Building a value network model for the design and use of learning solutions

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Abstract
It is generally agreed on that ICT can have a meaningful role in teaching and learning. However, learners – children and young people – are still in an unequal position in regard of access to ICT and its pedagogically varied use in learning environments. There are also wide differences in how children use ICT at diverse life spheres, namely at school, home and with their friends. An essential concern is how well the existing ICT solutions apply to the personal needs and capabilities of learners as well as the teaching practices at the different levels of educational system.

This paper presents a value network model for the implementation of learning solutions in close interaction between research, pedagogical experts and designers of technology-based learning solutions. The aim is to build research-based principles for the design and use of learning solutions. The design principles focus especially on user-driven design process and usability evaluation. The use principles determine ways of support and good practices in the actual use of learning solutions and effects on learning. The value network currently includes seven partner countries, which enables and requires also focus on issues of localization and globalization. The paper presents experiences of the value network in Finland as well as in the six partner countries.

Keywords: learning solution, ICT use, value network

Introduction

Does a web-based math environment '10monkeys' engage and motivate children to learn the concept of number? How can a location-based Nomadi-tool be utilized in teaching and learning for example history? What kind of features and contents the users expect from an evaluation tool for information society skills? Or how does a service concept for tablet use support teachers in take-into-use of technology? These are some of the questions that are examined in the Systemic Learning Solutions (Systech) project. These are also examples of the technology-based learning solutions under development in the Systech value network.

The Systech value network has the following main aims: firstly, to promote 21st century skills with user-driven and motivating learning solutions and secondly, to enable a large-scale and more versatile implementation of digital learning solutions across educational systems. The value network currently includes seven partner countries, which enables and requires also focus on issues of localization and globalization. This paper examines the creation and implementation of a value network model for the design, use and localization of technology-based learning solutions. The paper will start with the analysis of trends in ICT use that have indicated the need for efforts in the design and use of technology supported learning solutions. This analysis is followed with determining the principles for value network creation. Then, the paper presents the implementation of Systemic learning solutions value network.

Trends in ICT use at Finnish Schools

It is generally agreed that ICT can have a meaningful role in teaching and learning. However, learners – children and young people – are still in an unequal position regarding the access to ICT and its pedagogically varied use in learning environments (e.g. Kankaanranta & Puhakka, 2006; Ilomäki & Kankaanranta, 2009). From the perspective of students, this means that they are in an unequal situation in regard to possibilities for 21st century learning enhanced with modern technology. Earlier research has indicated several enablers but also challenges for versatile ICT use, such as the rapid development of technology, existing digital divides between students and teachers, and controversial trends of ICT's pedagogical use (see Kankaanranta & Vahtivuori-Hänninen, 2014).

Last decade has been a period of strong and rapid development of information and communication technology (ICT). It has paved the way to digitalized schools. According to Ilomäki and Kankaanranta (2009) the nature of technology has changed from a technical connotation towards a communicative one, mainly because of the development of new applications in the Internet. This has increased the use of ICT dramatically in almost all areas of society, including education. Weller (2007) suggests that technological features have become social features and influenced the social values of the net. However, these elements do not characterize learning communities, not even e-learning communities. The challenge is how to integrate the technological possibilities – especially the sophisticated communication strategies of the learners accustomed to the Internet - and the formal structures of learning organizations (Ilomäki & Kankaanranta, 2009).

Access to ICT has developed rapidly during the last two decades. Similar trend of heavy ICT investment in education has become evident at schools all over the world (Law, Pelgrum, & Plomp, 2008). Nevertheless, despite the rapid ICT development, all schools have not adopted ICT for use in teaching and learning according to the available possibilities for ICT access. International comparisons have indicated large differences between regions, schools, and school levels but also within schools in the extent and quality of ICT use (Kankaanranta & Puhakka, 2008; Law et al., 2008).

One concern has been the formation of digital divides between students and teachers. The concept 'digital divide' refers to different social groups' access to digital services, and their abilities to make use of various digital possibilities (e.g. Facer, 2002; Ilomäki & Kankaanranta, 2009; Van Dijk & Hacker, 2003). Already in 2006, Pedersen et al. argued that students and teachers were utilizing entirely different software, and they also had very different perceptions of what constitutes digital competencies. As van Dijk & Hacker (2003) point out the digital divide shows relative and gradual differences in the possibilities of using information and communication technology. According to Ilomäki and Kankaanranta (2009) the different experiences and conceptions about technology can lead to a digital gap in education. There also seems to be wide differences in how children use ICT in diverse life spheres, namely at school, home and with their friends. As ICT has a strong status in children and students' everyday life, it is necessary to bridge out-of-school ICT-enhanced learning and school-based teaching and learning in ICT literacy (Ilomäki & Kankaanranta, 2009). This is necessary also in order to ensure that all children have an equal opportunity for varied ICT use and to become competent members of the knowledge society.

