ДИДАКТИЧЕСКИЕ АСПЕКТЫ ИНФОРМАТИЗАЦИИ ОБРАЗОВАНИЯ

HOW FINNISH TEACHERS ARE ENCOURAGED TO ADOPT INFORMATION AND COMMUNICATION TECHNOLOGY

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The aim of this reflective paper is to analyse how Finnish teachers are encouraged to adopt the use of information and communication technology (ICT) in teaching and learning. The paper is based on our research group experiences. First, a Finnish education context and a Finnish school model are introduced. Second, different approaches, like strategy-based development and pre- and in-service teacher education approaches in the context of ICT use, are discussed. Finally, the outcomes of 25 years of development of ICT use in education are briefly evaluated. Most examples are presented in the context of science education.

Key words: education in Finland, information and communication technologies, teachers preparation and retraining.

Finnish Education Context. According to Finland's "equality" policy, students should have equal opportunities for learning; therefore, education is free, including books, meals, and health care. One important consequence of this policy is effective special education. Its aim is to prevent student dropout and support the learning of all students. The basic education act emphasises different levels of support for individual students [17].

Another characteristic of Finnish education is the culture of trust. Education authorities and national-level education policymakers trust teachers, together with principals, headmasters and parents, who know how to provide the best education for children and youth in a particular district. Schools and teachers have been responsible for choosing learning materials and teaching methods since the beginning of the 1990s, when the national-level inspection of learning materials was terminated. Moreover, there have been no national or local school inspectors since the late 1980s. Teachers are valued as experts in curriculum development, teaching, and assessment at all levels [16].

Finnish Schools. Finnish school operations could be approached using the framework of the National Core Curriculum for Basic Education [16]. This national document

describes the values and aims of the Finnish school system, as well as the roles of teachers and principals. National values, like equality and the aims described in the curriculum, are guiding the schools' processes and the behaviour of school professionals. For example, teachers are to prepare the school curriculum and lessons, and then implement their teaching and assessment in line with the curriculum. In addition, there is no national-level testing in Finnish schools (Figure).

