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Designing a Knowledge Environment for Teachers in the Context of Professional Development Programme DigiTiger

Master Thesis

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Statutory Declaration

Hereby I, Kersti Peenema, born 2nd of September 1977, declare that I wrote this Master Thesis without any help of third parties and without using any other aids than stated. This is my personal achievement and a result of an original investigation. It has not been submitted in equal or in similar form to another examining board for any academic degree before at any other university. I cited all references respecting current academic rules.

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Introduction

The development of technology has caused cultural changes in society. We have knowledge-creation civilization. Internet has become the first realistic tool for students to connect individually with civilization-wide knowledge building and to make their own classroom work a part of it. (Scardamalia & Bereiter, 2006)

We must adapt to continuously changing world and thereby change our perceptions of several important spheres. Rapid development of information and communication technology has created revolution in both working life and education. The nature of work is changing: there are more people who are working in knowledge-based professions and have a continuous need for updating their competence (Ecklundh, Groth, Hedman, Lantz, Rodriguez, & Sallnäs, 2003).

Henceforth the current approaches on learning and teaching do not fully match changed conditions. Environment has substantially also changed for school and hence the current teaching practices need to be revised and adapted to new conditions. The role of the teachers has changed - they are no longer source of singular truth and knowledge. Internet brings about changes: schools lose monopoly in knowledge transmission (Bereiter, 2002). ICT development has enabled students' access to information that is no longer limited to their school or even a country. The widening use of Web 2.0 solutions also widens the perspective of learner. (McLoughlin & Lee, 2007). There is a need to expand our vision of pedagogy so that learners would become active participants of a community and co-producers of knowledge objects rather than passive consumers of predetermined content.

Individuals have now the opportunity to participate in a collective development of knowledge and also benefit from a vast amount of knowledge available world-wide. Users of Web are actively involved in co-creating the content (Kimmerle, Moskaliuk, & Cress, 2008). Therefore the rigid distinction between consumers and producers of knowledge is not clear and does not make sense in present anymore.

Advanced creative thinking is quite often the product of collective knowledge. Best possible results are achieved through individual sharing of ideas and knowledge. As a result of continuous questioning and improvement knowledge shared by collective continues to grow and change (Nelson, Christopher, & Mims, 2009). Hence the success in education may no longer rely in traditional plodding taking place in classroom but the core focus should be given to cooperative learning process that will further continue in later work process. This learning process has recently

grown out of the framework of obtaining knowledge and shifted into a new - knowledge creation paradigm. Hence the schools may be nowadays viewed as environment for knowledge building (Bereiter, 2002).

Although Web 2.0 technologies enable to support creative and collective contribution practice has shown that new knowledge will not be generated automatically by large numbers of collaborating users (Kimmerle, Moskaliuk, & Cress, 2008). Creative thinking and knowledge construction can be encouraged through well-designed application, production, and publication. Web 2.0 solutions offer teachers and students creative and collaborative choice, they provide possibilities for sharing and building knowledge (Nelson, Christopher, & Mims, 2009) and therefore represent new paradigm of learning.

Despite ICT development has created opportunities for knowledge building already some time ago, it takes certain time for all those possibilities to reach schools. One of the main restrictions is the social-economic situation of Estonian country. On the other hand the reason is relative recent nature of the paradigm so that it has not expanded yet too widely. Still, we need to answer - what kind of new paradigm it is and how should schools cope with changing situation. What types of requirements for coping does it create to teachers, to school and society at large?

In Estonia the schools have been supported by Tiger Leap Foundation that has been at the forefront of technological change and both organized and provided various training sessions in the fields of information and communication technologies to numerous teachers. The trainings first started out as individual projects (e.g. on how to handle e-mail), have by now received fairly systemic content. In 2005 the Tiger Leap Foundation established DigiTiger training programme where the main focus was targeted towards use, application and teaching of web-based environments, teaching methods and distancing from direct application of Microsoft software applications. Furthermore, the training was linked to standards on teachers' educational technology. Despite DigiTiger training programme is not too old, both Tiger Leap Foundation as well as the trainers felt that it fails to meet current opportunities and needs.

Based on the above - the goals of the present study are:

- To assess and analyze the impact of training DigiTiger to virtual communities of practice of teachers.
- To assess emergence and use of the latest technologies (in particular social software) among teaching staff in Estonia.
- To assess how DigiTiger training met the needs of participating teachers.

The study addresses the following research questions:

- Which of the new skills gained in DigiTiger course have been implemented into practice?
- To what extent and how the training supports the formation of virtual communities of practice among teachers?
- What are the barriers for implementing new knowledge environments in teachers' work?
- What impact has the chosen learning environment on collaborative knowledge building practices of teachers during and after the DigiTiger course.

To answer those research questions, the master thesis is organized as following. 1) The first chapter identifies the most important underlying theory and recent changes in learning paradigms. 2) The second chapter uses phenomenological literature on knowledge environments to map its main linkages with learning and identifies key components of successful knowledge environments. 3) The third chapter critically analyzes Estonian education system with the main focus on DigiTiger training programme and based on the previous chapter - analyzes the main advantages and shortcomings of DigiTiger knowledge environment. 4) The fourth chapter analyzes the collected data - 504 responses of teachers who participated in the survey. 5) Finally, the fifth chapter concludes with some generic findings and proposes future research.

Current research materialized thanks to the financial support of Tiger Leap Foundation.

1. Paradigm Shift in Teaching and Learning

1.1. History of Paradigm Shifts in Teaching and Learning

Compared with ICT development, educational science may be considered rather old field of research that has faced during its history several scientific revolutions. According to Kuhn the major changes in research happen when existing methods became unable to explain new phenomena. If there are number of those phenomena then scientists start questioning suitability of existing paradigm and the most innovative researchers may come up with a new model that would be better able to explain them. If sufficient numbers of scientists suggest that new approach is more suitable then the new theory will be accepted as a norm. This type of change is characterized as a paradigm shift (Kuhn, 1996).

In learning and teaching the mainstream approach has been behaviourism that was replaced by cognitivism approximately 40 years ago. Until recently, cognitive psychology was the main paradigm of learning. By now the revolution in learning theory and instructional design has transcended the behaviouristic-cognitivist dialectic and entered a new era of theorizing - constructivism (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). In the following sub-chapter all three paradigms will be briefly introduced.

Behaviourism

Behaviourism has been the most common theoretical perspective used in education since it seems functional and scientific. It emerged after the enlightenment, as a product of the age of science, when it was generally agreed that the only data that was scientifically useful was empirical and measurable human behaviour (Jarvis, Holford, & Griffin, 1998).

Behaviourism is based on stimulus and response theory. All human behaviour is explained through the right reaction to the environment: the learner has to respond to a stimulus. Main source for learning is innate ability of individuals to avoid events that lead to distress or hardship. This subconscious motive shapes human behaviour and causes automatic responses to environment (Krull, 2000). Behaviouristic approach to learning focuses on the measurable behavioural outcome of learning rather than knowledge, attitudes and values (Jarvis, Holford, & Griffin, 1998). Knowledge is viewed as a storehouse of representations, which is used for reasoning and can be translated into language. The mind is like an information processor with short- and long-term memories (Hung, 2001).

Cognitivism

For the past four decades a paradigm shift from behavioural to cognitive psychology has taken place. This process was begun by Winn in 1975, who emphasized learners' interaction with the environment and gaining knowledge, skills and competence from it (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). Cognitive psychology claims that reasoning may be modelled and mapped onto learners' thinking patterns and the goal of the learner is to mirror reality as interpreted by teacher. Knowledge is still seen external to the knower and can be transferred by communication from one person to another. Learners' role is to first remember and then reproduce this knowledge. The quality of learning is a function of how well the learner can reproduce the thinking of the instructor (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). Human mind is still treated as a container.

Constructivism

According to constructivism paradigm - learning is generally viewed rather as an active process of constructing than acquiring knowledge, focusing in processes and interaction (Hung, 2001). Processes and interaction are in focus. (Hung, 2001). The source of learning is internal activity of an individual, which is expressed through interest towards the surrounding world (Krull, 2000). Active learning occurs via participating in and interacting with the environment (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). Its emphasis is not so much in the interaction itself, but more on how the mind of the individual constructs knowledge (Hung, 2001). The goal of learning is making meaning and most learning is considered to be context-dependent (Jonassen, Davidson, Collins, Campbell, & Haag, 1995).

Knowledge is a function of how the individual create meaning of his/her experience. Constructed knowledge is not inert, but rather usable in new and different situations (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). Cognition as an individual activity is emphasized (Hung, 2001). The mind is the instrument of thinking and interprets events, objects, and perspectives. The mind acts as a filter of the world in the process of making those interpretations (Jonassen, Davidson, Collins, Campbell, & Haag, 1995).

Hung has summarized main characteristics of three approaches described above as follows.

	Behaviourism	Cognitivism	Constructivism
Learning	Stimulus and response	Transmitting and processing of knowledge	Personal discovery and experimentations

		and strategies	
Type of learning	Memorizing and responding	Memorizing and application of rules	Problem solving in realistic and investigative situations
Instructional strategies	Present of practice and feedback	Plan for cognitive learning strategies	Provide for active and self-regulated learner
Key concepts	Reinforcement	Reproduction and elaboration	Personal discovery form first principles

Table 1 - Adjustment of key concepts of dominant learning theories described by Hung (2001, p. 284)

1.2. Participatory learning

There are several terms like participatory learning, social constructivism, situated learning, social theory of learning which all describe same approach to learning. This approach has been rising for the last 20 years.

Social constructivism focuses mostly on knowledge socially constructed "in the world": the individual dimensions are neglected. Human knowledge is socially constructed and the interpretation of knowledge is dependent on the cultural and social context through which the knowledge was constructed (Hung, 2001). Knowledge of the socially constituted world is socially mediated and open ended. (Lave & Wenger, 1991)

Learning is an integral part of generative social practice in the lived-in world (Lave & Wenger, 1991). It is socially and collectively constructed process, which is made up of members of the community involvement to activities and interaction (Soransen, Takle, & Moser, 2006). Learning is conversational, and the thinking of a community of performers or learners is distributed throughout the group (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). This means that knowledge and intelligence are also shared by community of practice (Jonassen, Davidson, Collins, Campbell, & Haag, 1995).

Learners inevitably participate in communities of practitioners. Individuals' intentions to learn are engaged and with the process of becoming a full participant in a socio-cultural practice. The mastery of knowledge and skill requires newcomers to move toward full participation in the socio-cultural practices of a community (Lave & Wenger, 1991). Such participation shapes not only what we do, but also who we are and how we interpret what we do. (Wenger, 1998). Viewing learning as legitimate peripheral participation means that learning is not merely a condition for membership, but is itself an

evolving form of membership (Lave & Wenger, 1991). Participation in social communities shapes our experience, and it also shapes those communities (Wenger, 1998).

Community of Practice is a self-regenerating, as such entities emerge and evolve, which is separated from the formal organizational structures. They have their own structure, behaviour, channels of communication and history. Members come often from large professional networks that extend across the organizations and join the community for the social and professional reasons (Farooq, Schank, Harris, Fusco, & Schlager, 2007). Members of Community of Practice do not only link the expertise, but it is a mixture of relationships between people, activities and the world (Lave & Wenger, 1991). Communities of practice have life cycles. They come together, develop, evolve, and disperse, according to the timing, the logic, the social energy of their learning (Wenger, 1998).

As process learning is seen social dialogical in which communities of practitioners socially negotiate the meaning of phenomena (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). Meaning is always the product of negotiations (Wenger, 1998). Participation in Community of Practice is based not only on situated negotiation but also renegotiation of meaning in the world (Lave & Wenger, 1991) as this is an open process with the constant potential for including new elements it always generates new circumstances for further negotiation and further meanings. The negotiation of meaning constantly changes the situations to which it gives meaning and affects all participants. It constantly produces new relations with and in the world (Wenger, 1998). It means that participation in a Community of Practice does not take place in a static context and change is fundamental for Communities of Practice and their activities (Lave & Wenger, 1991).

There are two kinds of preconditions for negotiating meaning described by Wenger (1998):

1. Some artefacts have to be in place - tools, plans, procedures, schedules, and curricula - so that the future will have to be organized around them.
2. Right people have to be at the right place in the right kind of relation to make something happen.

In Communities of Practice will develop a collective objective-oriented activity system: a mix of different visions, traditions and interests of its members (Engeström Y. , 2001). A division of labour will occur in the community over time, creating different roles for different members, which later may give rise to conflicts inside the community (Lave & Wenger, 1991). These conflicts are a source of change and development, which will always exceed the negotiated (Engeström Y. , 2001).

To become a full member of a community of practice requires access to a wide range of ongoing activity, old-timers, and other members of the community; but also to information, resources, and

opportunities for participation (Lave & Wenger, 1991). It is important to engage with the technologies of everyday practice, as well as participate in the social relations, production processes, and other activities of community. Participation involves artefacts, words, and concepts. These artefacts used and produced by community carry a substantial proportion of that practice's heritage (Wenger, 1998). Knowledge within a Community of Practice is encoded in artefacts (Lave & Wenger, 1991).

Practice is ultimately produced by its members through the negotiation of meaning (Wenger, 1998). Practice is an ongoing, social, interactional process. That members interact, do things together, negotiate new meanings, and learn from each other is already inherent in practice - that is how practice evolves. Old members in community of practice share their competence with new generations through a version of the same process by which they develop (Wenger, 1998).

Community of practice is a living context that can give newcomers access to competence and also invite a personal experience of engagement by which to incorporate that competence into an identity of participation. When these conditions are in place, communities of practice are privileged locus for the acquisition of knowledge (Wenger, 1998).

Well-functioning community of practice is a good context to explore radically new insights. A history of mutual engagement around joint enterprise is an ideal context for this kind of leading-edge learning, which requires a strong bond of communal competence along with a deep respect for the particularity of experience. When these conditions are in place, communities of practice are a privileged locus for the creation of knowledge (Wenger, 1998).

All together social theory of learning integrates the components necessary to characterize social participation as a process of learning and of knowing. According to Wenger (1998, pp. 4-5) these components include:

1. Meaning: a way of talking about our (changing) ability - individually and collectively - to experience our life and the world as meaningful. Learning as experience.
2. Practice: a way of talking about the historical and social resources, frameworks, and perspectives that can sustain mutual engagement in action. Learning as doing.
3. Community: a way of talking about the social configurations in which our enterprises are defined as worth pursuing and our participation is recognizable as competence. Learning as belonging.
4. Identity: a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities. Learning as becoming.

1.3. Knowledge building

There are theories related to learning, which Paavola and Hakkarainen call theories of innovative knowledge communities that explicitly emphasize innovative aspects in relationship to learning and epistemology. These theories are basis for approach to learning which they call knowledge-creation metaphor (Paavola & Hakkarainen, 2005). One of those theories is created by Scardamalia and Bereiter is called "knowledge building". Scardamalia and Bereiter started using the term "knowledge building" around 1987. Later it has become merely a synonym for learning (Bereiter, 2002).

