Chapter 12
How to Improve K12 Teachers' ICT Competence in Finland: The Joensuu Region Case

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Abstract Unlike the usual, administration-led approach to plan and offer ICT training for K12 teachers, an action-driven approach emerges from the school activities at the grassroots level. A Finnish instance of the action-driven K12 teachers' ICT competence training was designed and implemented in the country's eastern region around the municipality of Joensuu in 2015. It was based on two innovations: (1) trying-out new ICT-based learning methods or tools as in-class tutoring by peer training, and (2) sharing the results at a regional continuing education festival. The innovations tacked four common challenges in the ICT training: level of abstraction, training transfer, financial, and professional identity challenges; all of them having a human and a technical dimension. A parallel case in the country's south western region helps to reflect upon the approach.

Keywords Finnish education · ICT competences · K12 · Teacher education · Contextualization · Computing education

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J. Zhang et al. (eds.), *ICT in Education in Global Context*,
Lecture Notes in Educational Technology, DOI 10.1007/978-981-10-0373-8_12

12.1 Background

12.1.1 Global Trends

There are remarkable national and international efforts to renew curricula to meet the requirements set by two interdependent trends: the so-called twenty-first century *human* skills demanded in a knowledge economy and the rapid development of *digital* technology. For example, Australia has introduced a 'Digital Technologies' curriculum, which addresses computational thinking and the use of digital systems and data, as well as cultural impacts of technology. The specific learning objectives of the Digital Technologies curriculum are heavily geared toward algorithmic problem solving skills (Falkner et al. 2014).

As another example, England's new national curriculum includes areas, such as "computing" and "design and technology". England's new curriculum will expose programming to pupils already during the first grades with the learning objectives to design, create, and debug simple programs. The new computing curriculum in England is divided into three stages, where the highest Stage 3 (grades 7–9 in the UK school system) includes rather specific computer science skills, such as sorting and searching algorithms, modularity, and decomposition (Brown et al. 2014).

A key question of the technology and computing education research (CER) community is the pedagogy that should be adopted when teaching ICT skills for all students (Falkner et al. 2014). As another evidence of the recent emphasis on the interaction between the human and the digital in education, one of the rising pedagogical issues is *contextualization* of teaching computing. The computing educators are more and more demanded to bring real-life context into their teaching (Rick et al. 2012). There is an ongoing debate whether additional, context-dependent knowledge distracts students when learning abstract computing concepts and context-independent skills. From another point of view, often the students are struggling and losing their motivation when they are not able to see how the decontextualized content would benefit them. Then, the context can provide relevance for teaching and learning (Guzdial 2010). Beside contextualization, the renewed curricula emphasize interdisciplinary pedagogical approaches and projects; another indication of the emerging importance of the encounter between the human and the technology.

The European Commission estimates a shortfall of up to 825,000 ICT professionals in Europe by 2020 (http://ec.europa.eu/digital-agenda/en/grand-coalition-digital-jobs-0). Of all job vacancies in ICT, computer programmers are the most in demand, outnumbering the demand for other ICT professionals. This far, there has been limited response from the European education systems. Estonia and England have already introduced computer programming for all ages across the school curriculum, and for example, in Denmark programming is taught at some school levels. Others countries, such as Wales and Finland, are about to introduce these new ICT skills in their curricula in the near future. In other countries, while

computing is not part of the compulsory curriculum, there are private and public initiatives and individual teachers who are trying to introduce programming into the classroom. It seems inevitable that all EU member countries must move in this direction if they are to meet the skills demands of the European economy.

It is clear that recent developments in school curricula and especially in ICT and computing education (CE) set new expectations for the learning environments and teachers' professional competencies. The main problem the school system is facing is the desperate shortage of teachers capable of delivering programming and coding as part of the curriculum. In particular, most primary school teachers feel hopelessly ill-equipped to do so and while there are an increasing number of extracurricular activities, such as technology and programming clubs for children, there are not enough ideas, resources, and training available for the teachers of younger pupils. This phenomenon is global—new school curricula all over the world propose that computing skills, including programming, should be taught at all school levels.

12.1.2 ICT Teaching in Finland

The basic right to education is recorded in the Finnish Constitution. It secures equal opportunities for every K12 student in Finland to get their education free including free textbooks and lunch during the elementary schooling. Finnish education policy is famous for quality, efficiency, and equity so every public school in the country is uniform in the quality. There are only margin of private schools in Finland and they all implement the same curriculum as do the public schools. Every Finnish school has its *school curriculum* that follows the National core curriculum. The National core curriculum is determined by the Finnish National Board of Education.

In Finland, the school curriculum does neither define the teaching methods, tools nor the textbooks. Teachers make their private decisions of the tools they use in order to implement the curriculum. In practice the teaching is arranged in the frames of those ICT tools that the school provides to the teacher and the class. The level of school ICT facilities and equipment has a great variation between the schools. The level depends mainly on the principals' decision of how to allocate the public funding among ICT resources and other school functions. In spite of the variation between the schools, Finnish schools in general have a good rate of ICT equipment.

Most of the K12 students also bring their own smartphones to the school with them, starting already from the first grade. Our estimate is that in the context of this paper, the Joensuu region in Eastern Finland, more than 80 % of 7 years old first grade students have got themselves a smartphone. In the group of 10 years old fourth grade students the number already exceeds 95 %. In practice, almost all the school children in Finland own a smartphone. Purchasing a smartphone to a child starting their school is a habit as common as purchasing a backpack or a pencil case. This is due to a Finnish habit of children spending their afternoons alone at home. There are no more landline phones at homes, so children need to have their own

mobiles. However, schools do not make use of this widely available resource of mobile devices efficiently for learning. This seems to be mostly due to the lack of teachers' ICT competence.