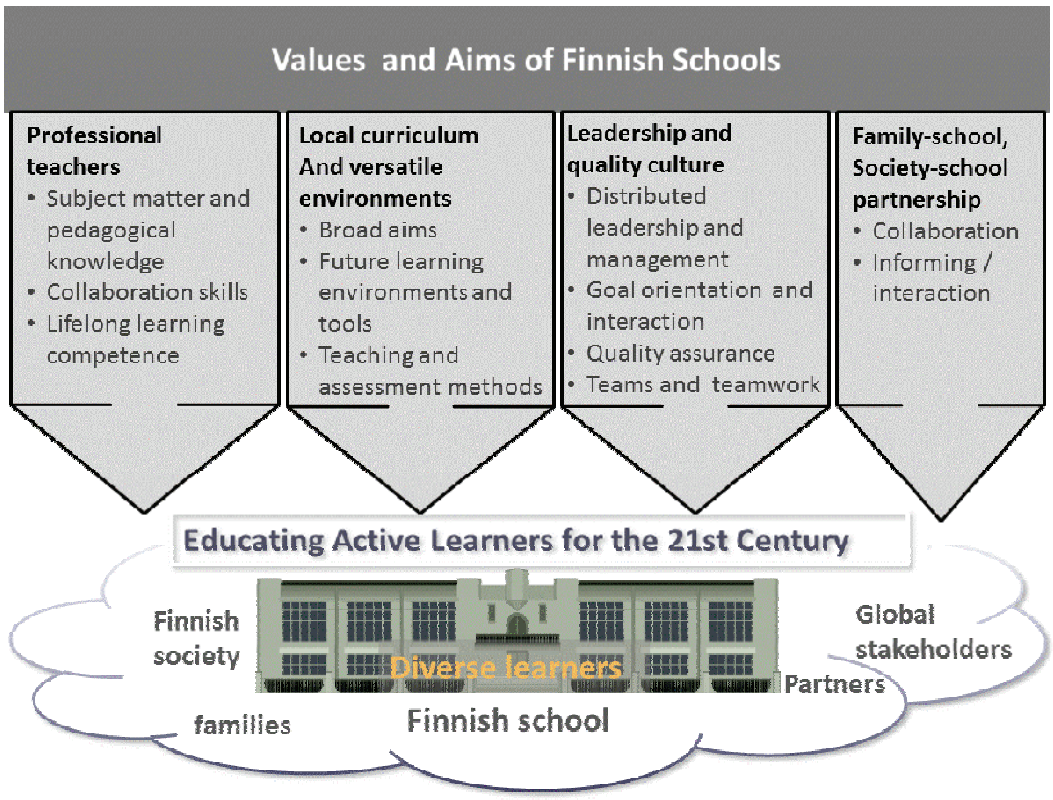

Fig. Finnish school model

The *principal* is supporting and facilitating the teachers' operations and school culture. The role of a principal is important in school development and in the implementation of the core curriculum at school. The principal is also responsible for quality assurance and school improvement. Goal orientation, interaction, and sharing of responsibilities are key characteristics of school leadership. The characteristics of leadership to be demonstrated by employees are participation, empowerment, and commitment.

Physical *learning environments* implemented at the school, including Information and Communication Technology (ICT), support students' engagement and learning, as well as other school operations. The term "learning environment" here suggests place and space — a school, a classroom, a garden, a library; 21st-century learning takes place in physical locations like these. Moreover, in our technology-driven world, a learning environment can be virtual, online, or remote. It does not have to be a place at all. The use of basic tool applications, social media, and tools designed for supporting distance

and flexible learning, as well as mobile devices and smart boards, support goal orientation and interaction in teaching and learning. High-quality learning materials, textbooks, and digital learning materials are an essential part of the learning environment.

Learning in a learning environment could support the fulfilment of basic psychological needs: the need for competence, the need for autonomy, and the need for relatedness, all of which are important for the development of engagement [24]. The environment facilitates the creation of meaningful and understandable knowledge structures on the basis of goals for learning. Meaningful learning is grounded on activity and intention, reflection and self-evaluation, collaboration and interaction, construction, contextualization, and cumulative learning [2]. One essential characteristic of a school context is strong networking, locally—and even internationally.

Many researchers agree that teacher behaviour and practices are important school-based factors in improving students' learning. Therefore*, professional teachers* are the heart of the school. A professional teacher has a profound and versatile knowledge base [25; 26]. Professional teachers collaborate with other teachers and are seen as academic professionals who are able to plan, implement, and assess their own teaching and their students' learning. They formatively monitor the progress of their students, particularly those with special needs, and try to support all students' learning. Moreover, teachers evaluate and develop the curriculum while continuously teaching and learning. There are no inspectors in the Finnish education system. To summarise, professionalism is not only the characteristic of a teacher, but it is also a characteristic of the whole school.

The parents of students are partners in education. A fruitful partnership facilitates the sharing of responsibilities of the students' weekly activities. In practice, family events and personal meetings with teachers are organised. Technology offers a variety of tools for enhancing the cooperation between homes and the school, and is applied for continuous interaction between the school and families. The aim of the home-school-partnership is for parents and teachers to share the same educational values and goals. An important consequence of this sharing is that parents trust the school's and teachers' abilities to carry out high quality teaching, and therefore there is no need to seek additional educational services.

The quality assurance is enhancement-led, meaning that quality assurance is a tool for improvement. Different types of feedback are frequently collected from pupils, parents, and other stakeholders. This feedback is analysed collaboratively among the staff members of the school. Student self-assessment is a part of quality assurance, as well. There are different levels in quality assurance. For example, the principal organises evaluation and assessment discussions once a year with the teachers of the school. Teachers prepare themselves for these discussions through analysing pupils' learning outcomes and feedback, as well as using different learning materials and tools. Moreover, the principal organises teachers' meetings in which the teachers analyse school operations collaboratively. As a whole, quality assurance is a complex system that allows freedom for different actors and, at the same time, requires responsibility of those actors. Therefore, professional teachers and principals are key in the development of a quality culture.