Before metaphor of knowledge creation and process of knowledge building is described a short overview of two other metaphors of learning will be given.

Approaches of learning described in chapter 1.1 and 1.2 can be divided into two different metaphors. Anna Sfard (1998) was the first who distinguished these metaphors of learning: the acquisition metaphor and the participation metaphor (Paavola, Lipponen, & Hakkarainen, 2002).

According to the acquisition metaphor learning is a process of individual knowledge acquisition taking place within the human mind. The human mind is considered as a container and learning is a process that fills the container with knowledge (Hakkarainen, 2009). Learning is a process of transfer. Knowledge is a property and possession of an individual mind (Paavola, Lipponen, & Hakkarainen, 2002). This view emphasizes propositional knowledge and conceptual knowledge structures (Paavola & Hakkarainen, 2005).

The participation metaphor view considered learning to be a process of growing up and socialising to a social community and its norms and practices (Hakkarainen, 2009). Activity and collaboration are emphasized (Hong & Sullivan, 2009). Learning as participation suggests that in the centre of learning are activities (knowing) more than a outcomes (knowledge). Knowledge does not exist in either in a world of its own or in individual minds, but is an aspect of participation in cultural practices (Paavola & Hakkarainen, 2005). Cognition and knowing are distributed over both individuals and environment. (Paavola, Lipponen, & Hakkarainen, 2002)

The knowledge-creation metaphor of learning means that learning is seen as innovative processes of inquiry where something new is created and the initial knowledge is either substantially enriched or significantly transformed during the process (Paavola & Hakkarainen, 2005)mediated by sharing objects of cognitive activity (Hakkarainen, 2009). Individual and collective learning goes beyond

information given and advances knowledge and understanding: there is collaborative, systematic development of common objects of activity (Paavola & Hakkarainen, 2005).

The learning as knowledge creation metaphor represents not only a shift in conceptualizing how people learn, but also in what the outcomes of learning should be and what conditions are best for fostering such learning outcomes. Growth of individual knowledge is the main goal (Hong & Sullivan, 2009).

According to Paavola and Hakkarainen (2005) the basic division is as follows: the acquisition view represents a monolog view on human cognition and activity, where important things are seen to happen within human mind, whereas the participation view represents dialogical view where the interaction with the culture and other people, but also with the surrounding (material) environment is emphasized. The knowledge-creation metaphor represents a triological approach. Trialogue means that by using various mediating artefacts (signs, concepts, tools) and mediating processes (practices, interaction between tacit and explicit knowledge) people are developing common objects of activity (conceptual artefacts, practices, products). The emphasis is not only on individuals or on community, but on the way people collaboratively develop mediating artefacts. As basis Paavola and Hakkarainen used theories created by Bereiter and Engeström.

Bereiter (2002) claims that knowledge building is not just a process; it is aimed at creating a product - some kind of conceptual artefact (e.g. explanation, design, an interpretation of a literary work). The focus in knowledge construction is rather on problems than the knowledge itself (Scardamalia & Bereiter, 1994). Problem solving is related to the notion that ideas are conceptual artefacts that can be improved (Van Aalst & Chan, 2007). The main challenge is to produce and develop theories to explain the contradictory ideas (Scardamalia & Bereiter, 1994).

In knowledge creation innovation processes are happening within communities (Paavola & Hakkarainen, 2005). Setting up of a community that is deliberately focused on going beyond the limits of existing knowledge is essential to knowledge creation (Paavola, Lipponen, & Hakkarainen, 2002). Creative knowledge work may be defined as work that advances the state of knowledge within some community of practice (Scardamalia & Bereiter, 2006). Community of Practice which is aimed at building knowledge is a group of learners who are involved to develop their collective understanding through cooperation with other learners (Hewitt & Scardamalia, 1998). Members of community of knowledge building are advance community resources continually contributing their ideas to the shared intellectual property of the organization. The resultant community of knowledge is a form of new information that other community members can all build on (Scardamalia & Bereiter, 2003).

Construction of knowledge takes place through social interaction. It is necessary to share one's experience with other members, discuss ideas and perspectives: to understand their own experience and create meaning through collaboration and discussion (Engstrom, Santo, & Yost, 2008). Collaborative knowledge building is a cyclical process. It seems that once negotiated, shared understanding becomes the learners' tacit knowledge, which can be later used again to build further new understanding (Mäkitalo-Siegl, 2008).

The investigation of a problem is led through the questions and a desire to understand. Negotiation process is related to a complex interaction with others: to include the active and / or more people, to support advanced research, to monitor developments in other communities of the same area (Scardamalia & Bereiter, 1994). Interaction takes place at three different levels (Engstrom, Santo, & Yost, 2008):

- the cognitive level - how the learner constructs meaning and knowledge out a collective communication,
- the social level - the ability of students to represent himself, feeling of belonging to the group,
- the level of teaching - designing an educational experience and conduct as supervisor.

From cognitive side of knowledge building participants read, analyze the sources of information, design and carry out their study, reflect experience and improve their understanding. From social side, the participants will contribute relevant information or comments or build up responses according to the questions raised. Participants also put into question ideas of others, ask new questions, re-examine and improve each other's understanding through the construction of theories (Chai & Merry, 2006).

Engeström's (1999) theory claims that learning is one form of human activity. It is based on actions in collective activity systems that take place within larger socio-historical context. The meanings of mediating artefacts (tools and signs) and activities are emphasized. Learning is based on expansive cycles of development.

The cycle includes (Engeström Y. , 1999):

- Questioning - questioning, criticizing, or rejecting some aspects of the accepted practice and existing wisdom.
- Analyzing - analyzing the situations. Analysis involves mental, discursive, or practical transformation of situation in order to find out causes or explanatory mechanisms.

- Modelling - constructing an explicit, simplified model of the new idea that explains and offers a solution to the problematic situation.
- Examining the model - running, operating, and experimenting on it in order to fully grasp its dynamics, potentials, and limitations.
- Implementing the model - concretizing it by means of practical applications, enrichments, and conceptual extensions.
- Reflecting on practice.
- Consolidating into a new stable form of practice.

Endless improvability of ideas is further supported by the following (Scardamalia & Bereiter, 2006):

1. Ability to create increasingly high-order conceptual frameworks. It is always possible to reformulate problems at more complex levels, by creating a rise above note that encompasses previous rise-above notes, or to create more inclusive view-of-views.
2. Review and Revision. Notes and views can be revised at any time, unlike most discussion environments that disallow changes after a note is posted.
3. Published notes and views. Processes of peer review and new forms of publication engage students in group editorial processes. Published works appear in a different visual form and searches can be restricted to the published layer of a database.

In community of knowledge building more experienced (who know more) people do not stand outside the learning process (as it can happen with teachers at school), instead they participate actively in the creation process. Advanced level of knowledge does not determine what is being learned or examined. New or less experienced/ knowledgeable members play a major role in helping to understand what is difficult for them and this could lead to new concepts and definitions (Scardamalia & Bereiter, 1994). During this process conflicts between members of community may arise. Those conflicts can be source for further negotiation and development.

According to Bereiter (1994, 2002) knowledge building discourse aim is progress in the state of knowledge: idea improvement. It involves:

- a) a commitment to progress, something that does not characterize dinner party conversation or discussion devoted to sharing information and venting opinions;
- b) a commitment to seek common understanding rather than merely agreement, which is not characteristic of political and policy discourse ;
- c) a commitment to expand the base of accepted facts, whereas, in court trials and debates, tacking the factual claims of opponents is common (Scardamalia & Bereiter, 2006).

The proof of knowledge building taken place in the community is knowledge that is publicly produced by the students. Visible idea improvement achieved through the collective efforts of community members. (Scardamalia & Bereiter, 2006). In school the conceptual artefacts students have produced through knowledge-building provide evidence that some learning has occurred, but who has learned what and how well are questions still to be answered. (Bereiter, 2002)

Although innovation and knowledge building processes are seen fundamentally social, at the same time emphasis is on importance of individual competencies and initiative (Paavola & Hakkarainen, 2005). Personal growth in the context of communal knowledge advances is also important (Van Aalst & Chan, 2007).

Knowledge building carried out in the adult world is often in a form of economic activity, a matter of adding value to concrete knowledge artefacts. Knowledge building carried on in a school is likely to be viewed and evaluated as a learning activity. Therefore Bereiter (2002) argues that teachers should see three different aspects of knowledge-building:

1. Knowledge building is a productive work. This is the same kind of work in the classroom as it is in the research laboratory. It is working collectively to produce conceptual artefacts that are of some use. For students, it is a matter of producing conceptual artefacts that help them understand the world.
2. Learning through knowledge-building. This is the learning of scientific, historical, literary, or other kinds of content through knowledge-building through solving problems of understanding or design in these domains. This is indirect learning, learning that occurs as a by-product of activity carried out for another purpose, and it cannot be taken for granted.
3. Learning to be a knowledge builder. This is unique added advantage of knowledge-building as an educational approach. It has great potential value for living and working in a knowledge society. But like any other kind of learning, it cannot be taken for granted just because students appear to be engaged in the relevant activity. Teachers have to ascertain whether the learning is actually happening and marshal their best pedagogical resources when it is not (Bereiter, 2002, pp. 295-296).

Models of innovative knowledge communities concentrate on processes where people collaboratively create and develop such conceptual and material artefacts and related practices for a subsequent use. The basic idea of the knowledge creation metaphor is that individual initiative serves the communal effort to create something new, and the social environment feeds the individual initiative and cognitive growth. Knowledge is embedded in mediating artefacts and skills

and practice. Knowledge is on artefacts like scientific theories, plans, models, instruments and so on (Paavola & Hakkarainen, 2005).

In order knowledge creation metaphor to reach our school it is necessary that teachers accept and come familiar with it. The study, conducted by Chai and Merry (2006) among the teachers in Singapore showed that teachers enjoyed learning in knowledge building community. They felt active as learners and followed with a high degree of autonomy on its own interests. Teachers admitted that participation in the community supported their thought process because they had to write to communicate and this helped them organize their own thoughts. Positive feedback was given also to the cooperation aspect of the community - after uploading any materials, it was possible to get feedback to them.

1.4. Conclusion

Learning paradigms have gone through a major shift. Several principles related to learning have changed. For example:

- Expected learning outcome - memorizing predefined knowledge has changed to active participation in knowledge building and creating knowledge artefacts.
- Activity - earlier learned in order to innovate; now to innovate is to learn.
- Role of students - from student as knowledge container has become active member of community of practice and creator of knowledge objects.
- Role of teachers - from teacher as only source for knowledge as become member of community.
- Locus of control - state delegates more responsibility to the school and teacher. In learning process taken place in classroom is trend to student as self-organizer, self-directed learner;
- Knowledge - from predefined facts to social constructed knowledge.

The paradigm change has been described by Paavola and Hakkarainen via the following metaphors: acquisition, participation and knowledge. Acquisition metaphor sees knowledge as a property of individual mind and predefined knowledge and conceptual knowledge structures were emphasized. Participation view claims that in the centre of learning are activities (knowing) more than a outcome (knowledge). Learning is a process of growing up and socializing to a social community of practice. In knowledge creation metaphor the process of innovation through developing and creating new knowledge is emphasized.

As learning paradigms have changed radically it creates new challenges for teachers where they have to rethink principles for teaching used so far.

Knowledge creation is productive work, which results in knowledge objects. These knowledge objects can refer to discussible ideas, ranging from theories, designs, and plans down to concepts, like unemployment and gravity. Knowledge objects are human creations and are created to some purpose. Work of community in knowledge building can be assessed via created or developed knowledge objects that have been published or made in any other forms available to the other community members or interested parties.

New knowledge may be created the most effectively by community of practice. Members of community of practice are joined together by common objective and commitment to knowledge building process. In order to build new knowledge together with the other members of the community there must be prior common understanding which in turn requires sharing experience with peers, open discussion, commenting the others' ideas i.e. negotiation of meaning. Continuous negotiation and creation means that knowledge building would not occur in static context but that it would be in constant change. Despite knowledge creation process is a social process the core to its quality is individual competencies and initiative. All community members are equal: studied knowledge object in hand is not predetermined by more experienced members but all have freedom to do that.

Problems and questioning have mediating role in knowledge creation process. Knowledge building makes it important to share ideas, asking questions, commenting, discussing, analyzing, modelling, problem solving, joint elaboration of artefacts, extending theories, responding to other notes, provide relevant information and reflection.

Openness is critical characteristic of effective knowledge creation community. In knowledge building it is important that all community members would have access to necessary resources to perform work - to both material resources and human resources. Access must be granted both from the technological as well as cultural aspect (readiness of members to share both work resources and results). Similarly knowledge building is supported when community work is easily followed and accessible to all interested parties. Also flexibility and openness to new ideas supports successful knowledge building.

2. Knowledge Environments

In the field of educational technology there isn't much discussion about knowledge environments; investigation of learning environments has been more popular. In this chapter the concept of knowledge environments and suitability of Web 2.0 solutions as knowledge environments are described. Pedagogical/philosophical background of knowledge environment is also described.

2.1. The Concept of Knowledge Environment

Knowledge creation metaphor is basis for the concept of knowledge environment. This metaphor refers to understanding how to organize long-term collaboration to simultaneously develop new knowledge and related processes. The role of mediation and the object-oriented nature of human activity is emphasized. Models and tools for organizing learners' activities around shared objects (e.g. texts, knowledge artefacts, but also practices) that are created for some real purpose or subsequent use are important. Individually performed activities and social interaction serve the longer-term processes of collaboratively developing specific, concrete, shared objects (Lakkala, Paavola, Kosonen, Muukkonen, Bauters, & Markkanen, 2009).

According to knowledge creation metaphor one of the characteristics of creative knowledge environment is its primary focus on research.

Scardamalia and Bereiter have defined knowledge building environment as any environment (virtual or otherwise) that enhances collaborative efforts to create and continually improve ideas (2003, lk 2).

Hemlin with colleagues have proposed wider definition and claim that creative knowledge environments (hereinafter abbreviated as: "CKE") are those environments, contexts, and surroundings, the characteristics of which are such that they exert a positive influence on human beings engaged in creative work aiming to produce new knowledge or innovations, whether they work individually or in teams, within a single organization or in collaboration with others. (Hemlin, Allwood, & Martin, 2008, p. 197). Therefore positive influence (supporting surrounding) and contribution of individuals are also important.

Knowledge advancement is fundamentally a socio-cultural process, enhanced by cultures of innovation. Knowledge building trajectory starts with the early, natural ability to play with ideas and extends the not-so-natural ja relatively rare intentional processes that serve to continually improve ideas (Scardamalia & Bereiter, 2003). These ideas are the building blocks of invention. Their

improvement starts with their objectification as cultural artefacts (Bereiter, 2002) and is enhanced by community discourses that maximize their potential.

