital skills also include developing digital judgment by acquiring knowledge and good strategies for using the Internet. The digital skills are considered a prerequisite for further learning and for active participation in working life and a society in a constant change. It is up to each teacher to make all decisions on digital technology, within the limitation of what hardware and software the school has made available. This notion of basic skills was introduced in 2006, and it was also kept when the national curriculum was renewed in 2020. It should be noted that from a didactic perspective, digital skills may mean different things in different subjects. Curriculum makers may see this is a general cross-disciplinary skill, and therefore it is up to each teacher to define what keyways of using technology should be emphasized in their subject. Unsurprisingly, this may lead to large variation when it comes to how teachers integrate digital competence in their instruction, not only across subjects, but within subjects as well.

Another aspect that makes Norway interesting when it comes to digitalization, is that the digital infrastructure is very good. Internet access at home has repeatedly been measured at 98% of the population (e.g., Statistics Norway, 2020), and students' overall access to technology has been significantly above the European average measured by the student-per-laptop ratio (OECD, 2015). The combination of high national expectations and high access to technology in schools and at home, makes Norway a good place to explore actual uptake of technology in the classroom, as it is both expected to happen due to national curricula, and possible due to high digital infrastructure.

What Do we Know about the Digitalization of Norwegian Schools?

Several literature reviews have addressed the general effects of ICT in classroom settings (Ditzler et al., 2016; Elstad, 2016; Haddad, 2008; Penuel, 2006). In the following literature review I will therefore very briefly address the topic of ICT access and use in a Norwegian context by examining what is known about access; teachers' general ICT competence, and teacher attitudes towards integrating ICT. These three factors are directly associated with the implementation of ICT (Bingimlas, 2009).

ICT infrastructure is an obvious prerequisite for integrating digital technology into instruction, and inadequacy of such structures at the school level is considered to be one of the key barriers to ICT implementation (Bingimlas, 2009; Gil-Flores et al., 2017). Norway has been a front runner in providing schools with ICT while 1:1 access is the norm in upper secondary schools, most lower secondary schools are also able to provide either permanent 1:1 access or lend students laptops or tablets for use in a specific lesson or take students to a computer room at the school. The access to ICT in Norwegian schools enables broad use of ICT for educational purposes, and the national curriculum explicitly places this responsibility on all teachers across all grades (Erstad, 2006).

As mentioned in the introduction of this chapter, access itself is not a reliable predictor of teachers' actual implementation of digital technology (Gil-Flores et al., 2017). The discrepancy between merely providing access and preparing teachers to actually utilize the technology in their everyday teaching is highlighted as being critical in the newest Teaching and Learning International Survey (TALIS) report from Norway (Throndsen et al., 2019), which brings us to the question of teacher competence.

Teacher competence is a key factor for successful implementation of ICT. Despite high political ambitions and good technological infrastructure, this is an area where Norwegian teachers do not consider themselves to be sufficiently competent. Data from TALIS 2018 show that one in five teachers report a strong need for more knowledge about how they can integrate digital technology into their everyday instruction—and this is the domain most of the teachers identify as an area where

they need professional development (Throndsen et al., 2019). Unfortunately, the need for more knowledge about integrating ICT in meaningful teaching practices does not change for newly qualified teachers or student teachers. Across countries, student teachers and novice teachers report that they do not feel that their teacher training has prepared them to use ICT in their classrooms (Røkenes & Krumsvik, 2016; Sang et al., 2010). Drawing on a survey taken by 356 newly qualified teachers Gudmundsdottir and Hatlevik (2018) found that nearly half of the participants define their own ICT training as poor; they also indicated that their recent teacher training had played a fairly limited part in developing their professional digital competence. International studies have similarly found that, while newly-educated teachers all have general experience with digital apps and social media, their experience with such digital technology for education is limited, and their repertoire of relevant digital technologies for teaching and learning is restricted (Sang et al., 2010; Valtonen et al., 2011). A reason why these findings about newly qualified teachers are so crucial, is that they nuance the assumption that young, newly educated teachers automatically understand how to implement t technology as an instructional tool.

Previous research has identified that positive attitudes toward ICT are associated with the use of ICT in the classroom (Anderson & Maninger, 2007; Baş et al., 2016). In line with the respondents in international studies, such as the International Computer and Information Literacy Study (ICILS) (Fraillon et al., 2014)), newly-qualified Norwegian teachers report that they have both positive and negative beliefs about the usefulness of ICT in the classroom (Gudmundsdottir & Hatlevik, 2018). Gudmunsdottir and Hatleviks' (2018) nationwide survey among newly-qualified teachers found that more than 80% of the respondents had a positive attitude about using ICT for educational purposes; however, they also found that half of the respondents were concerned about the negative aspects of its use, such as digital distractions while teaching. Gudmunsdottir and Hatlevik (2018) further showed that integrating digital technology still relied on enthusiastic teachers who procure technology and have ambitions of utilizing more technology in their classroom, which aligns well with internationals studies on the same topic (Drent & Meelissen, 2008).