As indicated above, in 2016 also the Finnish education system is about to go through a major reform of the National core curricula following the reform of the school curricula in both the primary (in Finland: grades 1–6) and secondary (grades 7–12) education. This reform is about to bring more ICT skills required in the teaching of all subject areas. In the core of the new national curriculum for basic education (grades 1–12) stand also seven dimensions of broad-based competence, including ICT competence. Within the dimension of ICT competence, the new curriculum obligates that children should learn several ICT skills, including the basics of software programming, already from the early age of 5–6 years (i.e., at Kindergarten before grade 1). This is a strong message from the Finnish policy makers—the Government, the Ministry of Education and Culture, and the National Board of Education—to strengthen the role of ICT in education both as a learning tool and as a learning outcome.

All Finnish teachers have a Master's level university degree and they have a wide pedagogical training. A teacher's university degree may contain studies of ICT uses in education, depending on their university and time of graduation. Teachers are trusted professionals, who enjoy recognized professional freedom and opportunities to influence their own work, methods, and development of their schools. Working teachers are obligated to take part in continuing education and training for 3 days per year. This is usually arranged by the school or education providers within the municipality. Teachers have also a possibility to suggest any training to be counted in these 3 days. In Finland teachers have been given a lot of responsibility for their own professional development.

Due to the large autonomy that Finnish teachers have in their work and professional development, the teachers' ICT competences has a lot of variation. Most talented ICT users seem to be the ones that have a true interest in the topic. Finnish teachers are not evaluated in their work through any external or formal measures. In practice the same applies to the use of ICT in education. In a European survey, the Finnish schools were ranked at the top in the opportunities to use ICT in education, i.e., the amount of technology at the schools was very high (https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/KK-31-13-401-EN-N.pdf). Somewhat surprisingly, however, Finnish teachers' willingness to use ICT in education and self-confidence in their own ICT skills was found to be low. This is maybe due to factor that ICT skills and the practical application of those are not widely present and adopted in their university studies, and the leap to gain these skills through personal development is too challenging for many teachers.

As a conclusion, the rich digital resources possessed by the Finnish schools could be in a more effective and efficient use if the teachers had more readiness to use ICT in teaching. The implementation of the new K12 curriculum in 2016 brings about a growing demand for improving K12 teachers' ICT competence. The challenge is well known among Finnish policy makers, educational leadership, and

management, as well as concrete learning communities at schools: teachers, students, and parents. However, the success stories are few, and the readers of this paper are invited to form their informed opinions of the potential and merits of our intervention—an intervention that expects to learn from the shortcomings of earlier initiatives.

12.1.3 Case Study Design of the Paper

The case study presented in this paper addresses the socioeconomically rooted reasons that set particular challenges to renewing teachers' ICT competences. The teachers need to become fully able to teach ICT at K12 schools in a way that prepares the current school generations to the future society that is heavily founded on information and communication technology, as explicated in the policies of most governments. The study pays a particular attention to the innovative aspects of the case and its expected outcomes: the changes in teachers' attitudes to be part of the teacher-to-teacher movement to use ICT in most diverse and creative ways. The case study takes place in the crossroads of two global trends: the change of the humankind and the change of the technology.

The case study is based on an example of a regional intervention that addresses the challenges in K12 teachers' ICT competences by a teacher-to-teacher scheme in real school contexts. The intervention builds upon analyzed tacit knowledge of the challenges and is designed as a program where an expanding group of ICT-enthusiastic teachers serve as tutors among their peers. The intervention is a bipolar interplay between learning to apply ICT in the comfort of the teacher's own classroom and showing the successes to the peers at an annual science festival.

While the intervention is a regional one, we enrich our presentation by showcasing a related Finnish intervention from another region. While our primary case was carried out in Eastern Finland, in the Joensuu region, the reflective instance is from the Turku region, in the Southwestern part of the country (see Box 12.1). The presentation aims at an informed, or triangulated, view on how ICT competences among teachers can be enhanced in way that makes a difference—a true change—by renewing the level of integrating ICT in the everyday school practice, and getting teachers passionate about this opportunity.

At the point, it is worthwhile to remind that our intervention is *not* based on a baseline study of teachers' ICT competences, neither at the national nor the regional level. However, the work is based on the expectations and ideas of the new national curriculum that, again, is based on the informed view of the current situation. Complementary to the change requirements from the policy makers, we use tacit knowledge that the authors have gained over several decades from working with teachers and their struggle for better ICT competences.

Box 12.1: The Reflective Case from Turku Region, Background
The reflective case from Turku region is based on activities of ViLLE Team research group (www.villeteam.fi) at University of Turku connecting researchers, developers and teachers for joint development of the practice.

The group has acquired and conducted many projects with cities and municipalities in Turku region funded by Finnish Board of Education, Finnish education evaluation center and Ministry of Culture and Education. The main emphasis was laid on how to utilize new educational technologies with "common sense" in teacher's everyday life. The group has organized various teacher trainings and peer/tutor trainings with ViLLE—collaborative education platform using which teachers can easily create electronic courses, lessons, exams, and automatically assessed exercises. All created exercises and materials can be shared, utilized, commented, and evaluated by other teachers.

12.1.4 Initiative Description

12.1.4.1 Teacher-to-Teacher Feature

Our initiative was to improve K12 teachers' ICT competence and readiness to use ICT in teaching in a teacher-to-teacher way that would empower the teachers to openly try out new ways to enrich their teaching by ICT and *share* their experiences with their peers. Trying out would take place in tutor-based training at their own schools and in their own classrooms. For sharing, the teachers, in addition to co-learning at the own schools, would join a region-wide festival where they would teach their peers hands-on, based on their own, newly acquired skills. Thus, the initiative would take place as interplay between

- the school level and a regional level;
- one's own learning and teaching peers;
- doing with learning; and the human aspect of empowerment and the digital aspect of the tools to be learnt.

We focused on K12 teachers in the Joensuu region, located in Eastern Finland. The choice of a regional approach for this study means that both the intervention and its analysis emphasizes the changes at the grassroots level, whereas a national focus would yield results at a higher level of abstraction. The context is described in more detail in the Implementation plan.

In particular, we aimed to improve teachers' ability to use ICT toward the level needed for the implementation of the new K12 curricula. The new Finnish K12 curricula are characterized by the use of ICT as both a tool and a learning outcome in all the subject areas.