A successful creative knowledge environment embraces certain management and working styles - where creativity is supported, where members of community of practice have considerable autonomy, and where self-leadership and social interaction are prominent. Work teams should encourage diversity among members so that an element of creative tension exists and conformity is not overemphasized (Hemlin et al, 2008). Although diversity between members of community can lead to different conflicts (due different experience, knowledge and beliefs), it is important to understand that diversity and conflicts support knowledge creation process as ideas generated and negotiated can origin from very different viewpoints.

Computer Supported Collaborative Learning (hereinafter abbreviated as: "CSCL") and Knowledge Building Environments are frequently treated as synonyms. They both get defined by a list of tools, which are similar to each other: electronic bulletin boards and conferencing systems; email and chat facilities; and supports for argumentation, negotiation, reflection, and weight evidence. They include also tools for knowledge management - for accessing, storing, organizing, filing, and searching documents and building repositories; tools for assessment and data-analysis; tools to support the work of geographically dispersed teachers working on common projects; tools to annotate and mark up artefacts and their representations (Scardamalia & Bereiter, 2003).

Also Nummenmaa and Nummenmaa (2008) argue that web-based learning environment (hereinafter abbreviated as: "WBLE") can be seen as social environment where students participate in a collective learning project and knowledge construction. The collaborative learning activities in a WBLE *include writing texts together and commenting* on them. The outcome is visible to all of them involved in the learning process. They can *read and evaluate comments and make corrections* with respect to the work. Such actions leave visible marks on the WBLE and provide the students with an opportunity to appraise and assess the behaviour of other students in WBLE and the use the WBLE as a means of collaboration.

Lakkala et al (2009) are critical about using existing educational web-technologies for knowledge building. They argue that typical functionalities of existing educational web-technologies, such as various Virtual Learning Environments, are quite inflexible and inadequate for shared work on knowledge objects as those environments provide only limited support for collaborative knowledge creation because they typically provide functionalities for information sharing and participation in social communication.

The same aspect is pointed out by Scardamalia and Bereiter (2003) who claim, that current web-based learning environments generally follow either of two models: one is a message model, derived from e-mail and bulletin boards and extended to threaded discussions. As these messages are typically unmodifiable - participants can only respond with other messages - they are inflexible. The other model is a folder model, where basic units are notes or documents, with some affordances for annotation, and the organizational framework is that of a filing cabinet. Their basis is technical - taking an existing technology and repurposing it to serve educational needs.

KBE should be distinguishable from web-based learning environments by its focus on processes of knowledge creation and idea improvement and by virtue of its ability to represent the resulting community knowledge. Characteristics of such an environment:

1. Support of self-organization that goes beyond division of work. Inasmuch as the process of knowledge building is inherently self-organizing a KBE should support these processes and self-direction and advanced knowledge processes that they require.
2. Shared, user-configured design spaces that represent collective knowledge advances built from the contributions of team members.
3. Support for citing and referencing one another's work so that contributions to the evolution of ideas are evident and can become objects of discourse in their own right, much as is the case in the history of thought.
4. Ways to represent higher-order organizations of ideas and to signal to rising status for improved ideas as contrasted with their nondescript entry in threads, folders, and repositories where they are lost amid information glut.
5. Ways for the same idea to be worked with in varied and multiple contexts and to appear in different higher-order organizations of knowledge. Flexible import-export functions to allow all of the valued ideas and artefacts to be incorporated into knowledge building discourse.
6. Systems of feedback to enhance self- and group-monitoring of ongoing processes and to tap idea potential - as distinguished from assessment and management tools used exclusively for filing organization, and end-of-work or external evaluation.
7. Opportunistic linking of persons and groups by virtue of contributions and shared knowledge building goals. Searches are not limited of finding notes and documents; the ideas represented in texts and artefacts also serve a match-making function, allowing participants to locate others working on parallel problems, and to identify the cutting edge of their area of inquiry.

8. Ways for different user groups to customize the environment and to explore the within - and between- community corridors that extend and provide to their knowledge work. (Scardamalia & Bereiter, 2003)

Hemlin et al (2008) have described characteristics of an effective KBE:

- a) supports the formulations of knowledge problems;
- b) preserve ideas and makes them accessible as objects of inquiry;
- c) supports democratic dialogue and favourable to idea diversity for constructive criticism and analysis;
- d) organizing ideas into larger wholes;
- e) dealing with recognized gaps and shortcomings of ideas.

A KBE can increase opportunities and possibilities for knowledge creation, but it loses that capacity when it becomes overly prescriptive. It should not use prompts, intelligent agents, prescribed projects, fixed task sequences, templates or other means to guide users to known endpoints (Scardamalia & Bereiter, 2003). As behind of knowledge building are initiative and curiosity of members of community knowledge building environment must be flexible and help covert that inventiveness into something of social value.

The adequacy on any KBE must ultimately be judged by knowledge advances resulting from its use. Collaboration, discussions, and information sharing may all increase, but if there are no corresponding knowledge advances, we do not have an effective KBE (Scardamalia & Bereiter, 2003). Therefore access to resources (material and human) is important.

Hemlin et al (2008) have described knowledge production processes as follows:

- Problem-identification,
- Idea-generation,
- Idea-elaboration,
- Evaluation (including identifying and rejecting poor ideas) and
- Selling (i.e. legitimating and convincing other of the value of) the idea.

In their own Knowledge Practice Environment Lakkala et al (2009) modelled through different types of mediation. They reformulated the types of mediation introduced by Rabardel and Bournaud in 2003:

- Epistemic mediation: creating, transforming, organizing and linking knowledge artefacts;

- Pragmatic mediation: planning, organizing and coordinating working processes;
- Social mediation: managing social relations around shared objects and linking people; and
- Reflective mediation: making visible and reflecting on the work processes.

Lakkala et al (2009) describe Knowledge Practice Environment as follows: in Knowledge Practice Environment (KPE) users are able to build collaboration environments by creating and configuring the means, as opposed to operating in predefined structures, of the common practice. KPE is a virtual environment that includes a set of basic, integrated tools (e.g., wiki, note editor, commenting, chat, semantic tagging and search) for working with the shared knowledge objects. KPE enables object-bound and thread commenting on all items (task item, files, web-links, and notes) in a shared space, as well as viewing of knowledge objects and their relations from several perspectives. The basic perspectives are content, process and community views.

1. Work with knowledge artefacts. Epistemic mediation is supported by functionalities that enable users to create, modify and organize various knowledge artefacts as well as their relation, in versatile ways.
 - Sharing and co-construction of knowledge artefacts with free visual arrangement and linking
 - Object-bound interaction around knowledge artefacts
 - Flexible use of metadata, tags and ontologies.
2. Organizing processes - Pragmatic mediation is supported by functionalities which enable planning, monitoring, and regulating joint activities and working processes. These functionalities allow users to define tasks, draft visual representations of processes, as well as they provide users with awareness features of the activities in the spaces.
 - Process planning through defining tasks and drafting visual process representations
 - Features for focused work on particular knowledge objects and tasks
 - Awareness features to aid process planning and coordination

Social relations around shared objects and processes - Social mediation is supported by functionalities that support users in maintaining their contacts and keeping up with the changing information about other participants, as well as their relations to the shared processes and content items.

- Organizing social structures, responsibilities and roles
- Integrated communication means and social clues

Reflecting processes for deliberate transformation of knowledge practices. This enables actors to reflect on and evaluate their joint activities as well as the shared objects being created and modified

collaboratively. The aim is to provide the user groups with information that allows them to take the community's knowledge creation processes as an explicit object of shared reflective activity, elicit deliberate transformation and improvement of their joint knowledge practices.

- Reflecting on the on-going processes through visual representations and awareness tools
- Reflection and analysis of past processes through analytical services.

Epistemic and pragmatic mediation embedded in the KPE enable the integration of users' collaborative and individual efforts in creating material artefacts and coordinating their activities. Social mediation allows user to lean on each others' competencies, expertise and experience and helps them align their thoughts and actions with those of others. Reflective mediation is afforded by various means for viewing and monitoring the transformation of knowledge content, activities and social relations (Lakkala et al, 2009).

Pedagogical practices that promote competencies for sharing, creating, and working with knowledge and knowledge artefacts in an innovative way are crucial (Lakkala et al, 2009). For teacher to successfully use some knowledge environment, is crucial to be familiar with knowledge creation process and opportunities of different environments.

2.2. Social Software as Knowledge Environment

McLoughlin and Lee (2007, lk 665) defined Web 2.0 as more personalised, communicative form of the World Wide Web that emphasises active participation, connectivity, collaboration and sharing of knowledge and ideas among users.

Web 2.0 is focused on people. It reflects the collaborative nature of human society. Peer production and co-creation of content (Rollett et.al. 2007) and sharing this content and information are reasons behind web 2.0 success stories.

During the past few years, a group of Web technologies and services became perceived as especially connective, receiving the name of "social software": blogs, wikis, Really Simple Syndication (RSS), podcasting, social networking sites, tag-based folksonomies, and peer-to-peer (P2P) media sharing utilities (Allen, 2004, cited by McLoughlin and Lee, 2006; Alexander, 2006,). Social software uses the web as a collaborative medium that allows users to communicate, work together; build knowledge and share and publish their ideas and thoughts - and all this is done bottom-up with an extremely high degree of self-organisation. These communities emphasize a crowd sourcing (collective intelligence). Web 2.0 technologies eliminate hierarchical constraints to harvest and aggregate

individual intelligence through technologies that permit people to manage information, mash-ups, into collective intelligence (Nelson, Christopher, & Mims, 2009; Tu, Blocher, & Roberts, 2008). This means that Web 2.0 solution provide possibilities for sharing and building knowledge and are therefore appropriate solution also for knowledge environment.

At the heart of the knowledge work of Web 2.0, and of knowledge transfer are conversations: individuals engaging with the community through ideas (Rollett, Lux, Strohmaier, Dösinger, & Tochtermann, 2007). Social negotiation process and development in Web 2.0 environments are distilled into deeper and finer process, such as generating, reflecting/organizing their own content, reviewing/reflecting/modifying others' content. Web 2.0 environment allow individuals to make their learning process visible and to view others' learning process. It offers individuals opportunities to take control of how they improve their thinking and refine their meta-cognitive strategies (Tu et al, 2008). Therefore reflection and self-organisation are supported by different solutions of Web 2.0.

Web 2.0 technologies lead learners from Web content consumers to Web content creators developing more participatory environments (Tu et al, 2008). Publishing collective works online is not just possible; it is plausible, using free web page development tools and wikis. The possibilities for collaborating and constructing knowledge using the Internet are limitless (Nelson et al, 2009). One of the evidence that knowledge building has happened is improved knowledge artefact which is published as that others can it see, use and develop further.

As a knowledge building relies on initiative of individuals the flexibility of environment support this initiative. McLoughlin and Lee (2007) have marked that one of advantages of using social software is that it enables choice and allows learners to make decision about which tools best suit their goals and needs for connection and social interaction.

McLoughlin and Lee have come up with the description of affordances of social software. In definition of affordances they have relied to Kirschner (2002), who defines educational affordances as the relationships between the properties of an educational intervention and the characteristics of the learner that enable certain kinds of learning to take place (cited by McLoughlin and Lee, 2007).

Affordances of social software tools are as follows (McLoughlin & Lee, 2007):

- Connectivity and social rapport: social networking sites (like Facebook, MySpace) attract and support networks of people and facilitate connections between them.
- Collaborative information discovery and sharing: data sharing is enabled through a range of software applications and experts and novices alike can make their work available to the rest of the online world. Social bookmarking tools allow people to build up connections of web

resources and bookmarks, classify and organise them through the use of metadata tags, and share both the bookmarks and tags with others. Users with similar interest can learn from one another through subscribing to the bookmarks and tags of others and actively contribute to the ongoing growth and evolution of the web-based content and knowledge.

- Content creation: Web 2.0 emphasises content creation over content consumption. Anyone can create, assemble, organise and share content to meet their needs and those of others. Wikis enable teams and individuals to work together to generate new knowledge through an open editing and review structure.
- Knowledge and information aggregations and content modification: the massive uptake of RSS, as well as related technologies such as podcasting and vodcasting, is indicative of a move to collecting material from many sources and using it for personal needs. The content can be remixed and reformulated (the concept of mashup).

Below follows a brief description of main social software solutions.

Blog

Blog is functioning as an online journal and consist of articles which are sorted by their publication date. Blogs can be written by one person or a group of contributors. Blogging enables the affordances of idea sharing and interaction (McLoughlin & Lee, 2007). Entries contain commentary and links to other Web sites, and images as well as a search facility may be included. Standard blog features include easy posting, archives of previous posts, and a standalone Web page for each post to the blog with a unique URL (Boulos, Maramba, & Wheeler, 2006). Using these permalinks, blog entries can be referenced or linked from other blog entries. Using trackbacks, the authors are automatically notified and the links become bidirectional (Rollett, Lux, Strohmaier, Dösinger, & Tochtermann, 2007). This helps bloggers to be informed about new knowledge being shared elsewhere, which is linked with a particular entry and thus contributes to a certain topic (Klamma, Cao, & Spaniol, 2007).

Bloggging gives an opportunity to generate and document content, activities, experiences and reflections. Open communication guides learners to a deeper understanding of the topic and allows bloggers to take ownership of their constructed knowledge (Nelson, Christopher, & Mims, 2009). Blogs afford learners the opportunity to capture and maximize their reflective criticism of the learning process. Although blogs may be perceived as a monologic expressive environment, by creating, posting, and commenting on blogs, learners are empowered to support role formation and the construction of online identities. (Tu, Blocher, & Roberts, 2008)

The reactions of other members of community or interested parties on the blog postings are the comments. They help blog entry to reflect, analyze and synthesize the content to keep the discourse in the knowledge creation process going on précising and refining ideas (Klamma, Cao, & Spaniol, 2007). These comments are forming new micro-content (Alexander, 2006).

The blog roll represents those blogs closely related to customized community feature.

Blogs are generally searchable and blogging tools often include their own search tools (Klamma, Cao, & Spaniol, 2007). So it becomes important for the author to tag their blogs correctly so that regular web search engines can find its page. Entry tagging is a means of sharing the notion about a certain blog entry.

Wiki

Wiki technology engages learning in processes of sharing, exchanging, and modifying. Their shared thinking processes are unveiled as learners employ each other as resources by providing information and sharing experiences. Interaction in wiki technology goes beyond information sharing and allows students to create an interactive space where everybody can edit. This permits fostering the vision of negotiated meaning, knowledge construction, and learner-to-learner interaction. (Tu, Blocher, & Roberts, 2008). Wiki allows learners to engage in learning with each other, using wikis as a collaborative environment to construct their knowledge or to be part of a virtual community of practice (Boulos, Maramba, & Wheeler, 2006).

The wiki concept is simple and efficient. Using the simple and easy-to-learn wiki syntax, pages can be created and edited on the fly, within the browser, without need for editing markup source code or using file transfer clients. They include functionality for editing by more than one person, either restricted to members of open to a wider public (Rollett, Lux, Strohmaier, Dösinger, & Tochtermann, 2007; Grant, 2009).