Strategy-Based Development. Strategy planning and implementation in the Finnish context has been based on the idea of autonomous decision making at the school

level. The Ministry of Education has published upper-level strategies, and the National Board of Education has designed an implementation plan for the school level. Education units (e.g., schools and universities) create their own strategies based on the national framework. This type of strategy-based approach has been applied in curriculum work and in the implementation of the use of ICT in school education.

There have been three official national ICT strategies and one national ICT development project during the last 25 years. In the 2010s, ICT strategies have been connected to other strategies in the field of education. The key objectives and recommendations are presented in Table below [14].

Table

The Objectives and Implementation Approaches of the National-Level Strategies

Year	Strategy	Objectives	Implementation Approaches
1986	Computers in education	Students as active workers of the information society IT as a school subject Basic IT skills for all Advanced IT skills for IT teachers	Funding the production of software suitable for computer-assisted learning Large in-service programme for all teachers at school Training of IT teachers
1995	Education, training, and research in the information society	Students active in information processing ICT as an inter-curricular subject Promote the use of ICT in learning	Funding the production of web pages and web-based learning environments Funding of in-service programmes for all teachers at schools
2000	The second strategy for education training and research in the information society	Promote the pedagogical use of ICT, emphasising open and distance learning (ODL) solutions. Teachers have not only technical, but also pedagogical, ICT competences	Funding of virtual schools or new learning environments that relate to future operational environments Funding of ICT infrastructure of schools and libraries Funding of in-service programmes for all teachers at schools and universities
2004	Information Society Programme for Education, Training and Research 2004—2006	Enable educational institutions to use ICT in a versatile way in all activities. Establish ICT-based procedures in education, training, research and industry. Promote social innovation through the use of ICT	Electronic materials available for science and research Education and research in information industry fields Information society services Social media innovations

Pre-Service Teacher Education. The Finnish education context is challenging for teachers because heterogeneous classrooms are responsible in broad planning and assessment at the local level, and, moreover, responsible in partnership with families and societies. For this reason, all teachers complete master's-level programmes at universities. In fact, there has been a 30-year tradition of educating primary/elementary teachers (Grades 1—6) and a tradition of more than 100 years of educating secondary teachers (Grades 7—12) in master-level programmes at universities. Primary teachers teach almost all the subjects at a primary level, whereas secondary teachers typically teach two subjects in the lower and upper secondary schools [6]. Primary teachers are educated at the Faculty of Education. Secondary teacher education is organised in cooperation between the Fa-

culty of the specific discipline and the Faculty of Education. Secondary student teachers take a major and a minor in the subjects they intend to teach, and they participate in undergraduate courses at the subject department. These courses help students develop a deep understanding of subject-matter knowledge and concepts as part of the conceptual framework of the subject [11].

An essential characteristic of primary and secondary teacher education in Finland is an emphasis on research orientation [6]. From the point of view of this orientation, the student teachers learn how to *consume* and *produce* educational knowledge within their pedagogical studies. Students consume educational, research-based knowledge when they combine theory and experience or interpret situations during their teaching practices. This type of knowledge is needed in the local-level, broad planning of teaching and in the development of teaching and school operations, as well as in the assessment of teaching and learning.

A core in both primary and secondary teacher education is pedagogical studies. During their pedagogical studies, students are supported to combine educational theories, subject knowledge, and their personal histories. Students' subject knowledge, knowledge about teaching, and learning in specific subjects and school practices are integrated into their own personal pedagogical views. According to the curriculum, students should, for example, be aware of the different dimensions of the teaching profession (social, philosophical, psychological, sociological, and historical bases of education), be able to reflect broadly on their own personal pedagogical "view" or assumptions on their own work, and have the potential for lifelong professional development.