12.1.5 Overall Objectives

As a regional project, supported by public funds, our objectives were pragmatic and based on the concrete challenges identified from the everyday school practice. Based on the authors' extensive experience in ICT training for K12 teachers in two regions of Finland, we can summarize the practical challenges in teachers' ICT competence and continuing ICT education in the Joensuu region as exemplified in the following:

1. Level of abstraction challenge. Training requested by the teachers should often be more pragmatic than the one commonly given by commercial ICT consultants.
2. Training transfer challenges. ICT training given by an ICT consultant transfers poorly to practice if the consultant is not a working teacher himself.
3. Financial challenges. Schools do not have financial resources to hire a substitute for the teacher that is taking part in ICT training outside the school.
4. Professional identity challenges. Teachers need to believe in themselves better. Teachers' professional identity need to be developed to include also the aspects of ICT use in education.

It is worthwhile to observe that all of the four categories of challenges have both a human and a technical, or digital, dimension, and the one can easily identify many more examples of them in addition to those mentioned above. For example, financial challenges have a human aspect of prioritizing and making decisions of the allocation of resources, and a technical dimension of substituting a teacher as a digital tutor. A financial challenge can also materialize as a demand for renewing the utilized digital learning platform. However, it is the above-mentioned challenges that our very initiative wanted to solve.

12.1.5.1 Innovation 1: Trying-Out by Peer Training

Our first innovation was to offer the teachers highly pragmatic ICT training that would transfer straightly into new practices better than before. We implemented it in the way that would not raise a need for hiring substitute teachers. The best trainer for that was found out to be a peer teacher with wide knowledge of both the ICT use and the new curriculum. The trainer was then asked to act as an ICT tutor to another fellow teacher or a small group of teachers.

The training took part in several manners; by private individual tutoring, by small study groups and by in-class tutoring. By *in-class tutoring* we mean training given to the teacher and his students in the class. This happened during the real school lesson. This was planned for two reasons. First, we wanted to avoid the need for hiring substitute teachers. Second, in-class tutoring helped to implement and practice the newly acquired skills as there was support and backup to the teacher while trying a totally new learning method or learning tool.

We also planned that ICT tutors would collect a group of suitable teachers for educating other teachers, thus expanding the primary peer tutor network. During their visits to the schools, ICT tutors collected information about suitable workshop holders for the incoming event of continuing education. During the ICT tutors' visit, teachers gained a new talent and afterwards they were asked to share it with other teachers by arranging their own workshops at a SciEDU continuing education event later during the semester.

12.1.5.2 Innovation 2: Sharing at SciEDU Continuing Education Festival

Our second innovation was to empower the teachers to find and recognize their existing ICT competence. To achieve this goal, we organized together a science and technology continuing education festival that we named SciEDU. It was meant for both the fellow teachers and also for the whole community of Joensuu region, for transparency and visibility. Organizing the SciEDU festival relied on the Joensuu region's teachers' cooperation and willingness to educate each other within the region.

At the SciEDU continuing education festival there were teachers from every school introducing their grassroots level ICT projects and teaching methods to their colleagues. The whole program was arranged according to the new 2016 curriculum to implement it already beforehand. This was actually the first time ever that the new curriculum was actually implemented beforehand.

Every teacher of the Joensuu region was assigned to take part in the science festival either as a visitor or as an organizer. Visitors got a 6 hours' continuing education day from their employees to take part in the program, and the organizers got if for organizing the program to the visitors. This was a real-life learning-by-doing experience for both the organizers and the visitors.

The SciEDU event was also designed to be a mobile game in itself to make the teachers familiar with the concept of gaming in education. This was arranged by using a Smartfeet mobile application that could run a game designed by the ICT tutors. See Fig. 12.1. Visiting teachers took part in the game with their own mobile phones or tablets.

To engage with the rest of the community and its various stakeholders, not least the parents of the school students, and to get visibility of the importance of learning ICT competences at school, the SciEDU festival was also open and free to access for the whole community. Anyone could come to the festival to meet the teachers of their children, see the new learning methods in action and see the new tools being demonstrated. At the same time it was also possible to see how the teachers are being trained toward the upcoming new curricula.

Table 12.1 indicates how the innovations described above were expected to meet with the identified challenges.

Funding. For ICT tutoring, we applied funding from the Finnish Ministry of Education and Culture. We received a 70,000 euros' grant for hiring one full-time ICT tutor and one part-time ICT tutor to work at the Joensuu region schools for

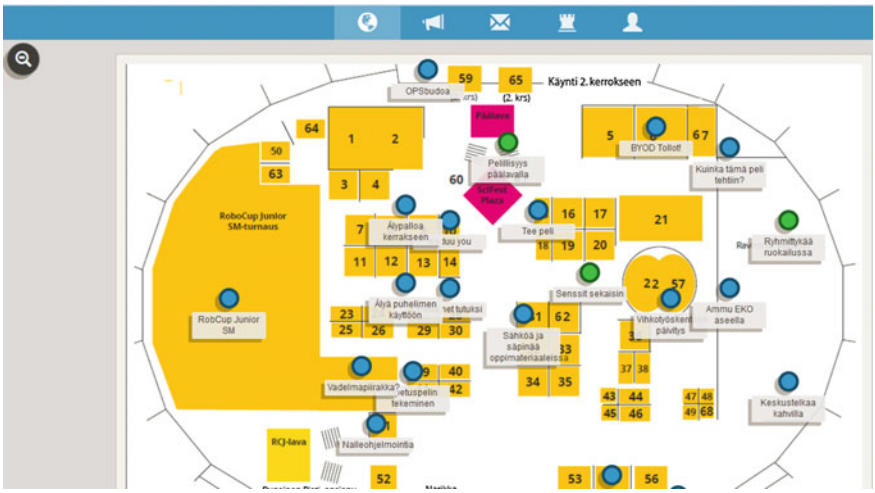

Fig. 12.1 Seppo mobile game. Seppo mobile game in SciEDU continuing education event. A player's map over the game zone Joensuun Areena. *Numbers* resemble the workshops given during the day, *dots* resemble the events in the Seppo mobile game

Table 12.1 Innovations meeting challenges

Challenge	Innovation 1: trying-out by peer training	Innovation 2: sharing at SciEDU continuing education festival
Level of abstraction	Giving continuing education in ICT competence via learning-by-doing: recognizing the organizing work also as one method of receiving continuing education	Continuing education event expanded as a mobile game
Training transfer		ICT tutors encouraging the teachers to demonstrate their new skills in the SciEDU continuing education event
Financial	Practical ICT tutoring at the schools by a fellow teacher during the lessons	Continuing education event open to all teachers of the area implementing the ICT skills needed for the new curricula
Professional	Empowering teachers' ICT competence via SciEDU teachers' continuing education event	

1.5 years. This funding was meant only for the salaries and traveling over the geographically wide area of Joensuu region.