Wikis have been used for a wide range of purpose: form private wikis for small groups to collaborate on business projects, to online special interest groups recording their history and work to date to an open-to-the-public attempt to collaboratively write a novel (Grant, 2009).

Social bookmarking

Social bookmarking tools exist and are used extensively by the Web 2.0 community. Simple and straightforward implementations allow storing and sharing of bookmarks as well as annotation and tagging of the hyperlinks. Other feature include storing the entire content of bookmarked web pages

in a cache for the purpose of later retrieval, indexing, and preserving their content as it appeared at the time of the original bookmarking. (Rollett, Lux, Strohmaier, Dösinger, & Tochtermann, 2007)

Social bookmarking is designed to act as a facilitator, providing learners with tools to chunk, scaffold, and/or organize information in a format that best suits the learners. Social bookmarking opens a path to learning by drawing on the strengths of community intelligence, social ties, and shared practices by providing a forum in which the information can be exchanged.

Social bookmarking can increase time on task, decrease search time, enhance the curriculum, and enable students to locate the best resources.

Tagging

As Web 2.0 as a platform allows easy contributions even by average users, it leads to both quantitatively more and more specifically targeted content and functionalities for a wider variety of niches than previously. Sharing is central on Web 2.0: cooperate, don't control, harnessing collective intelligence, and wisdom of crowds (Rollett, Lux, Strohmaier, Dösinger, & Tochtermann, 2007). By this semantic search and tagging become crucial tools in knowledge creation process.

Tagging permits users to collect, organize, and share web-based resources. Tags allow teachers and students to search, analyze, and locate identified educational resources with distinctive keywords. (Nelson, Christopher, & Mims, 2009). Tags can be arranged into concept maps called "tag clouds", which allow revisualization of the way one considers one's work.

Statistical analysis of the tags permits tag recommendation and the detection of related tags, as well as of relations between Universal Resource identifiers (URIs) and users (Rollett, Lux, Strohmaier, Dösinger, & Tochtermann, 2007).

RSS

RSS technology can be strategically integrated into Web 2.0 to enhance distributed learning resource management systems, which will support learners in managing the distributed learning resource strategically and efficiently (Tu, Blocher, & Roberts, 2008).

RSS is the most prominent feature of a wiki and blog. It enables of syndication and aggregation of content using the feeds provided by blogs. Feeds offer the most recent entries in a machine-readable markup language to allow other software to read and use the content of the entry so that users can easily receive content updates from their favourite services (Rollett, Lux, Strohmaier, Dösinger, & Tochtermann, 2007; Boulos, Maramba, & Wheeler, 2006).

Online socio-cultural learning that emphasizes collaborative, meaningful, and authentic learning activities could be effective strategies to improve learning. Ideal meaningful and authentic online activities should allow learners to acquire ownership in negotiating, planning, and managing processes (Tu, Blocher, & Roberts, 2008).

Many advanced networking technologies require that learners learn and manage these technologies deliberately. It will require learners with a certain correct understanding, technical skills, and positive experiences to maximize the advantages Web 2.0 provides (Tu, Blocher, & Roberts, 2008).

Web 2.0 solutions enable members of community of practice use different solutions for knowledge creation and management. Individuals self-organization and reflection about content and process are also enabled. Social bookmarking, tagging and semantic search supply users with different resources. Using social software also supports communication between members of community of practice as well common knowledge building. As there are several different solutions members of community can pick out the ones that are for them most suitable.

2.3. Knowledge environment and paradigm of learning

Sometimes it is argued for a certain learning environment is pedagogically neutral. Pedagogical neutrality implies the avoidance of preferred paradigm, ideology or religion and means that concrete learning environment is disconnected from any specific pedagogical approach. In the context of learning management systems, pedagogical neutrality becomes visible in user interface design – in the vocabulary, functionalities, structure and affordability. Instead, concepts from technical domain or 'neutral' school practice are used: file upload, chat, forum discussions, whiteboard, assignment handing or dropbox, helpdesk, student tracking. Although pedagogical neutrality might sound like good characteristic argues Friesen (2004), that 'applications that are truly pedagogically neutral cannot also be pedagogically relevant' (Laanpere, Põldoja, & Kikkas, 2004). Therefore every environment still carries some pedagogical or philosophical background along.

Hung (2001) has described how use of ICT solutions is bound with different approaches to learning (see Tabel 2) started from tutorial instruments and presuming student working alone and good for basic information sharing (supported by acquisition metaphor) until collaborative environments supported by participation metaphor.

Behaviourism	Variety of drill and practice computer-based learning software	For example, EBLs that drill students on multiplication and addition
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		(individual instructive tools)
Cognitivism	Tutorials and information databases	For example, encyclopaedia and Internet resources (informative tool)
Constructivism	Individual generic purpose tools	For example, Exel, Word and PowerPoint, simulations, hypertext and hypermedia, organizational tools (individual constructive tools)
Social constructivism	Collaborative generic environments	For example, e-mails, bulletin boards, knowledge co-construction/exchange forums, computer-mediated collaborative problem solving environments (social communicative / /constructive tools)

Table 2 - Computer-mediated tools and learning theories (Hung, 2001, lk 285)

Lakkala et al. (2009) are critical about present ICT solutions and claim that existing solutions are mainly suited for sharing information (acquisition metaphor) or for supporting social interaction (participatory metaphor) as respective social activity. They are more critical about concrete tools as well: if Hung sees e-mails and Virtual Learning Environments already supporting participatory metaphor, then Lakkala with colleagues argue that these solutions belong still to acquisition metaphor.

Lakkala et al (2009) have introduced new framework that is displayed on figure below (Figure1).

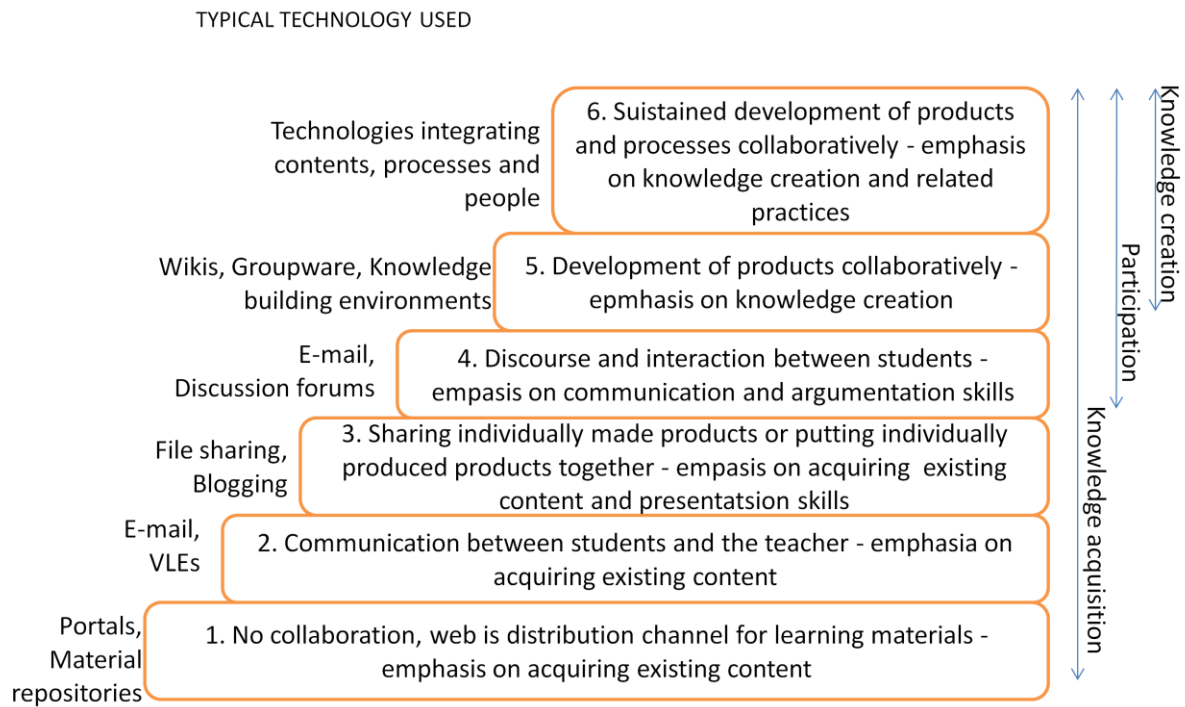


Figure 1 - Stairs of Web-based Collaboration Practices in Education (Lakkala et al, 2009)

Lakkala et al (2009) describe that the steps in the framework are defined according to the increasing extent and complexity of collaboration that the practices reflect and the changing role of knowledge and technology in the process. The framework aims at defining various form of collaboration in a practical way.

In step one network serves as a transmission channel of educational materials without any communication between actors. Interaction occurs between teacher and the student; students are not in contact with each other.

Practices from the third step upwards allow students to interact directly with each other. For example: students prepare written materials about some topic individually and share the outcomes for all to read through file-share system. Student might write some comments to each others' work, but actual collaboration between students remains minor, it the outcomes are distributed only for reading.

The fourth step describes direct and reciprocal interaction between students and communication with each other. Primary objective of this kind of activities is to practice communication and argumentation skills (presenting, defending opinions, and accepting different viewpoints).

The most challenging type of collaborative work is described in the fifth and sixth steps. Some recently developed network applications, such as wikis, have been especially designed to afford of co-construction of knowledge through the Web and support knowledge creation metaphor. Collaborators are mean to produce and modify concrete products or outcomes as the result of shared effort. Active participation and responsibility of commenting, planning, revising and developing common sketches or versions of the product is waited from all members. In fifth step students' working is directed to the development. In sixth step the collaborative process (the way of working itself) is also a subject of joint reflection and development (Lakkala et al, 2009).

To describe paradigm sift in pedagogy and Web McLoughlin and Lee (2007) have come up with the term "pedagogy 2.0" that shows how individuals link with communities and networks in the process of knowledge sharing, construction and understanding.

Pedagogy 2.0 makes use of the affordances of social software tools to enable connectivity, communication, participation in dynamic communities of learning and the development of common knowledge objects. Defining Pedagogy 2.0 following dimensions can be identified (McLoughlin & Lee, 2007):

- Content: micro units of content that augment thinking and cognition, learner-centred content that accrues from students creating, sharing and revising ideas;
- Curriculum: not fixed but dynamic, open to negotiation and learner input, consisting of "bite-sized" modules, inter-disciplinary in focus and blending formal and informal learning;
- Communication: open, peer-to-peer and multi-faceted, using multiple media types to achieve relevance and clarity;
- Process: situated, reflective, integrated thinking processes; iterative, dynamic and inquiry-based;
- Resources: multiple informal and formal sources that are media rich and global reach;
- Scaffolds: support for students comes from a network of peers, teachers, experts and communities;
- Learning tasks: authentic, personalised, learner-driven and designed, experiential and enabling multiple perspectives.

Affordances of new knowledge environment based on new social media approach are closely interrelated with and affected by new pedagogical paradigm. Therefore if we change one of them we have to change also another.

2.4. Conclusions

In this, study knowledge environment is defined as a virtual environment, which supports individual and collaborative production of new knowledge objects, facilitate innovation and continually improve ideas. The main focus of knowledge environment is on inquiry and problem solving. Identification of problems, followed by generating, elaborating and evaluating ideas are crucial components of inquiry.

As support of self-organization and individuals' initiative are important, community of practice aspect cannot be forgotten. When working collaboratively and sharing ideas, communities can be significantly more productive than individuals working in isolation (McLoughlin & Lee, 2007). In this sense knowledge environment is definitely a social environment.

Knowledge environment has to support four dimensions (Lakkala et al., 2009):

- Epistemic dimension: members of community of practice have to be able to create, transform, organize and link knowledge artefacts;
- Pragmatic dimension: to cover planning, organizing and coordinating working processes is important;
- Social dimension: managing social relations around shared objects and linking people helps knowledge creation processes; and
- Reflective dimension: making visible and reflecting on the work processes supports knowledge in both community and individual increase of knowledge.

Web 2.0 solutions support mediated knowledge creation, information sharing, personalized structures, and collaboration among users. These communities emphasize a crowd sourcing (collective intelligence) (Tu, Blocher, & Roberts, 2008).

Web 2.0 has introduced distributed architecture of Web-services. Different services have different solutions: Flickr for photo sharing, Youtube and Vimeo for video sharing, Wiki and GoogleDocs for knowledge building, blogs for reflection.

Multitude of different environments enables the user to choose appropriate environment for particular task and to design it to fit the user. In order to make knowledge building freely accessible it is necessary that its environment would be flexible enough and would enable to collect information and observe various sources.

Using RSS enables to select sources, to observe activities and supports the interest and/or aims of knowledge creation of individuals or communities of practice. Usage of RSS supports learners in managing the distributed learning resource strategically and efficiently.

As Web 2.0 solutions enable quantitatively a big amount of creation of knowledge objects. So semantic search for finding knowledge object could be used. For this purpose social bookmarking can be used: although bookmarking can increase time on task it decreases searching and enable students to locate the best resources.

Tagging permits users to collect, organize, and share different web-based resources. Tags allow teachers and students to search, analyze, and locate identified educational resources. For visualisation the usage of tag clouds are useful. Also tagging helps to find and use other interested parties the material created by the particular community of practice.

Access to necessary resources: Web 2.0 helps to search and find necessary resources besides knowledge objects it is possible to use some solutions to find necessary people.

A good knowledge environment allows reverting knowledge building process back in a few steps and to start again from a particular spot in history. The historic aspect allows to reflect upon the knowledge building process and to see the contribution done by members of community in creation of common knowledge object.

As there is a number of knowledge builders who create also a lot of content it is necessary to pay attention to legal aspects. Good knowledge environment includes the part where it has been legally regulated if and how the necessary resources are used.

As knowledge building is collaborative work, the support of interaction between members of community of practice is important. Therefore it is important that knowledge environment supports both asynchronous and synchronous communication.

As pedagogical practices that promote competencies for sharing, creating, and working with knowledge and knowledge artefacts in an innovative way are crucial (Lakkala, Paavola, Kosonen, Muukkonen, Bauters, & Markkanen, 2009) it is important that teachers understand the concept of knowledge creation and have experience how to use suitable environments for this purpose.

3. In-service teacher education in the field of educational technology

In this chapter a short historical overview of teacher education in the field of educational technology will be given. Last chapter describes learning environment IVA used in DigiTiger course. Chapters from 3.1 to 3.3 are based on the report from research conducted by Laanpere and Peenema (2009).

3.1. Historical overview in Estonia

Systematic training in information and communication technologies among Estonia's general education teachers began in 2005 by the Tiger Leap Foundation. Although prior individual training sessions had been held (e.g. e-mail tutoring by Anne Villems in 1994-95), massive training was launched in 1997. Until 2000 most training sessions were project-based, initiated mostly by individual active IT-tutors or school headmasters whereby trainer him/herself gathered a group and appointed by himself training content and duration, the Tiger Leap Foundation just covered the application. Most of these primary training courses lasted 8-16 hours, and generally covered: operating system MS Windows graphical user interface, file management, introduction to word processing, e-mail and web use.