Methods

I will refer to empirical data from two different projects in order to discuss challenges in digitalizing education and conducting research on this topic. First, I will draw on the large-scale video study Linking Instruction and Student Achievement (LISA) funded by the Research Council of Norway on a FRIPRO grant (see Klette et al., 2017). During the 2014–2015 school year, our research team systematically collected data from 47 different Grade 8 Language Arts (LA) classrooms (13- to 14-year-old students) across Norway. Three or four consecutive lessons were videotaped in each class over a one-week period, totaling 178 lessons. While 1:1 access to laptops and tablets still varies across Norwegian schools, all the teachers in the

sample have access to a digital interactive board (Smartboard) or a projector and a laptop, which makes it timely to investigate the degree to which and the ways in which this technology is integrated into their lessons. Many of the videotaped classrooms also provided class-sets of computers or tablets, supporting 1:1 use.

The schools in the LISA-project were purposefully sampled to include both a demographic and geographic spread and various levels of student achievement, as measured through national reading tests in grades 8 and 9. The teachers included in the study vary in age and in number of years of teaching experience. The number of professional development courses attended by teachers also varies, as does the schools' overall commitment to implementing ICT, which reflects the general variation across schools. Written and informed consent to participate was provided by the parents, students, and teachers. For more about this project, see Klette et al. (2017).

The second study I will refer to in the discussion of digitalization is a parent survey developed to assess how teachers responded to the school closure in Norway in March 2020 due to the COVID-19 outbreak. This survey was distributed to parents and teachers digitally because the timing of the survey was crucial: we wanted parents to respond during the period of homeschooling and school lockdown, not in retrospect. The inclusion criteria were parents with students in Grades 1–10. As with many other one-time internet surveys, we had to opt for a non-probability convenience sample (Fowler, 2009; Patton, 2015) where we invited participation from whoever saw the survey invitation online. As with any non-probability-based sample, the greatest limitation is the unknown relationship between the sample and the population and the missing theoretical basis for estimating the repetitiveness of the sample. We have included several background variables about the respondents (e.g., where they live and their educational background) to systematically monitor these variables in our samples and compare them with nationally representative samples.

The parent survey was answered by 4642 parents from all over the country. A total of 262 of the country's 365 municipalities were represented with good geographical distribution, and the respondents represented different categories of large and small towns, municipalities, villages, and rural areas. If the parents had several children in primary or lower secondary school, they chose one of their children prior to starting the survey and answered all questions for that child.

The main ambition of the survey was to investigate all aspects of homeschooling, including what kind of remote teaching students were offered and how parents and teachers experienced the homeschooling situation. The parent survey had background questions about the school location, the student's gender and grade, and the parent's level of education and work situation during the period (work outside home, home office, laid off/unemployed, and stay-at-home parent). After completing the background information, parents answered 24 questions related directly to the homeschool situation, such as digital equipment, attendance requirements, communication with teachers, tasks, subjects, students' engagement and efforts toward schoolwork, and the parent's own experience during the period of homeschooling. For more about the survey see Blikstad-Balas et al. (2021).

How Are Teachers Using Digital Technology in Norway?

Drawing on the video data from the LISA-study, we can investigate in what situations teachers are using digital technology and for what purposes. Video data has proven particularly useful in this kind of detailed analyses of classroom settings (Bjørkvold & Blikstad-Balas, 2018; Blikstad-Balas & Sørvik, 2014; Dalland et al., 2020). Figure 13.1 shows the distribution on the lesson level of use of ICT in the 176 recorded language arts lessons. Here, we see that in 42,4% of the lessons, there was no use of digital technology from either teacher, nor the students. We will soon look further into what this use actually entails.

While it should be noted that there are more schools with 1:1 access today than when these data were gathered, all teachers in the material had the opportunity to project their screen or use a Smartboard. When we look at what the teachers used the digital technology for, the figure becomes more interesting. As Fig. 13.2 shows, we have investigated how all the time spent using digital technology across lessons is distributed between different software, educational apps, and websites:

A key finding is that the technology was mainly used to aid the teachers in presenting information about content. This kind of teaching relied on PowerPoint presentations or other documents and was very often monologic. While a few teachers used the digital board pen for highlighting and/or writing in their presentation or the document that was shown, most of the teachers did not. Thus, most of the content was written before the lesson and not changed during the course of the lesson, regardless of student responses. This is an important point, because discussions around ICT in education tend to assume that once the equipment and the possibilities are in place, the innovative use will follow (Selwyn, 2016; Selwyn et al., 2018). Another point worth making is that school literacy in general has been heavily criticized across countries for relying solely on textbooks and not giving room for other