For the science and technology festival SciEDU and its 1200 teacher participants, we did not have a specific funding at all. We made the festival mostly by voluntary work and with the strong support of SciFest Science and technology festival overlapping for the day. SciFest was arranged at Joensuu Areena building by the Joensuu Science Society and the University of Eastern Finland. Joensuu Science Society and University of Eastern Finland covered together most of the expenses of the infrastructure to the event.

Our objectives were to reach all the teachers of the Joensuu region by empowerment and to enhance the ICT competence of the teachers.

The description of the initiative in the reflective case, with its innovative features, overall objectives and funding, is presented in Box 12.2.

Box 12.2: The Reflective Case from Turku Region, Initiative Description

In Turku region, the challenges and actions were quite similar to Joensuu region. Here we present two innovations to tackle these challenges.

Innovation 1: Sharing Electronic Learning Resources Through ViLLE Collaborative Education Platform—"From Teachers to Teachers"

ViLLE is a collaborative education platform, enabling teachers to create electronic courses, lessons, exams, and automatically assessed exercises easily. All created exercises and materials can be shared, utilized, commented, and evaluated by other teachers. Moreover, ViLLE automatically gathers data about students' learning behavior and performance while they are using the platform. This creates new research possibilities as huge amount of quantitative and qualitative data becomes available.

The deliverables from teacher training and peer tutoring sessions included electronic exercises, lessons, and exams which were published in the ViLLE platform for public use. This enabled sharing electronic learning content and collaborative work between teachers in very pragmatic way.

Innovation 2: Peer/Tutor Training in Classrooms

All training sessions were connected to the ViLLE platform. The main goal for the tutoring session was to ensure that all participants achieved positive experience of using learning technologies in classroom with various learning settings. Instead of just showing how to use technologies in classrooms, teachers were given the possibility to find their own ways of adapting the platform to support their classwork.

- Teacher, peer/tutor trainings with ViLLE Team research group
- The use of ViLLE—collaborative education tool:, i.e., utilizing automatically assessed exercises with immediate feedback in various learning settings
- First four learning sessions with the teacher were peer/tutor trained by ViLLE Team research group member
- Followed by three learning sessions later in the course's timeline in which the goal was to reflect and to catalyst the adaptation process.

12.2 Implementation Plan

The implementation context: the Joensuu region

The scale of the implementation was local and regional. For this implementation, we chose the Joensuu region that covers an area of seven municipalities, with 12,000 elementary school students, 1000 elementary school teachers, and 200 high school teachers. Joensuu region is geographically challenging area for cooperation because it is scattered and wide.

The schools of the region are located in urban and suburban settings of towns and in the rural countryside. Municipalities differ in their size and resources for education. In our implementation, we planned to reach 100 % of the primary school teachers (grades 1–6) and 30 % of secondary school (grades 7–12) teachers of the region, either via peer tutoring or via the SciEDU continuing education event. We did not aim to reach all the secondary school teachers, because there was another extensive series of continuing education for two main secondary schools of the region going on at the same time and their teachers were already signed up for the events of those series.

A dual strategy

According to the initiative description, the plan was to organize a dual of ongoing ICT training and an annual gathering for sharing the competences learned at schools with peers, i.e.,

1. *Peer training* to the local schools by having an ICT tutor teacher rotating between the schools for the whole school year; and
2. SciEDU continuing education festival to be held for the teachers and for the community with the following principles: free for everyone to access; free of charge to the schools, participants, and visitors; implementing the upcoming curricula in practice; encouraging teacher cooperation and voluntary work in event organizing; having a mobile game in event itself for intensifying the participation of the teachers.

Due to the dual plan, the plan consisted of two intertwined threads: one for peer training, and the other for the SciEDU festival. The focus of both of the threads was to ensure that technology contributes to the effective teaching and learning. The effect of the intervention, and thus the outcome, was to be evaluated by how the four challenges presented in the initiative description were met.

The peer training was planned to be realized by the schools' demands, so the emphasis was on hiring capable ICT tutors (see below) for the task.

The SciEDU festival was to be arranged as a part of the SciFest festival as a set of workshops. Again, the plan was not to define the program beforehand, but to assemble the program of the festival from what would emerge from peer training. Moreover, the workshops were expected to feed back to peer training. The overall plan for the festival is given below.

SciEDU Program
8.30 Doors open, registrations
9.00 Opening speech, National Board of Education
9.15–10.15 Workshops
10.30–11.30 Workshops
11.30–13.00 Lunch and exhibitions
13.00–13.45 Workshops
13.45–14.00 Coffee break
14.15–15.00 Workshops
15.00 Closure and awards

Designing the Seppo game. A Seppo educational mobile game for the SciEDU day was built beforehand. Seppo is a commercial product made by Flying Chalkboard Ltd. Seppo is alike a board game that is in the internet and that can be played via mobile phones, tablets, or computers. Our game had one task for every workshop at the event. The mission was to complete as many tasks as possible during the 6 hours' training day. The game was meant to be played in groups of ten participants. In practice, this meant that all the members of the groups were able to collect points at the same time from different tasks. This allowed participants to make individual choices about their own continuing education plans. To make the game a bit more exciting there was some mission about socializing too. For example, the group members were asked to have lunch together and post a selfie photo for the game from the lunch and form the coffee break. This was made to encourage teachers to get known with each other.

Human resources to be allocated.