In 2001 Tiger Leap Plus training program started. The program was coordinated by Tiger Leap Foundation. More than 10 000 teachers have passed its curriculum over four years of time. This 40-hour course was based on training program "Teach to the Future" created by Intel's computer firm and was implemented at national level in many countries. Tiger Leap Foundation gathered training team, which included 50 trainers from all Estonian regions. The Foundation signed agreements with 25 schools, which became regional training centres. While most of the courses were carried out in these centres, some training sessions were also carried out in other schools, which were able to form a group and to ensure required learning environment. All trainers of the training "Computer at school" were working in schools by themselves as teachers, managers or administrators and had passed specific training organized by the British instructors. All the trainers used the same curriculum. The training was based largely on getting to know Microsoft Windows and Office software, but unlike the previous courses paid also attention to the different methodology: the use of computers in school lessons. The main disadvantages of the training program "Computer at school" were 1) limited use of group work, 2) focusing merely on Microsoft software and 3) lack of web-based learning environment.

In 2005 a more active group of trainers of the course "Computer at school" with the support of Tiger Leap Foundation started with preparations of new training program named DigiTiger, which was to become a follow-up of the course of "Computer at school". The main differences between "Computer at school" particularly concentrated on deployment and teaching of web-based learning

environments, focusing on teaching methods and reduction of the use of Microsoft's software products. An important innovation was linked the training to standard of education technology.

"Common European Principles for Teacher Competences and Qualifications" (European Commission, 2005) has noted that the core competencies of a teacher are the abilities to actively work with knowledge, technology and information. Teachers' ability to use information and communication technology can effectively integrate learning and teaching and to contribute to the quality of the learning process.

3.2. Educational technology competency standards for teachers

There are three alternative international competency standards which focus on teachers ICT skills. Each one of these standards is developed and promoted by a different prominent international organization.

- ISTE (cnets.iste.org) was the first organization that began development for teachers aimed at education technology knowledge standard already in 2000, while this standard is implemented by the major North American countries.
- ECDL / ICDL (www.ecdl.com), which deals with the context of independent qualifications, computer skills standardization and evaluation. In several European countries the teachers training in ICT skills is either constructed merely based on ECDL implementation (eg, Poland, Italy) or its adapted version (Teachers' Computer Driving License Lithuania and Denmark).
- UNESCO has developed an international teacher training ICT-knowledge standard: <http://unesdoc.unesco.org/images/0015/001562/156207e.pdf>

Estonian teachers' Educational knowledge standard is mainly based on the ISTE model and is relatively close to the Finnish standard OPE.fi.

3.3. DigiTiger: a competence-based training program for teachers

DigiTiger training program and materials rely on teacher vocational standard as the main official document that defines teacher competencies. However, the new learning methods and professional standards for information technology-related competencies and global level are only briefly defined, so we used in this study the Tiger Leap Foundation vocational standard framework document "Teacher's educational technological competencies" DigiTiger training is primarily aimed at teachers

ICT-related competences (knowledge, skills and attitudes), and related pedagogical skills development in the following areas:

- e-learning environments
- e-Portfolio
- definition maps and mind maps
- new media and collaborative teaching
- study software and Web Evaluation
- knowledge of control techniques, and meaningful learning.

Competence based approach to training gives priority to study outcomes that are closely related to the definition of the daily tasks and leaves open how to achieve the competencies - either to 1) work on their own / or informally while testing of new things, 2) studying individually on the basis study materials, 3) to be a part community of practice by actively contributing to the activity or 4) participation in formal training courses. Even with formal training competence-based approach can be built up in such a manner that they would leave sufficient flexibility to the learner in setting study goals, planning learning activities and learning design - as long as the end of the training would be available for all participants at competencies. Competence-based training is the counterpart to the traditional content / subject-based training, in which all the participants are expected to study materials and perform tasks in the pre-foreseen order and volume given by the trainer.

Competence-based training covers diverse schools of thought, such as Carr and Kemmis have identified three competing paradigms (1983):

1. **Dominant technical paradigm**, based on study model of behavioural psychology (stimulus-response-feedback). The trainer's role is simply to choose the appropriate technology, knowledge, which leads to the loss-free and noise-free knowledge transfers. The training is aimed only at the individual knowledge or skills in coaching, which is easy to measure (eg Computer Driving Licence exam-style), but neglects the needs of the individual worker and compatibility of the new knowledge, skills, experience and blend in with the existing schemes of meaning;
2. **Interpretive paradigm**: learning is seen as interactions between the trainer and the learner, which provides facilitation of the acquisition of new knowledge and attitudes. The trainer's role is to be facilitator and shaper in achieving the learner's objectives and competence molding;

3. **Strategic paradigm:** The trainer emphasizes the critical role of reflection. The goal is primarily the student's own goal-setting stages of planning and professional development, self-examination, identification and, where appropriate, modification of existing the existing schemes of meaning (cited by O'Donnel & Garavan, 1997).

Competence-based training is mostly criticized due to dominance of technical paradigm. Ecclestone (1994) is concerned that competence based training reduces the role of the trainer and the trainer only trains on specific skills, but does not transfer values. Hyland (1996) outlines a problem that the system only rewards the achievement of competence in practice, by a formal approval or receipt of diploma or accreditation, and not the student development and lifelong learning. The technical paradigm has also been criticized by Norris and Melton, who argue that the approach to training is too output and product-based, focusing rigidly on tasks and leaves aside employee growth of as a personality (Norris, 1991; Melton, 1994).

In contrast, O'Donnel & Garavan (1997) note, that trainers play a vital role to ensure that learning takes place. This does not mean only that the necessary level of competence demonstrated by the students but there is a deeper understanding from the lessons learned. This understanding will come about through detailed feedback (Eraut, 1996) and reflection.

Rather, all the paradigms highlight a problem. Since the trainees have a strong need to implement the lessons learned (Wlodkowski, 1999), then returning with new knowledge and skills acquired to the workplace, it might appear this is not possible. As a result, the trainee becomes frustrated, and he perceives the training loss of time, leading to lost motivation to do their job properly (Ruohotie, 1990). Thus, it is useful in planning the training to simultaneously take into account both the needs of organization and aims of individual (Lucia & Lepsinger, 1999).

DigiTiger course is not for pure competence-based training, because participants are invited and expected to participate in contact days, working through teaching materials and execute the tasks given by trainer. It is also not possible to complete the training DigiTiger exams externally, using one's previous work as the supporting evidence of their competence.

3.4. Knowledge environment at DigiTiger

IVA web-based learning management system was used as a virtual learning environment at DigiTiger course. To assess whether the environment was used in DigiTiger training the principles described in chapters 1.4 and 2.4 were used.

Epistemic dimension: participants of the training are able to create and transform knowledge objects. They can use blog, wiki and are able to upload different files. It is possible to give feedback by adding comments to different knowledge objects. Therefore processes like generating, elaborating and evaluating ideas are supported. IVA environment enables asynchronous and synchronous communication between members of community, but to be able to use synchronic communication, one has to have user account in Skype. One of the shortages of IVA environment is missing forum. Therefore inquiry of problems is partly enabled.

Pragmatic dimension: Participants cannot give tasks to other participants and plan working flow, this is enabled to teachers only. Participants have an opportunity to create groups and invite people to participate in the work of these communities. Self-organization and goal setting in order to enable participants to take responsibility for knowledge building is not enabled. The initiative of individual is therefore restricted.

Social dimensions: Participants can create different communities based on the criteria of their choice. In these community pages they can see photos of different members of concrete community. Despite IVA allows this - none of the training participants have used this opportunity.

Reflective dimension: Learning environment used in DigiTiger training enables participants to create their own wiki and blog. Although the opportunity to use blogs and wikis to reflect their growth of knowledge is there, participants did not use this availability.

Distributed architecture of Web-services: in IVA are places where participants can collect their bookmarks; create blogs and wikis, but they are not able to share them with community.

Opportunity to select and design suitable environment - It is possible for participants partly to choose between different environments, but they are not able to design their own environment.

Social bookmarking - participants can use their private bookmarks, but they cannot share them with the other members of community.

Tagging - Participants cannot tag different knowledge objects.

Openness and access to different resources - is very restricted. Access to IVA environment was only for teachers who participated in DigiTiger training. After the training teachers were not allowed to continue using this environment. It was possible to use knowledge objects uploaded into environment and do collaborative work but only with those people who participated in the same course. Potential members of community of practice were not enhanced.

RSS was enabled. So participants had a chance to see what other participants of the course were creating, uploading and commenting. But as teachers did not actively participate in knowledge creation process there was also no need for a tool like RSS.

History-based awareness. By using wikis it was possible to turn back in history and revert to the earlier edition and thereby observe the process of knowledge building. However, this opportunity was not used by the training participants.

Legal aspects were not described and clarified.

Search. Participants had no possibility to use search. This restricted to find different resources necessary to knowledge building process.

Although IVA enabled group-work, write blogs, investigate problems, the environment was mainly used to spread learning materials. For collaborative knowledge building it would have been more useful to use open environments which participants of the course could have used later on and where also other potential members of community would have taken part in the work of the community. At the moment of the main processes of communities of practice - negotiation of meaning - is not supported enough. Missing opportunities to use tagging and search also blocks knowledge creation process. IVA in DigiTiger course is not used as knowledge environment, but delivery platform for learning materials.

4. Empirical study

In order to assess the knowledge environment created for teachers, suitability of delivered training to teachers and creation of community of practice, different studies were carried out. IVA community that was used in as knowledge environment was analyzed on the basis of criteria that were derived from the theories in literature review. The suitability of training to teachers, their participation in the community of practice and knowledge building after the training was assessed on the basis of questionnaire that was handed to the participants of the training. The questionnaire was developed by author of this thesis in co-operation with Mart Laanpere.

4.1. Method

4.1.1. Assessment of Training Based on Kirkpatrick Model

Kirkpatrick's (1998) model of training evaluation was used to evaluate the training. Kirkpatrick's model is the most commonly used recent framework assessing the quality of training programs. While critics complain about over-simplified view of the effectiveness of the training, the use of causation as the next level of achievement of each knowledge depends on the previous training level and overstatement of information, no better comprehensive model has been proposed to evaluate training (Alliger & Janak, 1989; Bates, 2004).

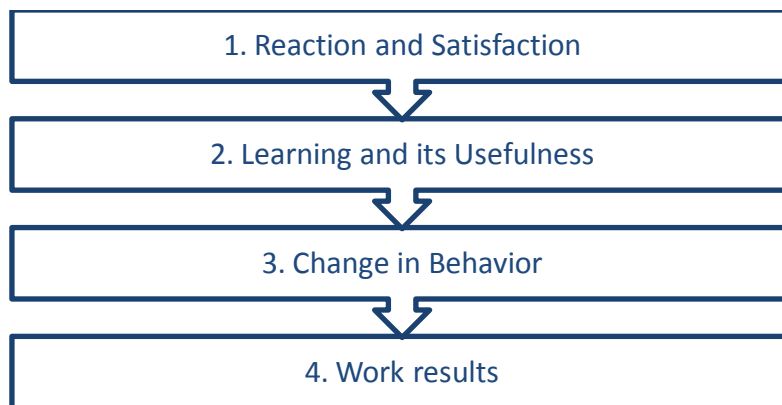


Figure 2 - Kirkpatrick Model on Training Assessment

Kirkpatrick training evaluation model is built on four levels. This model enables to assess the training participants' (Kirkpatrick, 1998):

1. **Immediate reaction.** Participants' direct reaction to the course ("customer satisfaction") is assessed. A positive reaction does not guarantee learning, but a negative reaction reduces possibilities that any learning took place at all. This level of assessment is similar to the evaluation of customer satisfaction: often "smiley sheets" are used in this phase. If the training is effective, it causes positive reaction among participants. Otherwise, they are not

motivated to learn. In addition, assessment of reaction may be used to collect ideas for improvement of the program.

2. **Learning and its usefulness to the participants.** Learning can be defined as the extent and scope of change in attitudes, increased knowledge, improved skills (or competences) as result of the training. It is useful to determine beforehand the level of knowledge and skills and assess them after the training. If acquired knowledge and skills are new, then there is the need for pre-test. In addition, it is recommended to use a control group that has not undergone the training. Traditional tests of knowledge or skills are often used in this phase.
3. **Changes in behaviour.** as the extent and scope of change in participants' behaviour as a result of training. In order for change to take place, it is necessary that participants are personally interested in change, know what and how to do things differently must work in the proper environment that allows for the change in behaviour and change in participants behaviour must be recognized by the peers and supervisors.
4. **Results** - work performance improvement. Kirkpatrick discussed results as implications of performance (or impact to the organization), which appear after participation in the training. This may be expressed by increased production, improved quality, lower costs or higher profits. Evaluation of the results is the latest of the four and is also the most complex. In business organizations it is assessed by measuring, work performance, entering into new markets, increasing business turnover or profits, waste reduction.

According to Kirkpatrick - all specified four levels are important. All the levels influence either directly or indirectly the subsequent level. Each new level of assessment requires more time and is more difficult and costly to assess than the previous, but it contains valuable information. Mostly because of associated cost and workload - most training assessment activities only focuses on the first two levels (Kirkpatrick, 1998).

The first two criteria are related to creation of a positive attitude towards change. The latter are related to the participant's job and direct manager. If the workplace does not provide supportive atmosphere, then most likely the change in behaviour would not happen. To create positive working environment, Kirkpatrick recommends including managers in phase of preparation of training (Kirkpatrick, 1998).

Assessment of learning and reaction should take place out immediately after training. Change of behaviour cannot be assessed so fast, it is important to wait at least a couple of months after the training. Survey or interview should be carried out either directly with the participant of the training,

with his immediate director, or with people who work closely together with the individual participated in training. Interview provides certainly more information than a survey, but its drawback is consumption of time. It is useful to re-evaluate change of behaviour after certain period of time (Kirkpatrick, 1998).

Current study focuses mainly on levels of reaction and learning levels, but touches also the third level: behaviour. In assessing behaviour, only teachers' self-assessment on the change of their behaviour is conducted. Due to lack of resources it was not decided to triangulate the data with additional interviews or questionnaires of managers and colleagues of the training participants. In our case the fourth level - performance - would be very difficult to assess because our measure demonstrates itself via social impact of colleagues.

4.1.2. Assessment of Development Based on Valsiner's Model

In this study, the application of the training outcomes to everyday work and its implications were analyzed on the basis of Valsiner theory of cultural developmental zones, which was created in 1997 (Goos, 2005). In the present study the theory has been taken as the basis to assess learning and behavioural changes of the teachers who passed the DigiTiger training.

The environment of the developing child is structured by sets of boundaries that define different environmental zones. Valsiner defines a zone - as a region or area set off or characterized as distinct form surrounding or adjoining parts. Based on Vygotski and Lewin - Valsiner uses three basic zone concepts that are viewed as organizers of development (Valsiner, 1997).