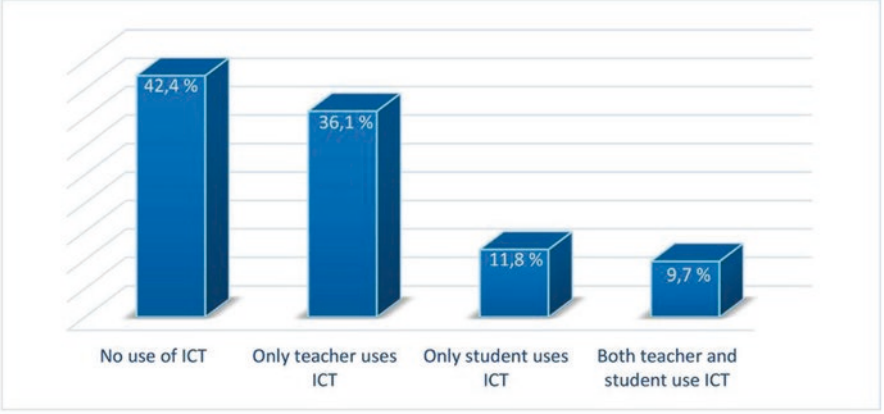

Fig. 13.1 Use of ICT across 178 lessons. (Figures 13.1, 13.2, 13.3 and 13.4 are reprinted with permission from the Nordic Journal of Digital Literacy Blikstad-Balas and Klette (2020))

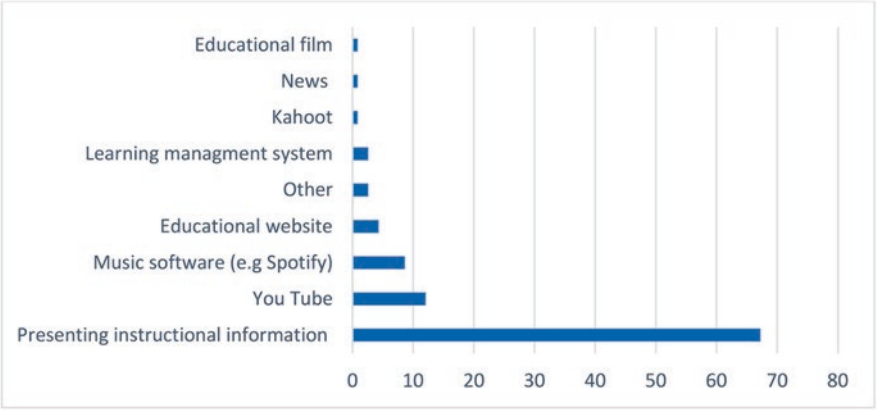

Fig. 13.2 Teachers' total time using ICT in the classroom distributed across different digital tools

voices. The use of texts from the authentic "outside world" in the classroom has therefore been advocated as an important pedagogical opportunity that is enabled by Internet access. The use of YouTube and musical applications showed that some teachers availed of this opportunity. Typically, the videos on YouTube were short poems/lyrics that the students were going to analyze, or relevant comedy clips whose theme could be related to the topic of the lesson. Thus, where teachers used Internet access, it was to embed authentic content into the lesson. This was also true for the one occasion when a newspaper was used to show argumentative writing in a contemporary real-life context.

The teachers' use of technology in the LISA-video material suggests a pedagogy which is not innovative, rather it is quite traditional, relying on teachers transmitting pre-made content to their students. This finding is very much in line with other studies that show that rather than transforming teaching, digital tools can also reinforce traditional teaching methods (Klette et al., 2018; Peck et al., 2015).

Figure 13.3 shows the students' total time using digital technology in class, distributed across different technological tools.

As can be seen, 71% of the students' time using ICT in their lessons was spent on writing in Microsoft Word on personal laptops. This is not that surprising, as the language arts (L1) subject has a particular responsibility for developing students as writers, and previous studies have shown that students have sustained opportunities for text production (Blikstad-Balas et al., 2018). While it is clear that language arts has a strong responsibility for developing students as readers and writers also in a digital world, it is important to investigate what kind of digital reading and writing students are engaging in. That the writing tasks also identified in this study were quite traditional and did not make use of or encourage students to draw on all the multimodal options available in any laptop or tablet. Students were not prompted to – for example – combine images and sound or make use of other multimodal possibilities. Multimodal text production was only seen in cases where students were producing their own PowerPoint presentations or looking at their teacher's