12.2.1 Hired Staff

Project was to be led by the ICT coordinator of the City of Joensuu Educational services. The project organization was planned to be carried out by two ICT tutors, who would work for the Joensuu region under the supervision of the City of Joensuu Educational services. Also the curriculum coordinator of the Joensuu region was to take part in the weekly planning sessions. Some help for organizing was also to be given by the ICT group of Joensuu region, which consists of ICT specialists from the municipalities involved.

As the ICT tutors, the plan was to hire two experienced teachers with good ICT skills and a wide knowledge over the new curricula.

12.2.2 Joensuu Science Society

In addition to the schools and teachers taking part in the implementation, the group of organizers consisted of several stakeholders. An NGO promoting science

education, called Joensuu Science Society, had hired one full-time person to build the SciFest event (www.scifest.fi) overlapping the SciEDU event. A lot of practical help was gained from taking into account the experience gained by Joensuu Science Society over the 10 years of arranging the SciFest science and technology festival for the children. Building up the SciFest to the venue of the Joensuu Areena gave a ready setting for the SciEDU event to occur easily.

Other stakeholders. University of Eastern Finland took part in the organizing of SciEDU event mostly via the School of Computing and the Department of Physics. Collaboration with all the municipalities of the region, several local enterprises, ICT specialists and authorities was essential. The whole ICT competence improving project was carried out together with another project about curriculum reform at Joensuu region.

12.2.3 Planning Schedule

Planning the festival was started in January 2015 by seeking for the appropriate workshop organizers and by informing the principals of the local schools for incoming training event for the teachers by the Educational services of the City of Joensuu. The amount of the participating teachers was counted in the first hand to make sure that the scale of the event would be planned correctly. The amount of workshops needed was accounted from the number of expected teacher visitors. The original plan had one workshop organized for every 20 teachers. When the amount of workshops was estimated, the ground plan for the festival infrastructure was drawn by Science Society of Joensuu.

The following 2 months were allocated for booking the workshop holders to the event. Approximately, half of the workshops were arranged by the fellow teachers working at the local schools. The other half was arranged by local companies that were connected to technology and education. The motivation for the companies to take part in the event was in both the teachers and the community, as the event would be open to all the community of Joensuu to visit during the day.

Every workshop holder was assigned for a place in the event and they were asked to bring all their supplies with them. Joensuu Science Society and University of Eastern Finland supplied the electricity and wifi for the workshops. Joensuu Science Society and Educational Services of City of Joensuu were responsible for the signs and maps displaying the arrangement and the names of the companies and workshops. All the workshop holders were called into arrange their workshops already a day before, so the festival would be ready in the morning when the event would start. This was made clear to all the workshop holders beforehand to make sure to have both a professional appearance of the event and a peaceful environment to the visitors to arrive.

12.2.4 Effectiveness Aspects of the Plan

Since the schools of the Joensuu region were already reasonably well equipped with ICT tools and other resources, the emphasis in the effective implementation of the plan was on rational allocation of the hired staff, to make sure that the program will make a difference it was expected to have. The following aspects were supposed to guarantee the results.

ICT tutors were expected to approach all the schools of the area via email and offer their services. One ICT tutor was to make careful bookings for her visits to the schools. The days of her services were to be booked up by the reservation order. She was also supposed to inform the schools for the rule of 2 weeks. This rule intended to keep her from staying over 2 weeks at the same location to ensure the rotation and allow as many schools to get her services as possible.

The ICT tutor was to be equipped with a set of 25 iPad2 devices to borrow to the school classes for a week. Her weekly plan was to go to schools on Monday to give one or two classes of the same school an iPad kickoff training. Devices were left to the class for 1 week to borrow. For the other days, ICT tutoring was to be booked to other schools to practice ICT use with their own facilities. The main idea was to demonstrate that there is much to do even with a limited number of devices.

At her visits, the ICT tutor was expected to encourage the schools to take part in the planning of the SciEDU event. The idea was that those teachers who would gain new skills via ICT tutoring would come to the event and arrange a workshop of their own. The ICT tutor was to share information about the upcoming events to the schools to prepare them for participating the event.

For a few days, ICT tutors we supposed to work at office and help with the arrangements for the SciEDU event, plan incoming training sessions, update the project website and coordinate the peer training part of the project. They were also to arrange small workshops for the teachers about media literacy and copyrights.

12.3 Implementation Process

As mentioned in the Implementation plan section, the implementation process of the planned intervention was *action-driven.* This means that the plans for the two main threads of the intervention—peer training and the SciEDU festival—were only to set up both streams, and then the implementation emerged from the actions of the streams. In addition, the peer training fed into the festival as workshops designed and carried out by the peer-trained teachers. Therefore, the implementation process was not supervised but supported, and was therefore not analyzed to the detail. Hence, this section presents the main features of the process, while the outcomes are collected and analyzed the Outcomes section.

The way of implementation was the key factor for the innovativeness of the intervention. We wanted the process to be open and attractive for the participants'

ideas and actions, without deciding beforehand the topic of, e.g., the workshops. While the actions grew from the grassroots demands of the school practice, the intervention paved the way how ICT can change the conventional schooling.

The implementation process took place in school year 2014–2015, from August 2014 until July 2015. During the implementation peer training was arranged in 70 personal training sessions, in total for 275 h by ICT tutors. There were also 22 small workshops arranged by the ICT tutor in the schools during the implementation.

Peer training was given to the teachers and classes in the following themes: the use of iPads in preschool education, the use of iPads in primary education, the use of the local e-learning environment called peda.net, copyright issues, and media literacy.

Science and technology festival SciFest was held in April 23–25 and had 11,000 visitors, mainly school classes and teachers. The SciEDU teachers' continuing education festival was held on Saturday 25 of April. There were voluntary teachers from the local schools and local companies, arranging 69 workshops to over 1100 teachers that took part in a 6 h training day. The SciEDU Saturday was arranged as a part of every working teacher's compulsory 3 days allocation for continuing education. The decision to do so was given by the heads of educational offices of all the seven municipalities in the Joensuu region.