- *Zone of Proximal Development,*
- *Zone of Free Movement,*
- *Zone of Promoted Action (Valsiner, 1997).*

The more detailed descriptions of the zones and their direct implications in the present study are the following:

- **Zone of Proximal Development (ZPD).** Zone of proximal development is the distance between the ability of child to solve a problem individually and the higher-level problem solving ability that is only possible to achieve with the help of assistance of an adult or a more advanced child.

Based on Lev Vygotsky zone for proximal development further entails the set of possible next states of the developing system's relationship with the environment, given the current state of the zone of free movement or zone of proximal development. The zone of proximal

development helps to capture those aspects of child development that have not yet moved from the sphere of the possible into that of the actual, but are currently in the process of becoming actualized. Zone of proximal development has a decisive role in development because it provides a link between the zone of free movement and zone of promoted action (ibid. p. 200).

In the present study - in teacher education the zone of proximal development may be considered a symbolic space where (ex in the sense of using technology) the skills of a beginner develop more during the assistance and mentoring of a more experienced peer.

- **Zone of Free Movement (ZFM).** Zone of Free Movement includes environmental constraints that limit freedom of activity and thought. As a result of being subject to those constraints a child learns to set up a zone of free movement in his or her personal thinking and feeling - the zone becomes internalized. Ultimately the zone of free movement provides a structural framework for the child's cognitive activity and emotions. The zone is socially constructed because it is based on adults' and other siblings' cultural meaning system, and is formed in direct interaction with them. The zone of free movement can be constructed in different ways: by peers or by children themselves. Hence it consists of the following structures:
 - a) Child's access to different areas in the environment.
 - b) Availability of different objects within an accessible area.
 - c) Child's ways of acting with the available objects in the accessible area.

In the present study - the zone of free movement is conceptualized as an inhibitory psychological mechanism, which is oriented toward the promotion of new skills. For teachers participating the training the zone may include:

- Their students, whose abilities, social-economic situation or behavioural norms may restrain teaching and application of ICT tools.
 - Curriculum, teaching arrangements, assessment criteria used in the given school where the teacher works. These may affect the choice of subjects, methods and identification of time needed for ICT application.
 - Available resources - such as digitally available teaching materials, computers, accessories (data projector, touchscreens) or availability of computer class. All of these factors affect the planning process of teacher.
- **Zone of Promoted Action (ZPA).** Zone of Promoted Action is a set of activities, objects, or areas in the environment, in respect of which the person's actions are promoted.

In the present study - zone of promoted action is related to preferences of education politics, school management or experienced colleagues. If they demonstrate and promote their preferences for certain methods, tools or approaches then it has an impact on the activity as well. The differences among different Estonian schools in how much they promote the use of certain ICT tools (ex. touchscreens or laptops) are relatively large.

In the long run, all three zones of Valsiner model are presented in a balanced manner on the 3rd and 4th level of Kirkpatrick's model. Provided that at least one of the zones is constrained then it may reduce both the work of the trainers as well as the work of local enthusiasts in disseminating new practices amongst the majority of teachers. In practice it may happen at Estonian schools in the zone of free movement as the official curriculum of schools is rigid and overburdened already.

4.2. Data collection instruments

In November 2008 the questionnaire was repeated among the teachers who participated in the training. In the framework of the study partially the same questions were asked as in the first immediate feedback questionnaire to assess longitudinally changes in opinions throughout time. Additionally, the application of the knowledge to everyday practice was studied.

The questionnaire consists of 4 parts:

1. Background information: name, gender and age of the respondents, data about the school, grade level and subject he/she teaches.
2. Feedback on DigiTiger training (reaction level).
3. Self-assessment of use of skills gained on DigiTiger course (behaviour level).
4. Impact of the training (behaviour level).

The survey was carried out using LimeSurvey software Estonian language format (<http://limesurvey.org>). Every respondent received via email individualized access code. At a later stage it was possible to resend invitation to those participants who had not responded to the questions yet.

An invitation to participate in the survey was sent from LimeSurvey system by e-mail to all the teachers who had participated in DigiTiger training between April 2007 until March 2008. In the primary list there were 1033 individuals, but the invitation was sent to all of them who had given their correct e-mail address. Unfortunately the respondents' list contained repeated e-mail addresses. Apparently, some teachers either didn't have any e-mail address or did not remember it

or did not want to share it. Some teachers had provided postal address instead of an e-mail address. Additionally, respondents with misspelled or expired e-mail address were excluded. As a result of these exclusions, 950 teachers received invitation to participate in survey.

4.3. Results and discussion

Out of 950 invited, 504 responded during the designated time. The most responses - 99 were received from the teachers in age group 41-45 years, 87 respondents were 46-50 years old. The smallest number of responses was received from the youngest teachers - only 3 from teachers who were younger than 25 years of age. Age layout of the respondents is displayed below at Figure 3 - Age Distribution of the Respondents.

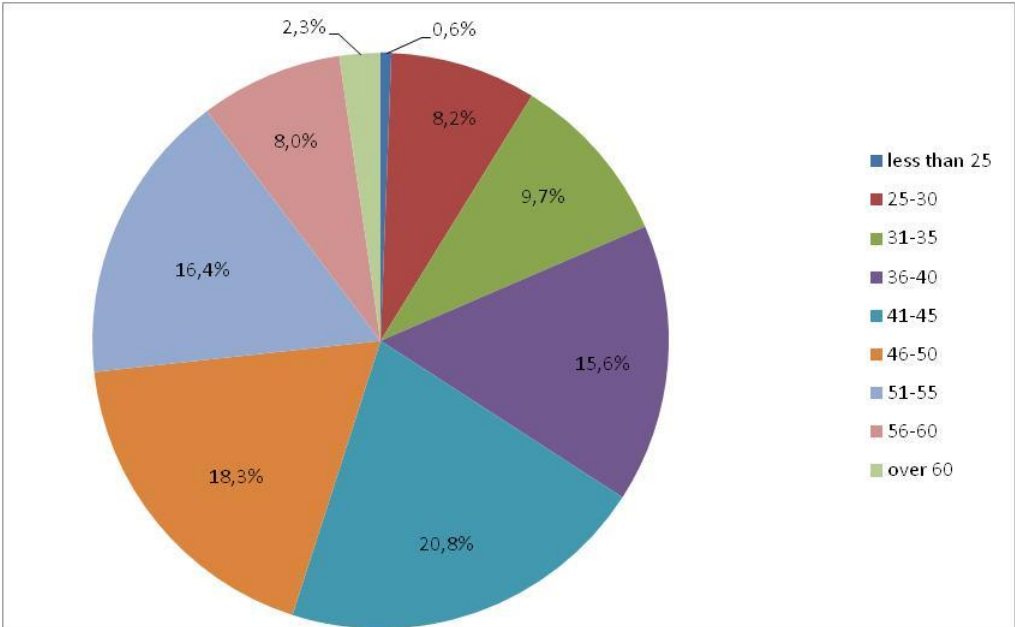


Figure 3 - Age Distribution of the Respondents

90.4% of the respondents were female and 9.6% male. 150 responses were received from the schools with 600-1000 students, 133 respondents were from smaller schools (100-300 students).

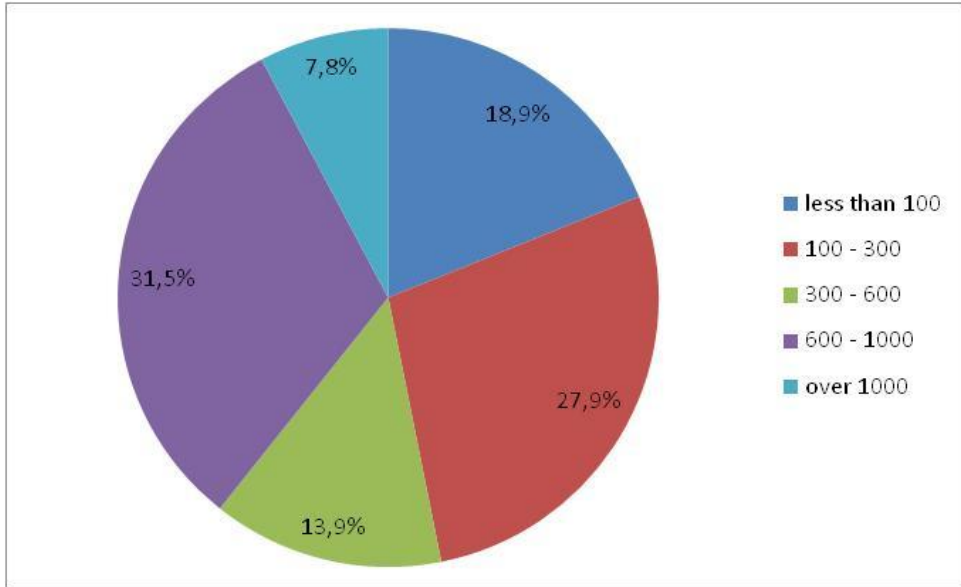


Figure 4 - Respondents According to the Size of the School (no. of Students)

The largest number of respondents came from Harjumaa region (19%) and Tartu region (11%). The smallest number of respondents was Jõgevamaa region with a single response (0,2%).

The vast majority of the training participants teach 7th - 9th grade (class) students. The least covered were the students working with primary school - 1st - 3rd grade (class) students.

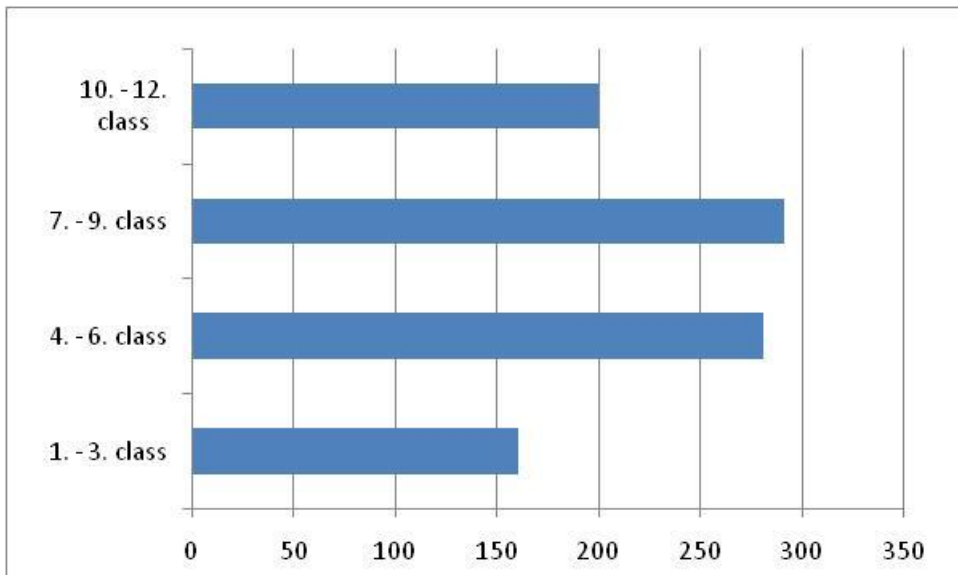


Figure 5 - Respondents Divided According to the Grade that they Teach

The most active participants were class teachers (106). The other active participants were foreign language teachers (82) and mathematics teachers (69). The smallest number of participants were among music teachers (4).

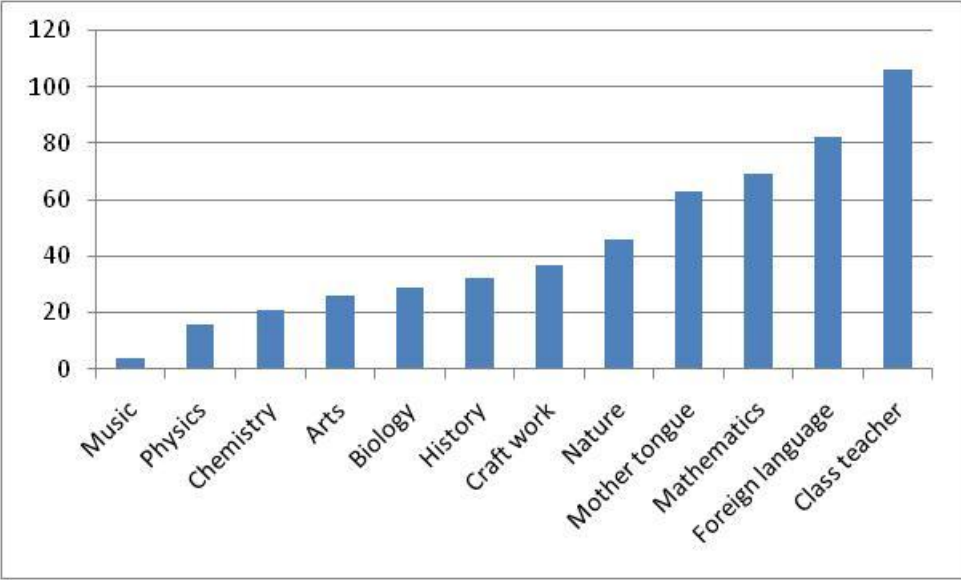


Figure 6 - Participants by Subject Areas

Based on Kirkpatrick model the first assessment was made about their reaction to the training. The instant reaction was measured immediately after the training was carried out by the Tiger Leap Foundation. The immediate results were assessed in the evaluation study by Laanpere and Peenema (2009). To check if the reactions have changed during the later period - some of the questions were repeated also during the later study.