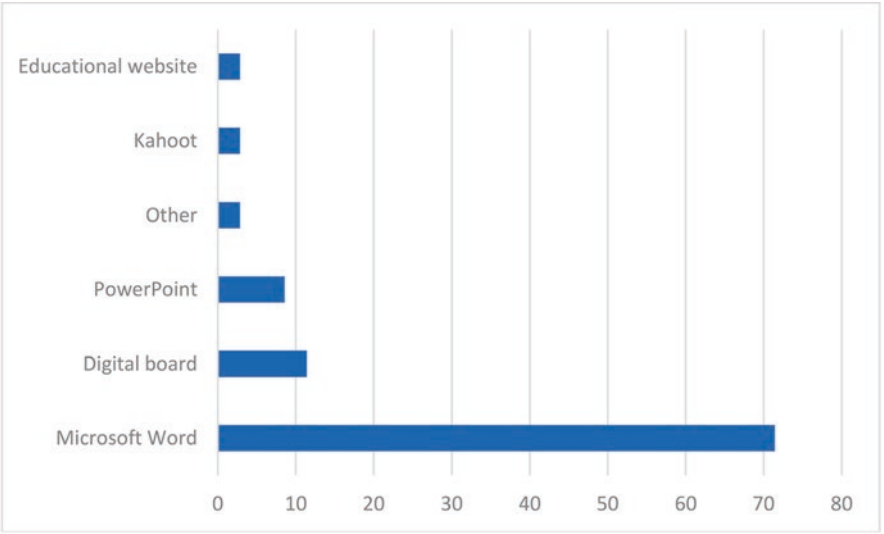

Fig. 13.3 The digital tools students are using in the classroom

PowerPoint presentations (8.5%), as these more often used a combination of different modalities. This means that the kind of digital writing students are doing very much resembles the writing tasks they would engage in without having for example internet access (Blikstad-Balas et al., 2018). This is also clear when it comes to reading, the students in this material are not really being prepared for reading digital texts or reading with the critical distance digital reading often requires (Magnusson et al., 2019). While the framework for digital skills used by the Norwegian directorate for education emphasizes that students should produce; search and process; communicate; and develop digital judgment (Norwegian Directorate for Education and Training, 2012), the emphasis in the lessons reported on here, is on basic production of digital texts.

The "digital board" category (11.4%) in Fig. 13.3 captures the four occasions across the entire material (178 lessons) when students were asked to write on the Smartboard. The "Educational website" category (2.8%) indicates that students themselves accessed an educational page, rather than when they watched the teacher access it; this is also true for "Kahoot" (2.8%). The "Other" category shows the rare occasions of unclear use.

It is often claimed that educational technology will change the ways we learn (Selwyn et al., 2018), and it is therefore interesting to look into not only what digital tools students are using, but also the purposes. Drawing on previous classroom studies analyzing use of digital technology (Juvonen et al., 2019; Sahlström et al., 2019), we analyzed the purposes of students' digital technology use (Fig. 13.4).

When students were prompted to use digital technology during lesson, it was – as we can see from the figure - mainly to write texts. This mirrors the findings presented in Fig. 13.3, where Microsoft Word was the software most often used. The

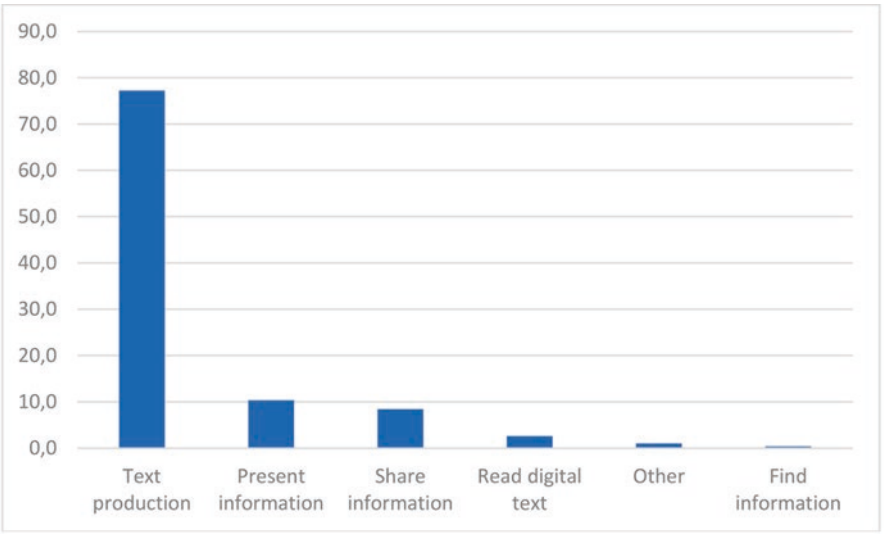

Fig. 13.4 Purposes of technology use

writing that was done in these lessons was often individual writing for individual assessment (Blikstad-Balas et al., 2018), and 70.3% of the time that the students were using technology was connected to individual work, often writing. The remaining time was either spent working in groups (25.2%) or in pairs (4.5%), often connected to preparing digital presentations. The purpose of presenting information was exclusively linked to students delivering digital presentations in front of the class, and the shared information was also connected to work that would later be presented to peers in the same classroom. While the texts read in the LA lessons were almost exclusively printed texts, in worksheets, handouts, literary books or textbooks, the students did occasionally read their teacher's PowerPoint slides or information on the LMS on their screen; thus, 2.6% of their time was spent "reading digital texts."

Summing up, the video data I have referred to as an empirical example for the discussion, suggest that access and high political ambition alone will not increase teachers' uptake of technology, nor will it increase their digital repertoire of teaching practices.