SciEDU was a mobile game in itself. While entering the building of the Joensuu Areena, the teachers also entered the Seppo educational mobile game that was designed and implemented for the SciEDU day. Teachers used their own mobile devices, e.g., tablets and mobile phones, for entering the game. They earned points for their groups by taking part in the different workshops. Groups were allocated randomly to enhance cooperation and getting involved with new colleagues. There were 6 h time to play, and at the end of the day the winner group was announced and awarded a small prize.

12.3.1 Process Management

The process was managed by a small core group of organizers. To the group belonged representatives from the City of Joensuu Educational services, Joensuu Science Society and University of Eastern Finland. Joensuu Science Society and University of Eastern Finland took together care of the infrastructure of the festival place including building the festival arena: illumination, partition walls to the workshops and basic functions of the festival. The City of Joensuu Educational services sought for appropriate workshop organizers, accepted the registrations of the visitors, informed the teachers in advance, and organized the mobile game of the day. Process management was done in the most cooperative and informal way, leaving space for the innovations and fast changes for the program of the day. Authority was replaced by shared expertise and trust.

The whole SciEDU event was arranged by a specific way of voluntary work, called "talkoo" in Finnish. That is a Finnish word for voluntarily carrying out an

extensive task together, with a large group of participants for common good. The word does not translate well to other languages, as it is typical of Finnish culture. There was no money paid for the workshop organizers or other staff that worked in the event. The only expenses of the event rose from the infrastructure and lunches for the participating teachers. Compared to volunteerism in, say, the Anglo-Saxon context, the Finnish talkoo concept resembles collaborative actions occurring, e.g., in the Amish communities.

12.3.2 Change Management

The motivation for the urgency of change management in the project is rooted in the target group's, i.e., Finnish teachers' highly autonomic role at schools. They do not easily buy the givens at the continuing education courses. ICT, much too often instructed by commercial consultants (see Initiative description above), easily raises a critical or even negative attitude. Therefore, the key idea of our intervention was to renew the school from inside, by a teacher-to-teacher approach, concretized in both peer training and the SciEDU workshops. The best advertisement for new practices is success stories, shared by peers.

The whole program of professional continuing education about ICT and technology was itself a huge process of change management, applied to the teachers' community. It aimed at the transformation of teachers and school organization to a state of welcoming and being able to implement the new curriculum in teaching with the help of ICT. A major focus of the change management was the attitudes toward a continuing state of change in the school world. By both the peer training and the SciEDU festival we encouraged the teachers to embrace the change instead of being afraid of it. By inviting teachers from every school to arrange workshops, we empowered the schools and teachers by letting them to notice that they already hold the keys and tools to the incoming curricular change by themselves.

The change management orientation of the intervention allowed us to identify several factors that affect teachers' perceptions and attitudes toward the changes opened by the new technology and the skills that are required to utilize the new tools in teaching. Teachers may feel *fear for technology* so that they do not know enough about rapidly evolving ICT tools that are brought into schools. Being aware of the "state-of-art" requires a remarkable effort and motivation to follow new products and to get familiar with their possibilities. However, teachers often forget that also existing and familiar tools can be applied creatively to deliver meaningful solutions and ICT education that is well aligned with the new curriculum.

Teachers might feel that they have lack of ICT skills that are needed to reach the expected quality in teaching. This is often connected to the fear of losing control when using technology in teaching. Students are in many cases more skilled ICT users than teachers, and they have their own mobile and smart devices with them. This easily leads to a situation where technology is considered as a distraction rather than advancement in the classroom. The recent "Bring Your Own Device"

(BYOD) concept may help to overcome this issue, but BYOD approach is not often appreciated by the school management and IT departments. Furthermore, teachers, especially the experienced ones, have probably used same teaching materials and methods for years but adopting new technology in teaching causes inevitably extra work that falls to the top of other professional duties.

The implementation process of the reflective Turku case in given in Box 12.3.

Box 12.3: The Reflective Case from Turku Region, Implementation Process

In the reflective case in the Turku region, there were readymade electronic materials and exercises for many topics in the ViLLE platform. The types ranged from automatically assessed exercises to electronic exams and interactive tutorials.

The whole process included the following steps:

- **Step 1: Teacher training**
  Teachers were introduced to many success stories about utilization of educational technologies and methods in teaching with practical approach.
- **Step 2: Adopting technologies with the tutor/peer**
  Teacher was instructed to find, with the tutor's aid, the ways how she could adopt novel technologies and methods in her teaching.
- **Step 3: Tutor/peer training in classroom**
  Four to six consecutive tutoring lessons in which the tutor aided the teacher to carry out the adopted change(s) in practice.
- **Step 4: Feedback collection**
  The process was reflective and the feedback was collected from the teacher and from the students to make necessary changes to the learning methods and materials.
- **Step 2–4: Sharing of electronic resources through ViLLE**
  In all phases of this process the ViLLE platform was used for utilizing existing and sharing of created electronic learning resources.

The third step was really important because while introducing new technologies the teacher needed to overcome many big "mental" hurdles like how to get student's into the platform, how to reset passwords for students, etc. When we combine this with the teacher's low self-confidence in the use of technology, the tutor's role as mental support was crucial for getting positive experiences.

By utilizing these steps the teacher felt that she received the support she needed. Many changes were small in the beginning of this process, like introducing small number of automatically assessed homework exercises, an electronic lesson, or electronic exam, etc. After the positive experience, many teachers utilized more and more changes with growing self-confidence, motivation, and attitude ("I can do this").

12.4 Outcomes

We implemented the new Finnish curriculum for the first time in Finland for a whole training day at SciEDU2015. We arranged the SciEDU continuing education festival for 1200 K12 teachers. There were over 70 themes raising from the philosophy of the new curriculum, all implementing various uses of ICT in the education. The whole co-training event was also a mobile game in itself. We got 1200 teachers to play through it during the day. They all got familiar with the concept of using gaming in education by their first hand experience.

The implementation of our dual strategy in enhancing K12 teachers' ICT competences in the Joensuu region was successful. The set of the outcomes from the project can be outlined as follows:

1. Quantitative outcomes, like the number of the trained teachers;
2. Qualitative outcomes, like the feedback from the participants and other stakeholders;
3. Peer training materials;
4. Workshop outputs;
5. Concepts and models;
6. An analysis framework for evaluating the effects of teachers' ICT competence training actions; and
7. Other benefits for the stakeholders.