Another essential concern is how well the existing ICT solutions apply to the personal needs and capabilities of learners as well as to the teaching practices at different levels of the educational system. In 2011, the majority of Finnish school principals weighed the role of ICT very positively in school administration (89% of principals indicated that ICT has a very important role) and as a teachers' tool for planning and management (62%) (Kankaanranta, Palonen, Kejonen & Ärje, 2011). Only 36% of the principals indicated its particular relevance as a tool for learning and teaching. In general, the principals were satisfied with how the existing infrastructure responded to the schools' needs. The trend was similar with the experienced role of ICT use as the existing infrastructure responded best to the needs of administrative staff and was less suited for teaching and learning practices.

Further examinations of ICT use for teaching and learning indicate more promising aspects. Almost all schools included the pedagogical use of ICT as a natural part of their goals, and in about 60% of schools, ICT was integrated in a majority of teaching and learning practices (Kankaanranta et al., 2011). Nevertheless, the results indicated that there was still a large variation—among schools, educational levels, and different regions of Finland—in the ICT access, in the actions as well as obstacles related to pedagogical use of ICT as well as the ways of ICT use. In late 2000, there was also growing evidence that the pedagogical use of ICT at schools was decreasing in many schools or that it was not at the level it could be based on the issues of access (Ilomäki & Kankaanranta, 2009; Law, Pelgrum, & Plomp, 2008; Pedersen et al., 2006). An international Innovative Teaching and Learning Study indicated a strong relation of innovative teaching practices with the learning of 21st century skills at schools (e.g.

Norrena et al., 2011). A deeper analysis of school practices revealed that innovative teaching methods were not widely used at schools. Innovators were most typically single teachers or small groups of teachers. The school factors most closely related to innovative teaching practices were collaboration between teachers, access to ICT, support of ICT use, and support of school leaders.

To summarize, one favorable development has been that most of the principals had a more positive view of the importance of ICT in the every day work of the school than they previously had. These administrators recognized the need for change and were committed to implementing the school's shared visions and a functioning working culture in order to improve pupils' future skills. (Norrena et al., 2011.) Ilomäki and Kankaanranta (2009) emphasize that the new technology has several such affordances and functionalities that are neither necessary nor needed for existing teaching and learning practices. This implies that to use the new functionalities effectively the existing practices should be changed. In formal learning contexts this seems to be difficult and demanding, as many studies indicate (Cuban, 2001; Ganesh & Berliner, 2005; Gibson & Oberg, 2004; Pedersen et al., 2006).

The enablers and challenges of ICT use inspired Finnish decision makers for several strong nation-wide and multi-field efforts to enrich and widen technology use in the educational system. In Finland, there have been several initiatives and programs for enhancing ICT use in the educational sector (see Kankaanranta, 2009; Kankaanranta & Vahtivuori-Hänninen, 2014). These have implied e.g. policy efforts, funding for schools to increase issues of access and in-service teacher training. Some of the main questions were:

- How to implement large-scale changes in the use of ICT at the whole educational sector?
- What is the added value of ICT for learning and teaching?
- How to support schools and teachers in scalable take-into-use of varied technologies?
- How to ensure transferability of best practices in the use of quality solutions?

This kind of questions necessitates a systemic and multi-party perspective for the design and use of learning solutions. This led us to conceptualize such work through the concept and model of a value network.

Value network – definitions and principles

Recently there has been a lot of scientific discourse about value creation in networks or simply value networks mainly within the marketing, management and other business science disciplines (e.g. Gummeson & Mele, 2010; Möller & Törrönen, 2003; Möller & Svahn, 2009; Lusch, Vargo & Tanniru, 2010). Since business is more and more done through technological development there is often a networked nature in developing new businesses or innovation. Instead of traditional production of physical products there is more concentration on the market on development of services which often are developed in cooperation with other actors. Thus networks, cooperation and co-creation can be seen having a growing importance in various fields (Palo & Tähtinen, 2011).

Even though in business disciplines value networks are perhaps in the spotlight there is less discussion of value and networks when expanding the focus on joined development activities in ICT use in education. There are various definitions of value networks in the literature but several viewpoints are reckoned to the context of this particular study. For instance, Allee (2009) defines value networks as "…any purposeful group of people or organizations creating social and economic good through complex dynamic exchanges of tangible and intangible value" (p. 429) stressing the complex dynamic exchanges happening within the network. Since the Systech value network consists of researchers, educators and learning solution developers creating innovative learning solutions a more specific term of an innovation network could also be applied. Innovation networks are perceived to cross organizational as well as industry boundaries and having the shared purpose of creating certain social goods or outcomes (Allee, 2009).