Survey on Remote, Digital Homeschool Practices

In March 2020, all Norwegian schools were closed, and all education went digital overnight. As accounted for in the methods section, we developed a survey for parents in order to get insight into what teaching practices characterized home schooling during the Pandemic (Blikstad-Balas et al., 2021). One question is particularly

interesting in relation to the present paper, namely what digital practices teachers engaged their students in – that is, what a "typical day" of remote digital learning would look like for the student. Up until March 2020, all teachers could in theory decide for themselves whether the wanted to digitalize their teaching, what kind of apps to include, what kind of competence they wanted their students to show digitally, etc. Those who wanted to opt for a low degree of digital devices in their teaching could, which the video data also show. However, from March 2020, all schools were closed – but the expectancy to keep teaching and minimize learning loss was explicit – as in many other countries around the world (Azevedo et al., 2020; Reimers & Schleicher, 2020). In Norway, due to the strong digital infrastructure, it was natural to rely on the existing platforms already established and make the remote learning digitally mediated learning. How each school decided to do that varied, which I will show and discuss in the following.

The parent survey included parents (N = 4642) with children from grades 1–10, and in the descriptive statistical analyses, we arranged students in three groups corresponding Norwegian primary school, middle school and lower secondary school: grades 1–4, grades 5–7, and grades 8–10, to show how the educational opportunities between these groups varied. We believe that most parents answering this survey have good insight into what their child has been doing during the period of homeschooling, particularly because 85.6% of the parents reported having been at home to a large degree during the period of school closures.

Access to equipment is a prerequisite for remote digital teaching, and as mentioned in the introduction Norway has been a frontrunner internationally when it comes to providing access. In the survey, parents were asked to report what equipment students used for homeschooling. Several answers were possible, and several parents reported up to three different devices. The results are summarized in Fig. 13.5.

Figure 13.5 reveals a tendency for younger students to use their parents' equipment, while older students were more likely to have their own equipment. Only 63% of the parents with students in grades 1–4 reported using equipment provided by the school, but 83% of lower secondary students reported using the schools' equipment. Figure 13.5 also shows that half of the students in lower secondary school and a third of the students in grades 5–7 used a personal cellphone for schoolwork. When asked if the equipment from school "worked sufficiently well," 92.4% of the parents confirmed that it did, while 4% answered no and the remaining 3.2% were uncertain. This underscores that students had good access to relevant digital devices during the period of remote learning.

Parents were also asked to list the main software used by the schools during the remote teaching to communicate with students and organize the school day. Here, we identified a clear trend: The platforms Microsoft Teams and Google Classrooms were used the most in lower secondary and in grades 5–7, while the platform Showbie was the most used learning system for grades 1–4. When asked how familiar the students were with the schools' chosen platform, only 48.3% of the parents answered that the platform was well known before the school closure. In contrast, 22.6% reported that it was known to some extent, while over a quarter of the parents

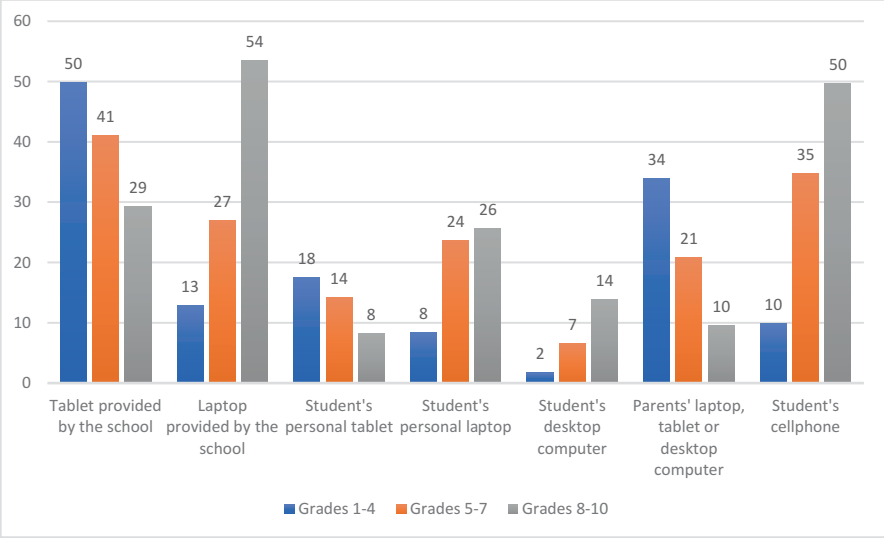

Fig. 13.5 Types of digital equipment used by students for schoolwork according to parents

(26.6%) reported that the platform was not something the students were familiar with. Again, the tendency was that parents who had children in the lower grades reported the least prior knowledge on how to use the school's platform. This finding was somewhat surprising, as all schools had a platform also prior to the Pandemic, and as seen in Fig. 13.5 there was also equipment available. This underscores again the weak link between having access (to both hardware and software) and actual uptake of new technologies. It may also point to different priorities among the grades and different values among teachers. Based on prior research, it would be possible that teachers in the earlier grades are more concerned with the relationships with the concrete world and the entry into the symbolic world (e.g Fleer & Hedegaard, 2010), which can be difficult if not impossible to obtain through remote and asynchronic learning. Having for example a Showbie platform in grade 1 that could be used to communicate digitally with students, may not correspond to the values of primary grade teachers of what learning is; while teachers in higher grades, where the subject content itself is more central in the instruction, may be more comfortable asking students to engage independently with relevant content and do relevant tasks.