The courses in pedagogical studies introduce a collection of teaching methods (instructional models and strategies), models of ICT use and assessment methods, and classroom management and organisation and classroom communication and discourse approaches. This kind of toolkit supports the student teachers in the selection of teaching, communication, and assessment methods in order to support their pupils/students to achieve the aims indicated in the national- and local-level curricula. Teaching methods are discussed in the framework of the "21st Century Skills" movement. This movement refers to the redefining of the goals of education and how learning is organised in order to meet the demands of the 21st century [27]. Individuals need both critical and creative thinking and should be able to use a wide range of tools, such as socio-cultural (language) and technological tools (ICT), to interact effectively with the environment, to engage and interact in a heterogeneous group, and to take responsibility for managing their own lives and acting autonomously. Use of ICT is practised during the theoretical and practical studies.

In-Service Teacher Education. The non-coherent in-service teacher training was changed to a more systematic one, together with the reform of teacher education over 30 years ago. In the beginning, the weak implementation of in-service training increased resistance towards the training among teachers. Therefore, at the end of the 1970s, in-service days organised by the pedagogical organisations of teachers were accepted as a substitute for training. For example, the Finnish Association of Teachers of Mathematics, Physics and Chemistry have annually organised in-service days for science teachers. Until the 1980s, the obligatory training days were allowed to be substituted with long-term university in-service courses. Examples of the structure of implemented in-service cour-

ses can be found in the report by Ahtee and Pehkonen (1997). The Finnish National Board of Education (FNBE) is responsible for national-level implementation of educational programmes and strategies (e.g., ICT strategies) and for financing ICT tools and long-term in-service training programmes for teachers. According to surveys conducted by teachers associations [21], Finnish teachers, in general, have a positive attitude toward in-service training and participate in the training voluntarily.

Contrary to pre-service teacher education, the professional development of teachers is the responsibility of the municipalities/cities in Finland. Therefore, municipalities have organised short in-service courses and professional development projects (PDPs) for teachers. Moreover, special centres for ICT use in education have been established in many municipalities for co-ordinating local development efforts and in-service training. Some projects have substantially benefited from local and national networking [10].

Long-Term Professional Development Projects (PDPs). There is a long tradition for research on teachers' PDPs. Characteristics of a PDP, which supports the adoption of professional knowledge, could be outlined based on our experiences as follows [8; 10]:

— Careful selection of the course content (i.e., domains of a teacher's professional knowledge);

— Grouping of teachers in heterogeneous and collaborative groups during the program in order to support teachers' learning;

— A series of face-to-face training sessions and distance-supported e-learning at the school level;

— Co-planning, implementing, and assessment of teaching modules by participating teachers;

— Reflection on the implementation of the modules in collaborative groups;

— A versatile context, including the use of technology and its integration into the modules;

— Cumulative development of teachers' professionalism starting where teachers are

— Follow-up meetings for sharing the results of the efforts.

One essential characteristic of a successful PDP is reflective activities. *Reflection* refers to a process in which an experience is recalled, considered, and evaluated, usually in relation to a broader purpose. Rodgers (2002) describes reflection as a meaning-making process, compares it to research, and lists the phases of reflection: setting of aims or recognizing the problem(s) or the question(s), making observations of one's own behaviour in practice, description of observations and experiences, and analysis of observations and experiences. Hiebert et al. (2002) state that professional knowledge has to be accurate, verifiable, and continually improved. Therefore, collaborative reflective activities are important to integrate to a PDP.

Factors which could have an effect to the implementation of a PDP program may be classified into four categories as follows [5]:

— Properties of the PDP, like usability and utility of the PDP;

— Local characteristics: teachers, classrooms, principal (leadership), use of textbooks, available technology, local projects/collaboration;

— External factors: national strategy/education policy, available learning materials;

— Networking: inside school, between schools, between teachers, between teachers and parents/experts/researchers, nationally, internationally.