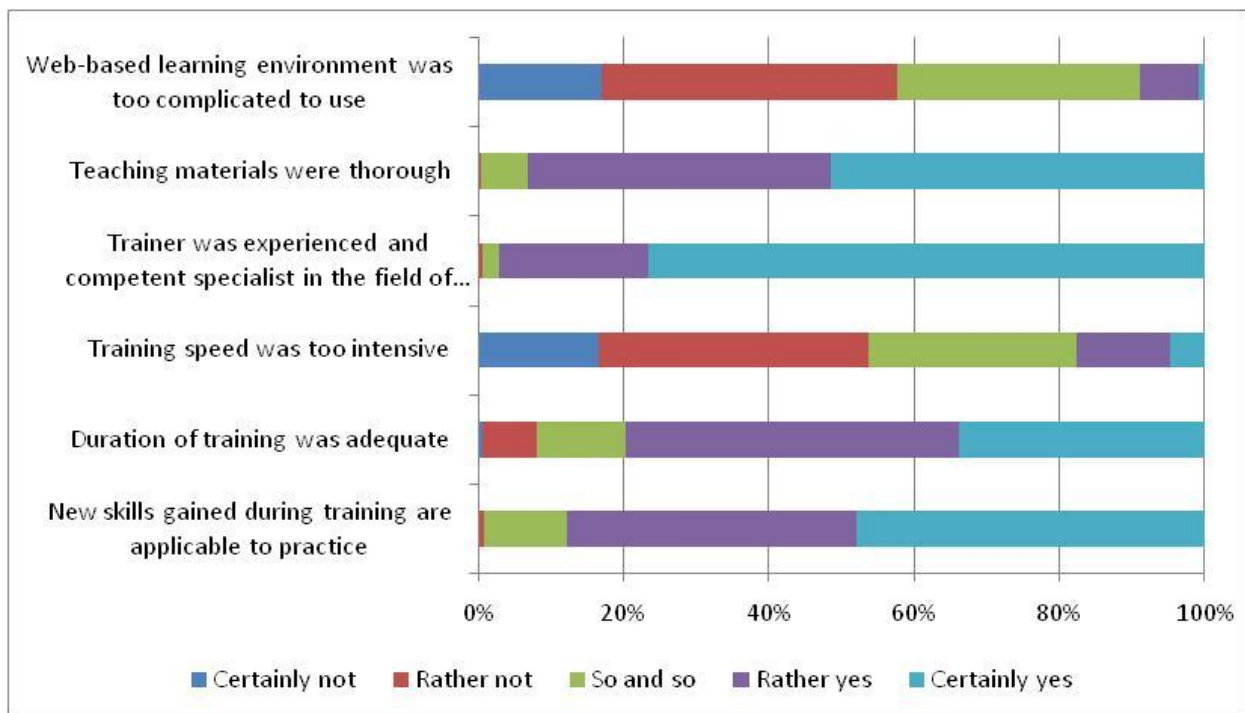


Figure 7 - Reaction after the Training - Satisfaction with the Training

Based on the data on Figure 7 - Reaction after the Training - Satisfaction with the Training, it is possible to conclude that the immediate reaction of the participants to the training programme was positive. 88 per cent (435 respondents) responded with "Certainly yes" or "Rather yes" to the question on whether the skills that were acquired during the training were useful. Very positive feedback was given to the trainer. Altogether 97 per cent considered the trainer competent. Also the training materials were regarded highly - 93 per cent (463 respondents) thought that the materials were good. Somewhat less positive was the response on the pace of training. 18% considered it the pace of the course too intensive. Also the web-based training environment was well received - more than half of respondents did not consider it too complicated for their use.

As a result it may be concluded that the participants' main attitude towards the training was largely positive. Also immediate feedback to the training was positive (look: Laanpere & Peenema 2009). From this we can conclude that training was suitable for teachers' abilities. It means that learning took place inside of Zone of Proximal Development described by Valsiner. Taken into consideration the fact that the participants had the chance to apply immediately their new knowledge into practice - it gave reasonable grounds to believe that what was learned during the training had been applied to practice as well.

On the basis of this the participants were requested to assess the change in their behaviour. For the sake of simplicity of questionnaire the key focus was given to the one sub-section of the training. Namely to the use of web-based learning environments, which was one of the most important building blocks of the training programme that focused on the use of knowledge environments in the study process. Derived from the opinions of the respondents - 72 per cent of the teachers think that the web-based learning environments help to organize their work in a more flexible manner. Almost ¾ of the respondents (73 per cent) are of opinion that the web-based learning environments also increase the interest of students towards the subject in question. A little bit more than half (57,6 per cent) of the respondents commented that they are using computer and Internet while preparing their study materials.

Despite the fact that general assessment of web-based learning environments has been positive, the direct impact and active use of particular tools has been applicable only for less than half (44 per cent) of the training participants. Starting using learning environments either IVA or VIKO requires either school headmaster and/ or information manager active approach. One of the barriers is the need for signing an official agreement with EENET for the use of the mentioned environments - this cannot be done by a teacher him- or herself, only by school principle. Furthermore - for a teacher alone it is too complex to start implementation the web-based learning environment. On the other hand, the same limitations do not apply to the use of blogging or Google Docs, where the active use of the environment mostly depends on nothing more than the active will of the teacher.

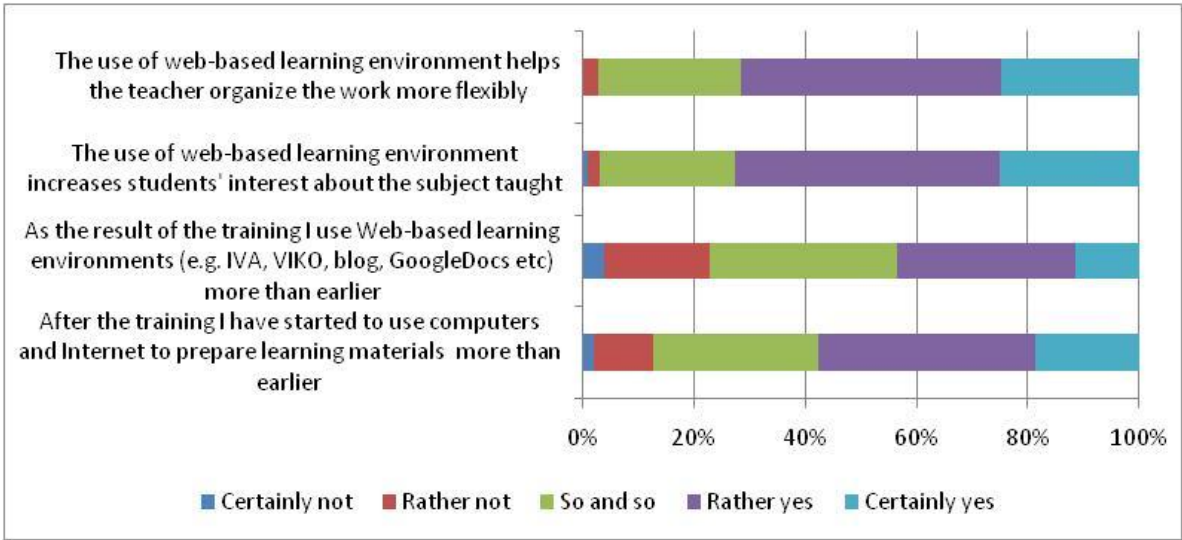


Figure 8 - Use of Web-Based Learning Environments

Based on the training program the survey also asked in more detail about the use of particular software tools, web services and teaching methods, as depicted on the figure below. While primary

feedback to the training was very positive and provided reasons to believe that what had been learnt has also been actively put into use in daily work. However, no equally positive information may be concluded on the basis of this question.

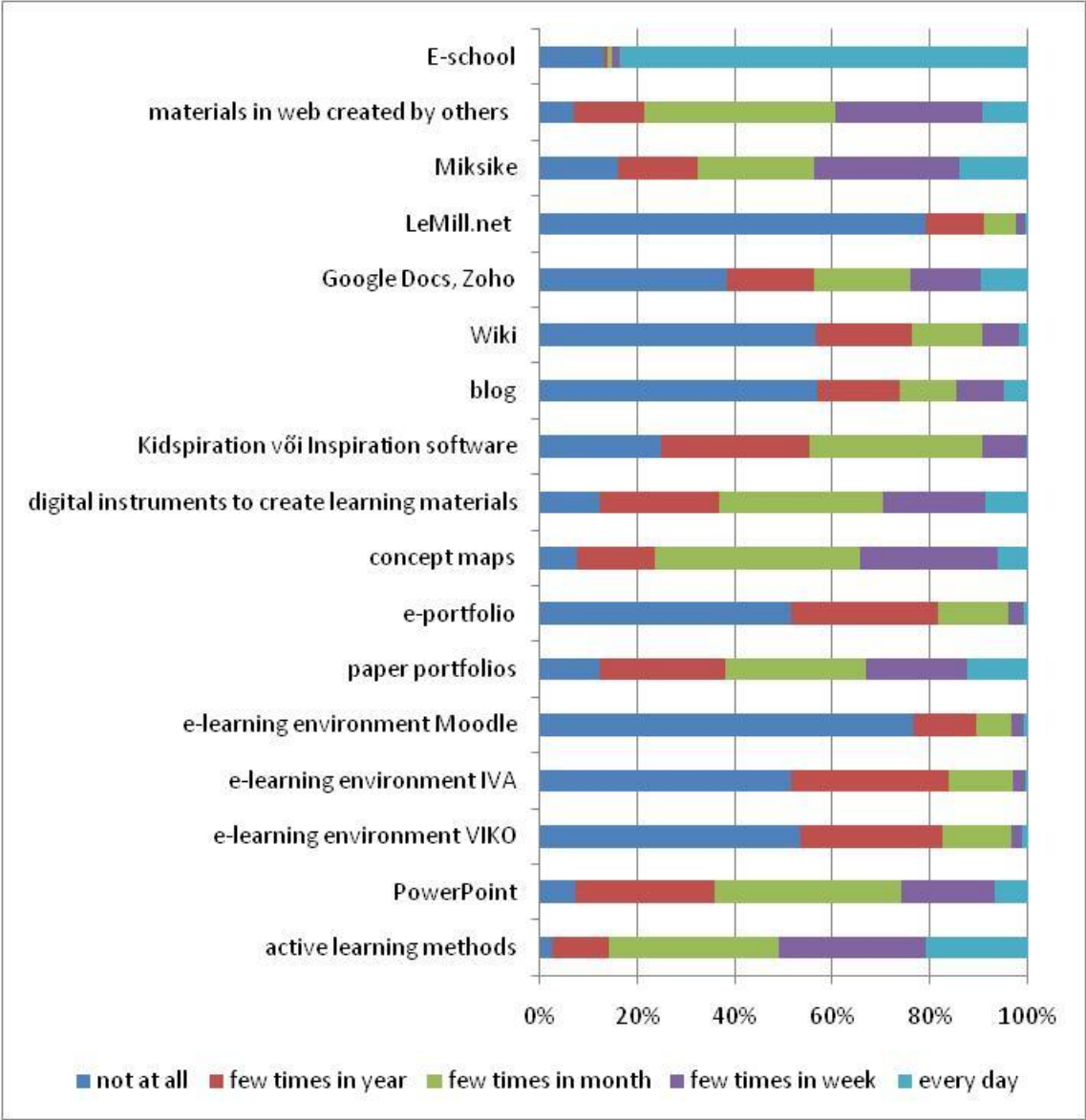


Figure 9 - How Actively and What Types of Learning Environments the Teachers have Used

Teachers use the most (either every day or a few times in a week) Miksike environment (44 per cent of the respondents) and materials that had been uploaded by other teachers (39 per cent). A third of the teachers use actively paper-based portfolios (33%) and concept maps (34%).

E-learning environments have not gained wide use after the training. 77 per cent have never used Moodle. Also IVA and VIKO have not been accepted actively, respectively 83% and 84% of teachers either never use those web-based environments or use only a couple of times per year.

Approximately a quarter of respondents use at least a few times a week PowerPoint software as well as GoogleDocs and Zoho.

Teachers are mostly indifferent towards the use of Wiki and blogs. More than half of them (57%) never use them. 20 % of teachers use wikis a few times a year and blogs are used by 17% of teachers only occasionally.

This figure demonstrates that the teachers mostly focus on those tools that provide opportunities for knowledge transfer. Computer-aided tools are mostly used for searching and downloading different learning materials. Limited usage of e-learning environments may be related to lack of resources to invest into those tools and lack of support from school managers. As these environments have limited access and teachers lack previous overview of potential use and available resources then the overall use of the environments remains modest. Other aspect is that learning environment used in DigiTiger training differed from the ones teachers have opportunity to work in every day practice. Student view of IVA is not comparable to teachers view. However, limited usage of GoogleDocs type solutions and elaboration of wiki and blogging tools is mostly related to the lack of motivation of teachers. Although teachers admitted that Web-based learning environments let them plan more flexible their work and increases students interest about the subject, teachers most probably have not recognized the benefit they could gain while using those environments. Hence the most teachers use the web-based tools mostly in order to pass knowledge on and they don't take advancements of different Internet sources and do not actively participate in knowledge creation..

For the reason of clarity, Miksike environment, paper based portfolio and use of PowerPoint software was not covered in training program and those have been included in the survey for comparative purposes.

As a separate aspect - the system E-kool (E-School) that has been used by 85 per cent of the respondents is neither a learning nor knowledge building environment, but helps mediating information between parents, teachers and schools.

Survey also included questions about factors affecting application of the lessons learned in training into practice: actions that are preferred by organization (falling under the Zone of Promoted Actions) and opportunities of teachers to change their practices according to new knowledge, skills and attitudes gained in training (Zone of Free Movement).

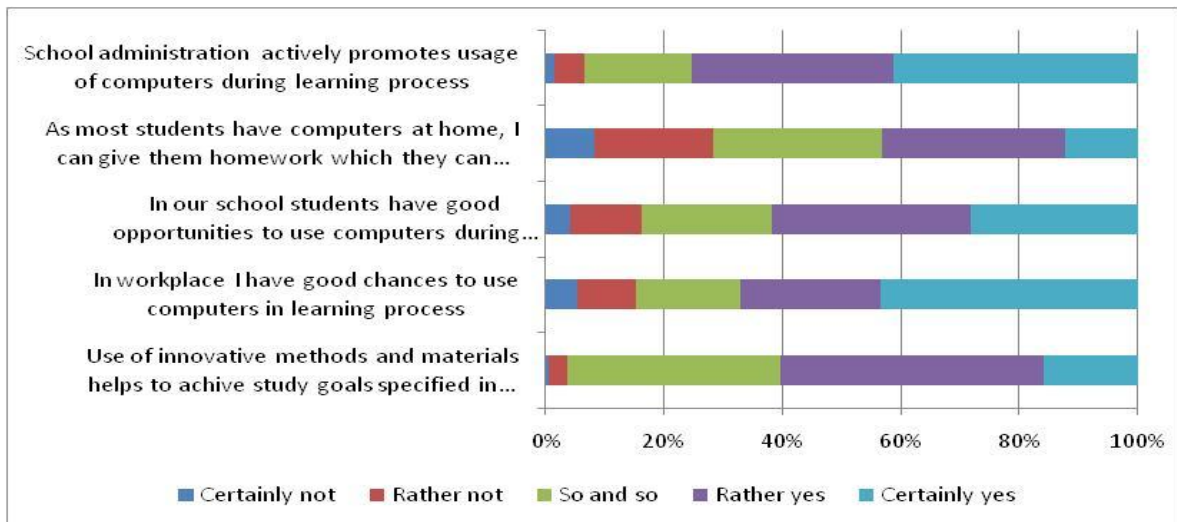


Figure 10 - Aspects Influencing Application of Teaching Results (Zone of Free Movement)

The figure above demonstrates that 75 per cent of teachers consider their school administration as supportive in computer usage. More than half of them (60 per cent) also consider that innovative methods learned during the training process help to achieve also the goals specified in official curriculum.

Free use of computers in school physical environment is easier for teachers than for students. The most difficult aspect relates to the potential use of computers at home. Surprisingly, only less than half of teachers (43 per cent) consider that it is possible to give online homework to students as all of them have access to computers at home.

This can be interpreted as serious limitation for the Zone of Free Movement. If teachers do not feel that they may give homework that requires use of computer - it is difficult to create study process in web-based virtual knowledge environment. The limitation applies to students' own initiative to create knowledge objects and participate in the work of community of practice in knowledge environment. The other issue is actually teachers cannot freely use computers also in classroom, only 28% of respondents are absolutely sure that students in their school have free access to the computers. Therefore teachers' desire using knowledge environments in learning process requires thorough planning and preparation by teacher.