Another relevant finding from this survey concerns to what degree teachers enabled lessons and contact between students digitally. An important pedagogical question for all teachers during the Pandemic, was how they could follow up on their students remotely and make sure they are participating from their homes. When both students and teachers are located in their own homes, the everyday contact in the classroom is replaced by other forms of contact, in either by the teachers or the students themselves. We asked parents to report on what was expected of the

students regarding attendance during a normal day of homeschooling. Multiple answers were possible.

As Fig. 13.6 shows, three of four students in lower secondary school and two thirds of students in grades 5–7 were asked to be present – logged on - at a given time each morning. This finding is in stark contrast to the two thirds of students in grades 1–4 who did not have to be present in the morning. Participating in home school involved very different commitments from the younger students and those in lower secondary school. We can also see that 23% of the parents with students in grades 1–4 reported that their children were not expected to attend online classes at all. Further, 27% of the parents of children in grades 1–4 reported that all their child had to do to show that they were participating was to complete different tasks with a given deadline.

The shift from classroom-based to remote teaching was expected to result in a number of new uses of digital tools, and some even claimed that this "shock digitalization" would be good for the school, as all teachers were "forced" to use digital tools. We asked parents to report on what kind of instructional practices their child would engage in on a typical day of homeschooling. As shown in Fig. 13.7, "Real-time instruction through Zoom, Teams, Skype, etc." was more common with older students than their younger counterparts.

While 60% of parents with students in lower secondary school reported that this was typical instruction on a day with homeschool during the Pandemic, only 16% of the youngest children engaged in such instruction on a typical day. About a third of the parents across all grade levels reported that pre-recorded videos with the teacher were typical. Tasks from the teacher were by far the most characteristic aspect of homeschooling, as 96% (lower secondary school), 97% (grades 5–7), and 98% (grades 1–4) of parents reported that such tasks would be assigned on a normal

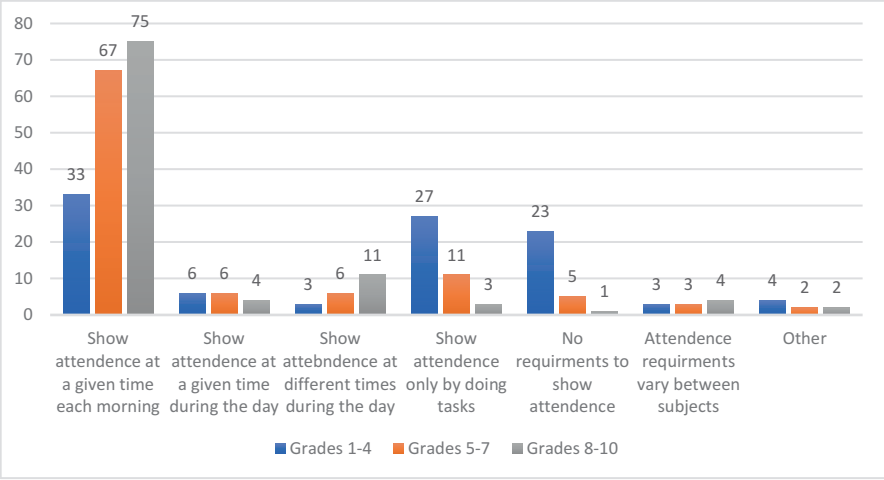

Fig. 13.6 Parents' responses to a question addressing if and how students should show attendance during a normal day of homeschooling

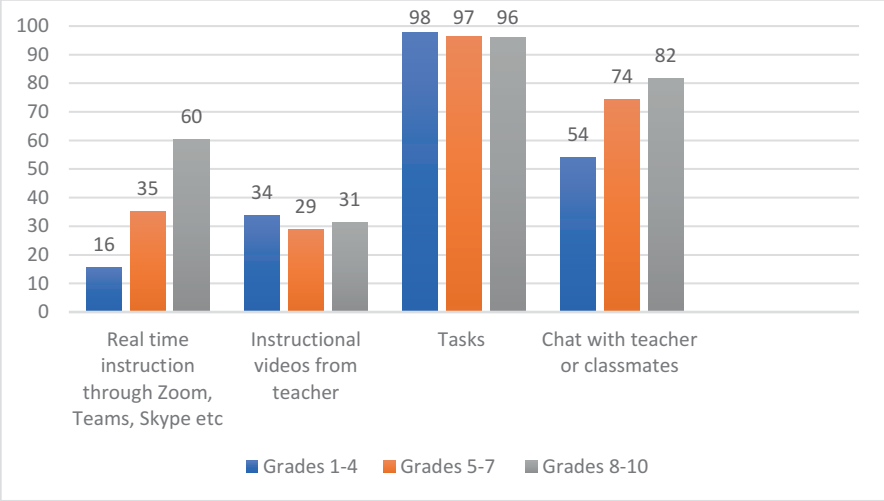

Fig. 13.7 Parents responses about what instructional practices would happen on a typical day with homeschooling