An example of a successful PDP project is a 3-year professional development project, the Finnish Virtual School of Science Education (FVSSE). It was launched with 0.3 MЂoutside support in autumn 2000, just after publishing the national ICT strategy [10]. In the beginning of the project, there were 31 active science teachers from secondary schools in 6 municipalities located in different parts of Finland. Twenty-five teachers actively participated in most of the project meetings and activities, and their contributions to the development of ICT use, locally and even nationally, have been substantial thereafter.

The FVSSE can be characterised as a PDP in which both face-to-face meetings and co-operative discussions in online newsgroups were used. The aim was to support the co-operation of teachers in groups, to share knowledge and experiences with ICT in science education, present teaching practices, and plan and arrange small teaching experiments in real-life school contexts and to evaluate them. When teachers talked in small groups, they inspected, evaluated, and shared their previous experiences and knowledge about ICT and learned from that experience or briefly reflected on it. This self-directed, distance-guided co-operative and reflective work was supported by lectures, demonstrations, and co-operative and reflective group discussions during face-to-face meetings, as well as through newsgroups, personal e-mail discussions, and web materials. Experiences with students were also published on the home page of the FVSSE. This kind of support material was important for teachers as they developed ICT use in science education.

The teachers became especially familiar with computer-assisted research. For example, they planned projects in which Micro Computer Labs (MBLs) were used in measurements, spreadsheets in organising and presenting the data, the Internet as a source for information, and word processing in publishing outcomes of investigations and other tasks. Because ICT has become increasingly important due to the growth of the World Wide Web (e.g., virtual libraries and databases), teachers concentrated on activities in which the Internet was the source of information. They considered it important to know how this information could be processed so that students would be able to acquire new knowledge and become familiar with scientific reasoning.

One of the key ideas in developing the use of ICT, together with teachers, was to emphasise the importance of analysing the objectives of science education as a starting point for planning teaching activities. Allocation of resources for some new hardware and software, including MBL packages, helped in motivating the teachers. The development of student skills needed in the acquisition and analysis of data was particularly emphasised in planning. In practice, this orientation led to the selection of appropriate contents, contexts, teaching or learning method(s), and in particular, the suitable use of ICT in reaching these goals.

Altogether, 13 two-day face-to-face seminars and numerous computer network conferences were held during a three-year period of FVSSE. Based on the results of the project, it can be suggested that PDP for science teachers in the use of ICT should emphasise the following: (i) empowerment (co-planning of the project and its activities, and dissemination, allocation of resources, and authentic evaluation); (ii) communication (ensuring a flow of ideas and creativity, allowing communication and reflection in small groups and in optimal locations); and (iii) context (integration of ICT into teaching methods and cumulative development of competencies in the teachers who use it) [10].

Development of the Use of ICT in Education Through Design Research Projects. In the following, an example of a design research project by our research team is introduced. This design research project focused on the use of ICT in primary science education [7]. At the beginning of 2000, national-level objectives for teaching and learning primary physics were specified for Grades 5—6 in Finland (FNBE, 2004). Because the teaching and learning of physics did not exist at the primary level, we launched a project in the beginning of 2000 that aimed to create an innovative environment for teaching and learning physics at the primary level. The designed web-based learning environment introduces primary physics through narratives; text, figures, and animations; experiments, and contextual examples. The contextual examples help pupils to meet physics phenomena in everyday, human body, environmental, and historical contexts.

Similar projects have been conducted by our research team [9; 12]. In this project, as in other projects, there has been common designing with the teachers and researchers.

Discussion. This reflective paper presents an analysis of how Finnish teachers have been encouraged during the last 25 years to adopt the use of information and communication technology (ICT) in teaching and learning. However, there are still several challenges. These challenges have been recognised by our research team [10; 15] as well as official entities, like European Commission (2013) and OECD (2004, 2006).

Several paradoxes can be recognised in practice and in the research literature considering the use of ICT:

— National level ICT-strategies and national curriculum guidelines for ICT use have been prepared during the last 2 decades in several countries, but the influence on the practice of teachers regarding the use of ICT in education seems to be remote.

— Students have rich experience in using ICT outside the school context, but not for learning in school.