Below, we will briefly concretize our main outcomes. However, since the quantitative and qualitative outcomes do not have a general validity outside of the region, we do not address them in this paper. The same applies to peer training materials that are completely in Finnish.

12.4.1 Workshop Outputs

An analysis of the workshop outputs reveals that a grassroots level approach which relies upon the teachers' own demands yields a set of workshops that cover the diversity of the original challenges surprisingly well. The workshops supported a large spectrum of ICT competences for different school levels and met the diverse challenges.

12.4.2 Concepts and Models

As an outcome we created a new way of peer training K12 teachers in a considerate and personal way via the Carelia ICT model, developed in the project. Figure 12.2

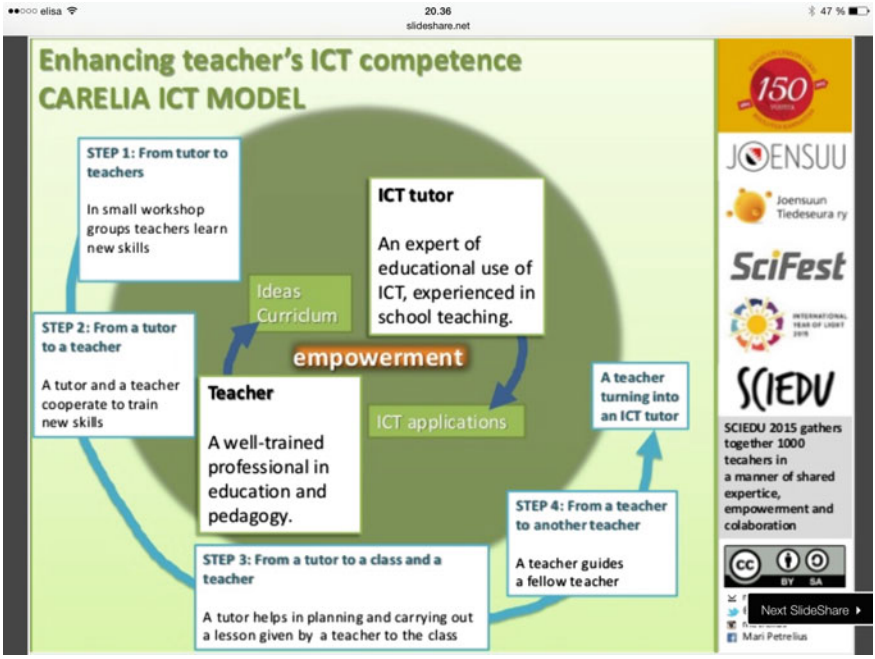

Fig. 12.2 The Carelia model

shows how the model expands ICT competence by transforming novices into peer trainers of their colleagues.

An analysis framework for evaluating the effects of teachers' ICT competence training actions. We derived a scheme that allows the organizers of a teachers' ICT competence training action to easily collect data on how the activities contributed to the growth of diverse ICT competences, checked against the challenges identified in a given context. Besides for evaluation, the framework can also be used as a planning tool for a given action.

Other benefits for the stakeholders were the following. The City of Joensuu and municipalities in the Joensuu region achieved a comprehensive training and first hand experiences for using ICT in education according to the new 2016 curriculum. Joensuu Science Society got to expand its science festival concept to the continuing education of the teachers from Kindergarten to the secondary school level. For the University of Eastern Finland, SciEDU gave a new way for recruitment and training of teacher students.

The outcomes of the reflective case in given in Box 12.4.

Box 12.4: The Reflective Case from Turku Region, the Outcomes
The outcomes of the reflective case in Turku are divided to number, pedagogic, and other outcomes.

In numbers

- More than 15,000 students are utilizing ViLLE platform
- More than 1000 teacher are utilizing the platform
- Over 750,000 exercises are automatically graded annually
- More than 7,500,000 immediate feedbacks for student while learning
- More than 15,000 public exercises in electronic form created by the teachers that are sharable
- Hundreds of readymade courses in public content

Pedagogic outcomes

- Teachers were more confident of using educational technologies
- Teachers were open minded to sharing their electronic learning content and doing collaborative work with others
- The changes are not limited just utilizing electronic learning content, the teachers found news ways to deliver education with technological support

Other outcomes

- **Data collection**: Huge amount of education data is stored while student are solving the exercise in the ViLLE platform
- **Learning analytics**: Educational data collection creates new research possibilities. For example, the researchers can conduct big scale learning analytics studies like automatic recognition of student's misconceptions and preventing drop-outs, and targeting extra support for those who are struggling.

12.5 Conclusion

Improving K12 teachers' ICT competence by pragmatic teacher-to-teacher ICT tutoring got a positive approval and feedback from the teachers, principals, and the school communities. It was given specific credit for its flexibility, personalized manner, and easy approachability from the communities. Principals and school leaders appreciated the easiness of the continuing education concept via an ICT tutor and the ready planned and carefully chosen contents of the training sessions. Teachers gave credit about the personal features of the ICT tutors as well as the reliability and good spirit in the training sessions.

The main limitation for the success was the amount of ICT tutors compared to the amount of teachers and schools. In the near future, we will increase the amount of ICT tutoring at the schools. For this we have applied and already received 600,000 euros funding from the Ministry of Education and Culture. With the help of new funding we will be able to hire four ICT tutors for the region to work until

the end of 2016. By that time the new curriculum should be taken into daily use at the schools and the need for improving teachers' ICT competence has to be met.

Improving K12 teachers' ICT competence by empowerment via arranging the SciEDU continuing education festival was a success. We got to arrange an event that was a mobile game in itself and that gave a possibility to individual teachers to choose the program for 6 h training day by themselves from a selection of 76 workshops.