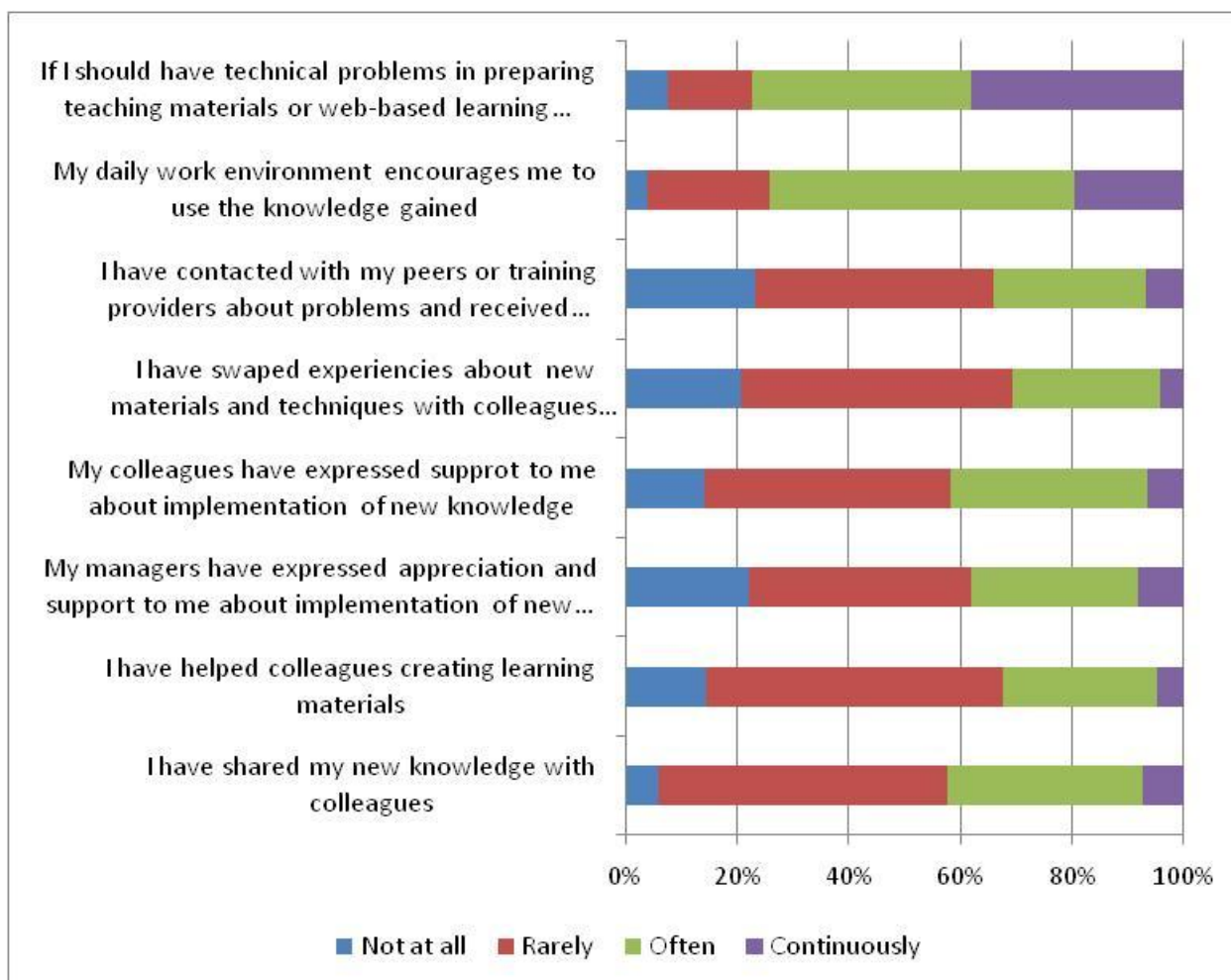


Figure 11 - Aspects Influencing Application of Teaching Results (Zone of Promoted Action)

Figure shows that 77 per cent of teachers have responded that in case of problems they may rely on IT support personnel in their own school. Almost as many of them (74 per cent) feel that their daily work environment encourages them to actively use new knowledge.

Somewhat surprising result is the outcome that teachers do not seek actively support of their peers who also participated at the same training - only 34 per cent answered the question continuously or often. In one of the earlier question the teachers had responded that during the training an active community of practice has been formed (69 per cent of the respondents answered either certainly yes or rather yes). At the same time - one of the key reasons why teachers have not been asked for support from other participants might be due to the reason that their local IT support at their school is able to solve their problems in those instances that these occur.

There is also a lack of knowledge sharing between teachers from different schools. Less than a third (31 per cent) has been actively engaging in knowledge sharing (responded with "continuously" or "often"). 20 per cent of teachers do not see any reason for sharing and do not do this at all.

Teachers seldom feel recognition from their school administration or colleagues in the school. The result where teachers do not feel the support of neither their managers (62 per cent) nor colleagues (58 per cent) or do so very seldom - does not account for appropriate environment for application of new knowledge. Complete lack of the support of school administration has been reported by 22 per cent of the respondents. At the same time Valsiner (1997), Kirkpatrick (1998) and Rouhotie (1990) that working environment has crucial role in implementing new knowledge. So if teachers don't feel the support needed, they lose motivation to change their behaviour and implement lessons learned.

Every kind of communication takes place between several counterparts. Teachers are not overly eager to share their knowledge or skills with the others nor help their colleagues. Less than half of respondents (42 per cent) help their colleagues in preparation of the study materials either constantly or often. Only one third of them share their knowledge with colleagues either constantly or often.

While school environment itself encourages teacher to apply new knowledge, the support from school management and direct colleagues is rather limited. Hence this constitutes a limitation in the Zone of Promoted Action. Taken into consideration that successful building of new knowledge may only happen through knowledge exchange in community and negotiation of meaning - hence one of the most important preconditions is the existence of community itself. Therefore it may be concluded from the current dataset that no active community of practice has been established among the teachers in schools or participated in training. The main reasons for why this has not been the case - calls for separate research. One of the main reasons might be the current high workload. Alternatively the community of practice might not be considered important because teachers do not see possible benefits gaining from this. The community of practice aspect of the entire study appears to be the weakest. The teachers are not too active in supporting others and do not consider the support of the others. Similar result was reached by Conrad (2008) in study conducted in Canada. Findings of that study indicated that participants in online community did not significantly contribute to the creation of enhanced community with workplace colleagues. Reasons for this happening require further investigation.

This might provide useful source for thought for school administrations to focus more on active support of communities of practice.

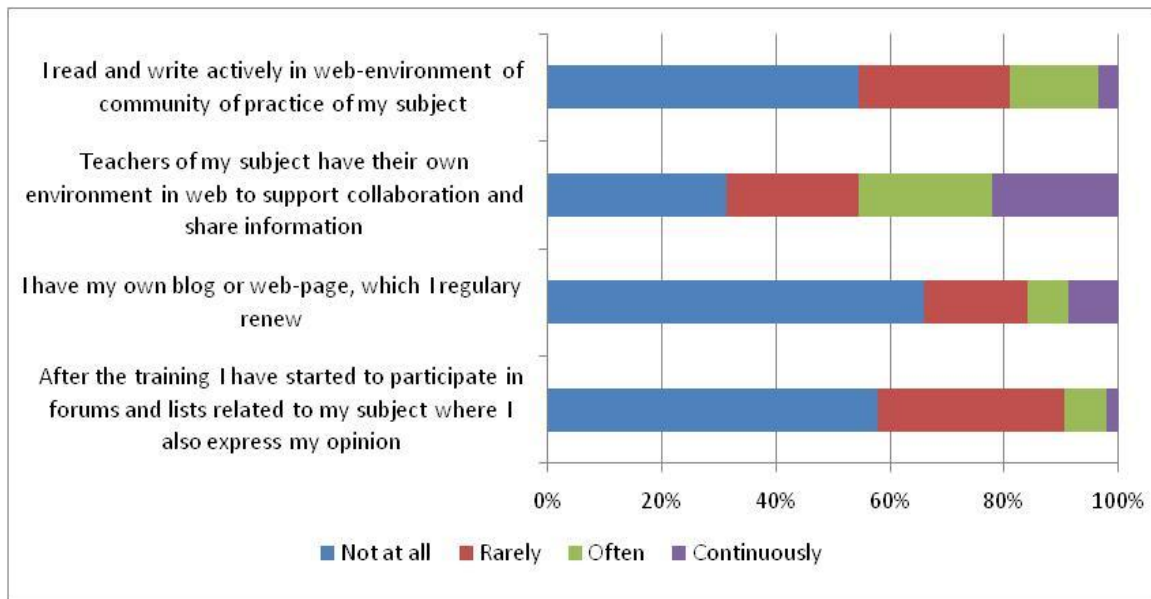


Figure 12 - Participation in Knowledge Creation

Figure 12 shows that 66 per cent of the respondents do not have their own blog nor website to regularly update. Regular users of their own blog are 79 teachers (16 per cent of respondents). More than half respondents (58 per cent) never take part in discussions in different forums nor discussion lists. Similarly, more than half do not follow activities of their subject network's web environment.

If to follow the impact of the training from the point of view of knowledge creation - it is possible to observe the passivity of teachers in dealing with knowledge building. Although knowledge building can be substantial enabler and source of professional development. Furthermore active participation in professional community of practice might be one of the first sources for support, assistance and understanding for teachers themselves.

5. Conclusions

In this study analyses the impact of the DigiTiger training program on the emergent of virtual communities of practice and collaborative knowledge creation among teachers.

Mäkitalo-Siegl (2008) has noted that knowledge building is rare in online learning environment. This study has come to the same conclusion. Results of study indicate that although participants of the course noted, that during the course a community of practice formed, then activities like sharing information and experience did not take place widely. As active communication, negotiation of meaning and common creation of knowledge objects is central in knowledge creation, the knowledge building as such wasn't enabled. As teachers encounter also limitations in Free Movement Zone related to students access to computers, it might be the reason why different web-based learning environments and solutions of social software have not been widely used among participants of the course. Although teacher themselves don't experience strong barriers in the Zone of Free Movement and recognize that web-based environments let them do their work more flexible and support students interest to the subject, they still don't use online learning environments and social software tools like blogs and wikis.

The main online environment used on DigiTiger course was IVA learning management system. Although IVA has various features which could support collaborative knowledge building, they were not used during DigiTiger course. Moreover, it was very difficult for teachers to start using IVA with their students after the DigiTiger course without help from local IT specialist and school principle. Thus, the current choice of online tools on DigiTiger course do not serve as effective knowledge environment for teachers - neither during nor after the course.

Therefore the following guidelines can be proposed to the organizers of DigiTiger course:

- As the course will continue until summer of 2011 it is not reasonable to change the content radically. Especially because the reaction of teachers to the course is positive.
- The IVA environment used in DigiTiger course should be replaced with the environment which teacher can use also after the course. This environment involve Web 2.0 tools and support collaborative knowledge creation process as well as formation of communities of practice among teachers.
- Formation of communities of practice need more support also forms pedagogical desing of DigiTiger course. For instance, more collaborative assignments during the course could have a positive effect.

- New knowledge building tools should not be just briefly presented during DigiTiger course. Instead, they should be taken into use repeatedly for various assignments.
- As the main communities of practice among teachers are subject-oriented, this study recommends to design an additional subject-specific training module for DigiTiger course.

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Annex 1 - DigiTiger Questionnaire

1. Background Information

1.1: Name:

1.2: Sex: Male / Female

1.3: Age:

1.4: Region:

1.5: Place of Residence:

1.6: Size of the School: less than 100 students; 100-300; 300-600; 600-1000; more than 1000 students

1.7: Subject taught: Mother tongue; Foreign language; Science; Biology; Chemistry; Physics; Mathematics; History; Arts; Crafts; Music

1.8: Grade of students: 1st - 3rd grade students; 4th - 6th grade students; 7th - 9th grade students; 10th - 12th grade students

2. Questions about DigiTiger training

2.1: When did you participate in training:

2.2: Location of the training:

2.3: Name of the trainer:

2.4: Your assessment of the training (scale: certainly not, rather not, so and so, rather yes, certainly yes):

- New skills gained during training are applicable to practice
- Duration of training was adequate
- Training speed was too intensive
- Trainer was experienced and competent specialist in the field of education technology
- Teaching materials were thorough
- During the training the participants formed an active community
- Web-based learning environment was too complicated to use

3. Application of DigiTiger training knowledge into practice

3.1. Application of DigiTiger training knowledge in teacher's work (scale: certainly not, rather not, so and so, rather yes, certainly yes):

- After the training I have started to use computers and Internet to prepare learning materials more than earlier
- As the result of the training I use Web-based learning environments (e.g. IVA, VIKO, blog, GoogleDocs etc) more than earlier

- The use of web-based learning environment increases students' interest about the subject taught
- The use of web-based learning environment helps the teacher organize the work more flexibly
- I recommend this training to my colleagues

3.2. I use in my work (scale: not at all, a few times a year, a couple of times a month, a couple of times every week, every day)

- active learning methods
- PowerPoint
- e-learning environment VIKO
- e-learning environment IVA
- e-learning environment Moodle
- paper portfolios
- e-portfolio
- concept maps
- digital instruments to create learning materials
- Kidspiration or Inspiration software
- blog
- Wiki
- Google Docs, Zoho
- LeMill.net
- Miksike
- materials in web created by others
- E-school

3.3: What kinds of computer-based tools or environments do you use in addition to those that were mentioned above?

3.4: To what extent do you agree with the following statements (scale: certainly not, rather not, so and so, rather yes, certainly yes):

- Use of innovative methods and materials helps to achieve study goals specified in national curriculum on general secondary education
- In workplace I have good chances to use computers in learning process
- In our school students have good opportunities to use computers during learning process
- As most students have computers at home, I can give them homework which they can only produce with the help of computers

4. Impact of DigiTiger Training

4.1.: Social impact of training (scale: not at all, seldom, often, constantly)

- I have shared my new knowledge acquired at training with my colleagues
- I have mentored my colleagues in creating learning materials

- My managers have expressed appreciation and supported me in implementation of newly acquired knowledge
- My colleagues have expressed support to me about implementation of newly acquired knowledge
- I have exchanged experiences about new materials and methods with my colleagues from other schools
- When I have had problems I have contacted either my co-trainees or training providers about problems and received assistance
- My daily work environment encourages me to use the newly gained knowledge
- If I have technical problems in preparing teaching materials or web-based learning environment, I have a specialized person who assists me at my school
- After the training I have started to participate in forums and lists related to my subject where I also express my opinion
- I have my own blog or web-page, which I regularly renew
- Teachers of my subject have their own environment in web to support collaboration and share information
- I read and write actively in web-environment of community of practice of my subject

4.2: What kind of additional training would you need in relation to the use of computers in everyday work?

4.3.: What should be changed in DigiTiger training in order to make sure that it would meet better the expectations and needs of participants?