— Teachers are rather skilful in using ICT, even if they are unable to make good use of their competence through applying ICT applications in their teaching.

— ICT is available at school, but teachers' beliefs about teaching and learning (e.g., beliefs about good practice in school) do not support the educational use of technology.

— Plenty of teaching and learning material, especially with a focus on using ICT in the classroom, already exists. However, teachers are not experienced in using these materials effectively within regular classroom activities.

— At best, today's schools can make use of ICT as a tool for information retrieval, for individualized learning, and for interactions between home and school.

— Despite wide availability, the use of ICT facilities has not yet become a natural part of everyday school life, their use currently does not support general educational objectives, and they are not utilized appropriately in various co-operative situations (e.g., between the school and the surrounding community).

In general, there is broad agreement about why ICT applications should be integrated to classrooms and its advantages for use in teaching and learning. According to much research, the use of ICT in education could support meaningful learning and student motivation [20; 12]. However, teachers do not rely on research-based evidence in identifying good practices, nor do they see the usefulness of ICT applications in the classroom. Moreover, it is known that, in general, the implementation of educational policy and reforms in education is either very slow or tends to fail [10]. Consequently, it is still a chal-

lenge to support teachers in adopting the use of ICT as a part of their teaching and appreciating the usefulness of ICT in the science classroom.

There is just now (autumn 2013) heavy discussion in Finland considering the use of ICT in education and preparation of teachers to use it.

It looks four main approaches will be followed.

An integrated approach to ICT use in education is needed, meaning not only investment in ICT infrastructure, like mobile devices, platforms social media and cloud-services, but also short-and long-term in-service-training for teachers, supporting the pedagogical use of in ICT infrastructure in the classroom and, moreover, the creation of pedagogical ICT coordinator posts.

An integrated approach to teachers' pre- and in-service training is needed. Teachers' pre- and in-service training should be better linked from the point of view of pedagogy used in modern learning environments. It is not appropriate to introduce all current ICT innovations in pre-service teacher education because there will be new innovations when a teacher student goes to a school. It is more important to internalise the ideas of meaningful learning and motivational aspects of learning. Meaningful learning is grounded on activity and intention, reflection and self-evaluation, collaboration and interaction, construction, contextualization, and cumulative learning [2; 13]. Central to motivation are basic psychological need: the *need for autonomy*, the *need for competence*, and the *need for relatedness (need to belong to a group)* [3]. In addition to learning and motivation, several other pedagogical views are important, like integration and inclusion or personalised learning. Moreover, research orientation and competence for lifelong learning are needed in a teacher profession.

An integrated approach to ICT policy and implementation of this policy is needed. Especially the policy should be better implemented to national and local level curriculum. Moreover, textbook authors and publishing houses should integrate ICT, like digital learning materials, platforms, mobile devices and cloud services to traditional learning materials.

Different kinds of networking foster the integration of ICT into education, such as co-operation between (i) schools, (ii) teachers, developers and research or (iii) schools and their environment or working life. Networking is needed in all levels: inside school and between schools and. moreover, at national and international levels.

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О ПОВЫШЕНИИ МОТИВАЦИИ ФИНСКИХ УЧИТЕЛЕЙ К ПРИМЕНЕНИЮ ИНФОРМАЦИОННЫХ И КОММУНИКАЦИОННЫХ ТЕХНОЛОГИЙ

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Целью данной статьи является анализ подходов к повышению мотивации финских учителей к использованию информационно-коммуникационных технологий (ИКТ) в обучении. Статья основана на собственных результатах исследований автора и коллег. В статье описывается ситуация в финской системе образования и финская модель школьного обучения. Кроме этого, описываются стратегические подходы к развитию системы подготовки и переподготовки учителей в контексте использования ИКТ. Наконец, дается оценка результатов 25-летнего опыта использования ИКТ в образовании. Большинство приводимых в статье примеров представлено в контексте естественно-научного образования.

Ключевые слова: образование в Финляндии, информационные и коммуникационные технологии, подготовка и переподготовка учителей.