day of homeschooling. Again, we see the tendency that digitalization may not automatically imply innovation, it can also imply very traditional and individualized forms of learning. The figure also shows how contact with the teacher and other students through chat increases with age. While 82% of the students in lower secondary school chatted with the teacher or with classmates, only half (54%) of the parents with students in the lowest grades reported the same. We also asked the parents what kind of learning their children had done most of during a typical day, and here a striking 94.6% of all parents reported the answer was individual work with tasks.

A crucial question when it comes to providing equal opportunities to learn for all students is teacher availability and engagement. Needless to say, this becomes particularly important when students are not allowed outside their own homes and into school – a situation that may severely increase the effect of socioeconomic background on education (Blikstad-Balas et al., 2021). With this in mind, we asked parents to report on how often students had contact with their teachers. By contact we mean both written and oral contact, for example through chat on the school's learning system, digital video meetings, SMS, or phone calls. As summarized in Fig. 13.8, the responses revealed substantial variation across the grade levels.

This question revealed quite striking differences between different grades. The older the student, the more contact they had with their teacher. While most students in lower secondary school had daily contact with their teachers, either once a day (29%) or multiple times a day (42%), over half of the students in grades 1–4 had contact with their teacher 2–3 times a week or less. The fact that 7% of the parents with children in grades 1–4 reported no contact with teachers during the period of homeschooling is quite concerning. However, it should also be noted that, when

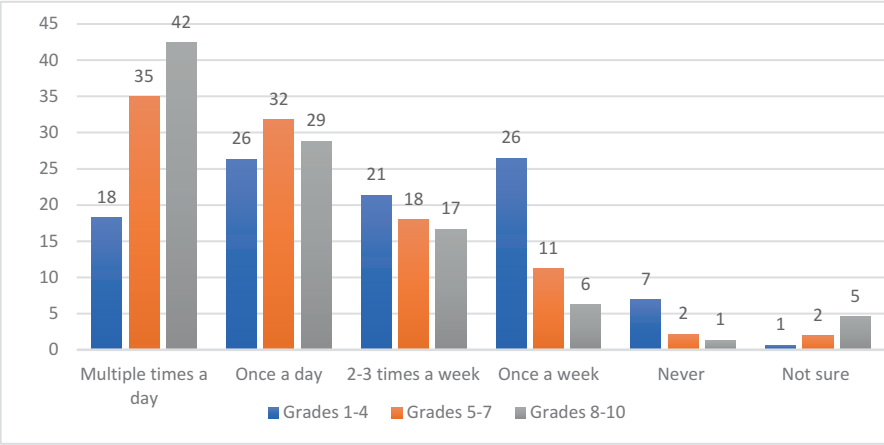

Fig. 13.8 Parents' responses to a question addressing how often their child had contact, written or oral, with the school

asked if they felt they could contact the teachers during the homeschooling period, a clear majority of parents answered that they felt they could contact the school to a large degree (51.6%) or to some degree (32.7%). Some parents (12%) reported they could contact the school to a low degree, and finally 3.2% reported uncertainties about whether they could contact their child's teacher.

Summing up, the survey data from the time when all teaching went digital overnight in Norway, shows clear similarities with the video data from normal classroom instruction, in the sense that the repertoire of digital instruction was rather limited, and that the time students spent using digital technology is associated with rather traditional teaching.

Discussion

Schools around the world are increasingly based around the use of different digital technologies. Drawing on the empirical data presented, I will now discuss why access to technology it not enough to digitalize education, and also what kind of didactical educational research we need to address digitalization in the classroom.

In Norway, the equipment and digital learning platforms and software is available for teachers to draw on in their instruction, but still we see that the actual uptake of technology is limited in the language arts subject. This is line with other studies that show how access itself will not transform education (Gil-Flores et al., 2017; OECD, 2015). Both the video data from regular classroom instruction and the survey from the "all digital" schooling referred to in this chapter, show that the number one way to use technology in school still revolves around students individually answering different tasks. I am not suggesting this is in itself always

problematic in all subjects, merely that this use of technology is in stark contrast to the innovative, collaborative practices that are often associated with digitalization (Blikstad-Balas & Davies, 2017; Salomon, 2016; Selwyn, 2016).