Service-dominant logic viewpoint on the other hand stresses value creation within and from the network as well as temporal loose structures. As defined by Lusch, Vargo and Tanniru (2010) value network is "…a spontaneously sensing and responding spatial and temporal structure of largely loosely coupled value proposing social and economic actors interacting through institutions and technology…" (p. 20). This is also a definition we see well fitted in our understanding of a value network as an expanding and changing loose structure with common goals and co-creation that different actors are approaching from various different viewpoints.

The purpose of a value network is in utilizing tangible and intangible assets to convert them into more negotiable forms of value. Furthermore, network actors can realize negotiable forms of value by converting them into gains or improvements in tangible or intangible assets. (Allee, 2008.) Applied to this context tangible assets could be understood for example as tablets or software components whereas intangible assets as pedagogical knowledge applied. Simply put, together the assets can form combinations that are in this context more valuable (e.g. game-based learning software for tablet use). When thinking about the basic principles of value networks also co-producing service offerings, exchanging them and co-creating value should be in the focus (Lusch, Vargo & Tannuro, 2010).

In their work Büchel and Raub (2002) have defined four stages of network development through which also value networks can be reviewed (Figure 1). In stage one the knowledge network is focused through aligning the burning issues that are addressed in that particular network, sufficient management support is ensured and links created to bring together network actors and enable the network communication.

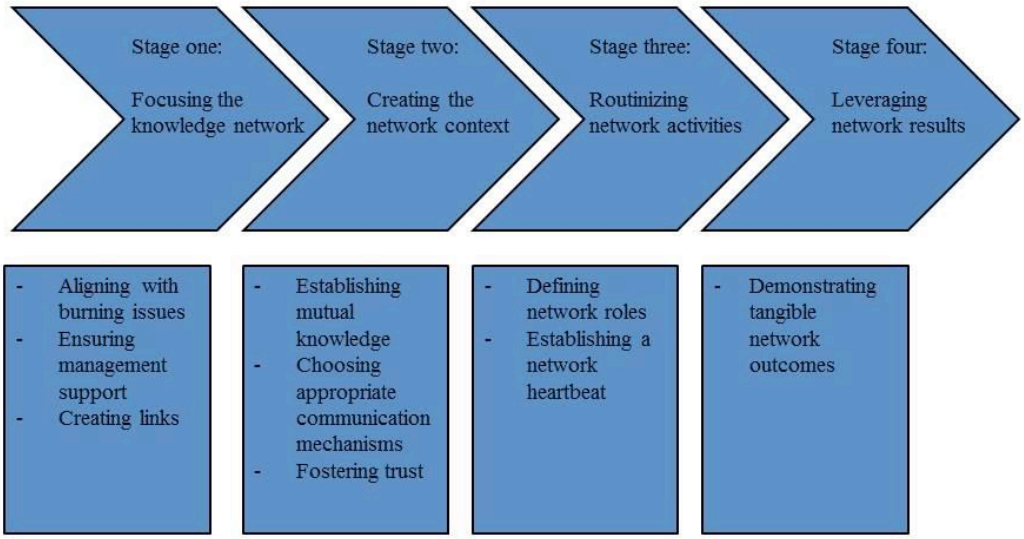

Figure 1: Four stages of network development (Büchel & Raub, 2002).

Stage two on the other hand handles the creation of the context the network is situated in by establishing mutual knowledge among network actors, making choices about the communication mechanisms that are the most appropriate for that network as well as creating and fostering trust within the network. Defining the suitable network roles within the network is in the key focus of stage three where network activities are routinized. This enables the network to establish the so-called network heartbeat that holds the network alive and pushes it forward. Finally, in stage four the network results are leveraged through demonstration of tangible network outcomes. It should be noted that a network does not necessarily go through the four stages linearly and it should not be assumed that a partly or entirely achieved stage could be automatically kept. The network is constantly developed and the network context changes all the time thus in different points of time a network (or parts of it) can be in very different phases. It is also noteworthy that in our opinion through the four stages also the sub-networks and their relationships to each other can be studied.

Creation of Systech value network

The concept of value network was central as the Finnish Funding Agency for Innovation (Tekes) launched in 2011 its program Learning Solutions. It called funding applicants to form value networks consisting of diverse parties of business and research units for the development of new know-how and networks. However, it remained up to the applicants to further determine or construct the practical version of the concept.