The four challenges of teachers' continuing education in ICT competence were met. By the feedback collected from the trained teachers it was clear that teachers' ICT training at the schools by the peer ICT tutors had got more pragmatic than training before by the ICT consultants, as we aimed in the first hand. The teachers did like the peer ICT tutoring a lot and they found it to be a good and personal way of receiving continuing education. The feedback contained a lot of personal thanks targeted at a specific trainer person. This makes us assume that the personality of the ICT trainer is actually an important tool and that teachers working as peer ICT tutors should possess accessible and friendly attitudes and therefore be selected carefully among the staff. It seems to be easier to go through one's personal professional development challenges with the support of a friend. Many of the trained teachers did get friends with their peer trainer.

As Finnish teachers do not go through a formal evaluation of their work, we have no quantitative way for measuring the trained skills transfer into the practice. Yet the feedback collected from the trained teachers gives us a signal that there has happened a change in the teaching methods and tools among the teachers trained in their class. The change pursued by this new continuing education method cannot be measured in one semester. It will show its merits in a more indirect way throughout the coming years and the implementation of the new curriculum in the schools of the Joensuu region.

There was no need to substitute teachers at the schools during this continuing education project. The training sessions were carefully planned and implemented either in the classroom with the whole class or at the time when the teachers were not involved in teaching, e.g., afternoons and jumping hours of their schedules. The SciEDU continuing education festival was arranged on Saturday when Finnish schools are not open. It was included in the amount of continuing education that the Finnish teachers need to take every year.

The change in the challenge of believing to themselves better and growing in professional identity as an ICT user is long and continuing. We believe that the amount of workshops arranged in the SciEDU continuing education festival by the local teachers was high. There is nothing to compare it with, since the event was the first of its kind. Over a thousand of teachers took part in the SciEDU continuing education event for 6 h. They all got to learn about gamification by doing it themselves during the event. Teachers were allowed to choose freely the practical workshops in the areas of their personal interest.

The reflective case from the Turku region features similarities to the Joensuu case. However, in Turku case the teachers could share their learning and new competences by the ViLLE platform. Similar and still somewhat complementary

experiences indicate a need to learn from a given region at the grassroots but at the same time learn from the experiences from another region. While a national, top-down curriculum has its merits, its realization has to take place from within schools and their realities.

Future Directions

The future will bring novel opportunities for the schools to apply ICT in a way that bridge digitization with the emerging human demands. The technology can embed the school into its context, so that learning takes place in a natural setting, on demand. This is based on open architectures that allow access and sharing of others' resources. It requires a new attitude from teachers to collaborate and constructively evaluate their own and others' materials and tools. Finally, technology does not dictate the way to learn in a given way, but rather follow one's own way and style of learning, as in a buffet.

A naturalistic approach—combined with advanced learning analytics—to learning paves way to digitizing one's learning path from a toddler to a doctor, in a learning landscape that exceeds limiting and artificial boundaries in a transdisciplinary way. For the teachers' ICT competences this trend and development means a continuously increasing challenge: it is also the continuing process itself that will be embedded in the everyday school practice as its ubiquitous thread.

To fully utilize and even enjoy the opening opportunities, the learning community needs to work in a glocal way: locally within a given learning setting, and globally sharing ideas, technologies, and common ethics.

References

Websites

https://peda.net/joensuu/jm
ICT-tutoring project for Joensuu region, http://www.carelianict.blogspot.fi
Learn more about Seppo educational game, http://www.futurelearningfinland.fi/
SciEDU2015 event, http://sciedu2015.blogspot.fi
ViLLE Team research group, http://www.villeteam.fi

Literature

Brown, N. C. C., Sentance, S., Crick, T., & Humphreys, S. (2014). Restart: The resurgence of computer science in UK Schools. *Transactions on Computing Education*, *14*(2), Article 9, 22 p. doi:10.1145/2602484, http://doi.acm.org/10.1145/2602484

Falkner, K., Vivian, R., & Falkner, N. (2014). The Australian digital technologies curriculum: challenge and opportunity. In J. Whalley & D. D'Souza (Eds.), *Proceedings of the sixteenth australasian computing education conference—Volume 148 (ACE'14)* (Vol. 148, pp. 3–12). Darlinghurst, Australia: Australian Computer Society, Inc.

Guzdial, M. (2010). Does contextualized computing education help? *ACM Inroads, 1*(4), 4–6.
Rick, D., Morisse, M., & Schirmer, I. (2012). Bringing contexts into the classroom: A design-based approach. In Proceedings of the 7th Workshop in Primary and Secondary Computing Education (pp. 105–115). ACM.

Author Biographies

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The team is developing ViLLE—collaborative education platform which is used in more 15 countries with more than 1 million submissions in a year with 7,500,000 immediate feedbacks to learners in all education levels. See: http://villeteam.fi.

Dr. Ilkka Jormanainen works as a postdoctoral researcher at edTechΔ research unit of University of Eastern Finland (UEF), School of Computing. His research interest includes educational data mining, educational robotics and tangible interfaces, and other concretization tools in education. He is also currently coordinating UEF participation in two Erasmus + KA2 Strategic Partnership projects (CONSTRUIT! and TACCLE3) focusing on developing programming education in Europe. Previously Dr. Jormanainen has been working as a project manager in a EU-funded "Congregational Mobile Technologies" project at the School of Computing, University of Eastern Finland, and as an Executive Director of Joensuu Science Society. In his work at Joensuu Science Society, he was leading and developing the annual SciFest festival for science and technology for 3 years. Furthermore, he has been strongly involved in development of SciKids' technology education concept at the University of Eastern Finland (formerly University of Joensuu). Dr. Jormanainen has consulting, research, teaching, and administration experience from various international initiatives in Finland, South Africa, Nepal, Tanzania, Zambia, and Mozambique. He has coauthored and published more than 20 academic papers.

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Sutinen has been working earlier at Purdue University, University of Linköping, and University of Eastern Finland. In 2010–12, he worked as the chief technical advisor of STIFIMO, a 22 M€

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Professor Sutinen received his Ph.D. in Computer Science from the University of Helsinki in 1998. In 2010–12, he was an extraordinary professor at North-West University in South Africa and, and is an adjunct professor at Tumaini University in Tanzania. He has also a secondary school teacher's qualification.