As Selwyn et al. (2018) discuss, learning management systems used across schools tend to function as a way to streamline existing school operations, and they can be used for delivery of teaching resources and content. This is very much the case in the empirical data presented in this article: digital technology is used primarily to support traditional frontal teaching through Powerpoint or for students' individual writing of different tasks. What we see little of are interactive learning apps, collaborative learning on social platforms or even classroom conversation in real time facilitated by digital technology. This finding calls for more research not on what schools have available, but the didactical and subject specific framing of the available resources, and the didactical rationales behind teachers' enactment of teaching. It should also include a specificity on different grade levels. An assumption that digital technology itself will transform teaching, is also an underestimation of the complexity of teaching and the everyday didactical choices teachers make (Salomon, 2016). Rather than only asking empirical questions about how much access different schools have, and how specific apps can be used, we should be more concerned with the didactical aspects of technology.

When digital technology is used in transmissive ways, it is easy to engage in teaching blaming and question teachers' digital competence. Rather than assuming that teachers digital skills are low, we should investigate empirically what hinders and promotes uptake of technology. We should also discuss critically how the emphasis on digital technologies affects different school subjects. If we want to meet the high ambitions for digital competence that most countries actually have, the repertoire of ICT use in pedagogically meaningful ways has to be increased and critically discussed within subject specific frames. Rather than focusing generally on ICT in teacher training, teachers should work systematically at the local level to increase the relevant repertoire—not the use itself—of digital technologies within their subjects. As I have shown in this chapter, technology and general ambitions for "modern schools" at the structural level are not enough. Implementing technology well requires far more than that. It should also be noted that during the period of digital teaching due to COVID-19, teachers were placed in a very challenging situation, and with varied support (Audrain et al., 2021).

Further, we need to address some methodological challenges in the field of research on educational technologies. In broad terms, the growing field of ICT classroom studies can be divided in two main strands. The first strand revolves around research in purposefully sampled technology-rich classroom environments. This tradition includes a number of qualitative case studies where digitally rich environments are sampled in order to document and explore uptake of technology and to provide a nuanced picture of what happens when new technology meets classroom practices (Blikstad-Balas, 2012; Rusk, 2019; Sahlström et al., 2019). It also includes a range of case studies with specific technology use as a sampling criterion, which has resulted in seminal studies on the integration of tools, such as interactive whiteboards (Jewitt et al., 2007) or 1:1 iPad programs (Ditzler et al.,

2016), specific games, such as Kahoot (Zarzycka-Piskorz, 2016), or collaborative platforms, such as Padlet (Fuchs, 2014). This tradition also includes a range of experimental and quasi-experimental studies where participants were sampled due to their willingness to try out specific technologies and be monitored by researchers while the technology meets classroom practices, for example as in studies where the use of a specific app, such as Dragonbox, is compared in a quasi-experimental design with the absence of the app (Siew et al., 2016).

The second broad strand of classroom ICT studies attempts to measure the access and use of ICT across large samples (Ainley & Carstens, 2018; Gil-Flores et al., 2017; OECD, 2015, 2019) This often happens through surveys and self-reported data from either school owners, teachers, teacher students, students, and parents, or a combination of these groups. Several of these studies have also attempted to measure and link the access and use of ICT, at the classroom or student level, to measurable learning outcomes. The latter approach has been used by several large-scale surveys and assessment studies, for example by the OECD PISA tests and secondary analyses of PISA data (Claro et al., 2012).

These two strands typically rely on either (1) small-scale case studies and experimental or quasi-experimental designs that delve deeply into specific contexts; or (2) large scale surveys that investigate self-reported access to, and/or use of, digital tools, and attempt to link such access to learning outcomes – without actually investigating how the technology is used across the investigated classrooms. In a sense, these could be seen as studies on micro and macro level, respectively. The former tradition typically draws from small samples and emphasizes local context and participants' own experiences, often with limited possibilities of generalization. The latter approach often draws on large sample sizes but can be critiqued for lack of attention to local contextual factors. While the methods used in both traditions have proven to be highly relevant for the field of ICT in education, there is an urgent need for more systematically sampled, comparative studies on the classroom level – the meso level – and more studies taking into account that relevant digital skills in for example mathematics grade 4 may be very different than relevant digital skills in language arts grade 8 or social sciences grade 12. In order to understand how technology affects classroom practices, we need to more carefully look into the didactical choices teachers make within their subjects – not only through self-reported data, but with robust observation data that links the intended didactical choices to actual teaching.

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Marte Blikstad-Balas is Professor in the Department of Teacher Education and School Research at the University of Oslo in Norway. Her research interests are literacy and the use of texts across contexts, including how digital technologies change what it means to be literate in school. She has published her research on these issues in acknowledged high-impact journals such as Reading Research Quarterly, Oxford Review of Education and Written Communication. She is the newly appointed editor in chief of the Nordic Journal of Literacy Research. She is also Vice Director of the Nordic Centre of Excellence QUINT (Quality in Nordic Teaching) and teaches and supervises at the Master and PhD-level at the University of Oslo. She is currently convenor of the EERA Network 27 Didactics – Learning and teaching and she has been appointed Link Convenor of this network in 2021.

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