Our basic idea for the development of learning solutions quickly received interested co-applicants or possible network members. As a preparation activity we conducted a survey of their expectations to better understand the perspectives of various parties. The expectations for the construction of a value network focused especially on the following five categories:

- to understand user experience and usability in order to better respond to real needs,

- to receive expert feedback for further development of products, special focus being on pedagogical items,
- to indicate learning outcomes, effects and quality of learning,
- to develop know-how - a possibility to develop staff's core competence and working methods, and
- general networking and synergies among the participants of the value network.

In many of the insights, the idea of an ecosystem for product development was brought forward. The survey raised expectations especially from the perspective of companies aiming at the development of learning solutions. However, our earlier projects related to ICT use at schools added to this the needs and challenges of educational sector. The examination of these led us to build a value network for the design and use of learning solutions with three main components:

- A research project aiming at the development of research-based principles for the design and use of learning solutions,
- Product development projects in companies aiming at the design of technology-based learning solutions as part of compilation of learning solutions, and
- Pedagogical network of educational and working environments for the creation and sharing of good practices and knowledge on the use and effects of learning solutions.

In the second phase of the Systech value network (2014-2015) we added as fourth component a network of international partners in six countries. This also widened the scope of the project to explore the issues related to localizing and globalizing of learning solutions (Mäkelä, Kankaanranta, Young & Alshannag, 2014).

Originally in the national phase of the Systech value network there were 13 Finnish learning solutions involved. These learning solutions were addressing different areas within the education spectrum (e.g. mathematics game for primary level students, team building skills, business simulations for higher education) as well as different target groups within formal, informal and non-formal education (e.g. primary school students, citizens wanting to assess their ICT skills). These learning solutions were originally described through a categorization of 6 product families: 1) learning games, 2) mobile learning, 3) portfolios, 4) learning and assessment tasks, 5) content solutions and 6) infrastructure.

Later on it was realized that such a categorization of the learning solutions was not necessary in the development of the value network since it was seen as too detailed. Thus in the beginning of the Systech second phase the categorization was simplified to consist of 1) content solutions, 2) tools and platforms and 3) pedagogical service concepts. At this time, several new learning solution developers also joined the activities of the value network and in total there were 18 Finnish learning solutions within the value network. As of fall 2014 more than 30 international learning solutions have been suggested for expert evaluations and it is yet to be seen how the value network expands when the international learning solutions are further explored.

Towards international value network for the design and use of technology supported learning solutions

There are several reasons and aims for the development of the international phase within the value network. Since nowadays technology-based markets are often both complex and globalized (e.g. Palo & Tähtinen, 2011; Teece, 2010), it is important to build a global understanding of the activities related to the value network. Thus providing and in-depth international understanding of the design, use and localization of the learning solutions is at the core of the research activities at the level of the whole value network.

The international phase is built upon three main elements, namely 1) collection of evaluated learning solutions, 2) analyzing and comparing national policies and practices and 3) development of criteria for localizing and globalizing of learning solutions. Naturally, building these elements consists of activities conducted in the seven partner countries of the value network.

At this stage there is constant sharing of international multi-disciplinary research experiences within the value network. This sharing of research experiences is one key component in the future development of the international value network, but the activities are seen to widen and deepen in the future in many additional ways. There are several options that can be identified for strengthening and deepening the collaboration in the future of the value network, where the activities are continuously expanded and developed further.

In the future it is possible to see sub-networks of different actors developing within the value network and expanding its activities. Examples of such sub-networks can be for instance international pedagogical networks consisting of teachers and other educators concentrating on sharing and developing good practices for ICT use in education; or sub-networks of learning solution companies concentrating on developing a pool of complementary and overlapping learning solutions supporting the learners' development in a more holistic level. It is also important to see the reciprocal collaborative activities between international experts, educators, researchers and learning solution developers deepening. Thus these sub-networks would not only consist of actors of the similar type but would develop around phenomena that joint activities of different types of actors could address.

One crucial element in the international value network collaboration is to build a collection of evaluated learning solutions, enabling the different network parties to effectively utilize this compilation across different countries is also of significant importance in the future. It is seen that easily grasping a wide picture of learning solutions available from different countries can benefit e.g. teachers and educators in their busy work schedules. Hence a compilation of readily evaluated and tested learning solutions should be utilized effectively. Since the evaluation of learning solutions itself provides a somewhat limited view of the use of the learning solution in the educational institutes' daily life, piloting of the learning solutions from the partner countries in different educational systems raises to be a central issue as well. As the value network is developed within international and intercultural collaboration a more in-depth understanding of the underlying cultural perceptions affecting the

collaboration can also be seen vital in terms of finding successful ways of collaboration also for the future purposes of the value network.

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