A Matrixulation Method for Mapping an E-learning Environment Designer's Conception of Learning: A Pilot Study

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Abstract

This paper presents a method for analyzing human conceptions related to e-learning, based on positioning data on what is called here a learning matrix. The set of dimensions comprising the matrix distinguish between emphasis on individuality and sociality in learning, between viewing learning as knowledge adoption and as knowledge construction, and between viewing learning as subjective and as objective to time. The learning matrix is used to visualize and compare conceptions of learning extracted from literature and from individual perceptions of learning, revealed through interviews. This study supports the development of e-learning environments and casts light on different conceptions of learning. In addition deriving and representing the learning matrix, the paper positions 13 learning theories on it. A concluding analysis of an interview with an e-learning platform designer implies that while certain aspects of a designer's conception of learning relate to learning theories, the overall conception remains unique and dynamic.

Keywords: conception of learning, learning matrix, matrixulation, e-learning environment, e-learning designer

Introduction

We all have some conception of what learning is (Marton, 1998; Tynjälä, 1999). These conceptions are unique, but classification allows them to be presented in a more general and universal way (Marton, Dall'Alba & Beaty, 1993). This distinction between a person's conception and general classifications is well known, for example in phenomenography (Marton, 1981; Uljens 1989). There is earlier research also by Häkkinen (1995, 1996) on conceptions of learning among designers of educational software, teachers and users and by Isomäki & Häkkinen (Isomäki, Kari, Marttunen, Pirhonen, & Suomala, 2001) among IS designers. However, there seems to be a lack of studies of electronic learning (e-learning) platform designers' and e-learning content producers' conceptions of learning in the context of developing e-learning environments. It is assumed in current research that there is a link between designer' and content producers' conceptions of learning and of developing e-learning. If the designer and the content producer, for example, have different learning conceptions, then the artifact being made will contain e-learning components representing and supporting their specific conception or conceptions of learning. If one conception or several conceptions predominate, they will be emphasized in the development process. Eventually, when the artifact is in use, it will support only certain types of learning (Häkkinen, 1996).

Eliciting designers' and content producers' conceptions of learning can help to understand what kind of learning a given e-learning environment might support. Conceptions are not always stable structures but change from one situation to another. In scientific research, they can be seen as different points of view on a phenomenon, such as learning. However, different conceptions of learning are not mutually exclusive (Eteläpelto, 1998). For example, a designer has a particular conception of learning and a particular idea of how learning will take place in a specific learning environment. Thus, the designer plans the environment to be used for learning. Content producer produces content for a learning environment with the help of, for example, a suitable curriculum. The user chooses between the available methods and selects suitable tools (Häkkinen, 1996). If there is no variance between methods and tools, learning takes place within the parameters boundaries set by the designer(s). These parameters reflect the designer's understanding of how learning takes place when the e-learning environment is used.

In constructivist terms, a learning environment can be understood by relating it to situation where a learner is performing a specific constructive process (e.g. Järvelä & Niemivirta, 1997). Thus, according to the constructivist conception of learning, the social and physical context of learning situations affects the process of learning. In this paper, the social context is understood as involving the environment where physical information systems are used. Or, in the words of Salomon & Perkins (1996), who are defining a learning environment in general terms:

"A learning environment - whether a classroom, an afternoon club, or a workshop held at science museum - can tentatively be conceived of as a system of interrelated factors that jointly affect learning in interaction with (but separately from) relevant individual and cultural differences."

Among other things E-learning environments may combine standard software, information systems (IS) intended to support learning, and technological collaborative tools (Fischer, Bruhn, Gräsel, & Mandl, 2002; Jermann, Soller, & Mühlenbrock, 2001). Standard software consists of the basic utility and communication software packages (e.g. the operating system) installed into workstations. Hence, an IS can be understood as a workstation running standard software. Here, the focus is on IS systems with learning-oriented functions. Learning-oriented IS are constructed from IT that foregrounds educational assumptions. Thus, they are linked with some particular learning models (Leidner & Järvenpää, 1995). However, when speaking of systems we are speaking of the artifacts surrounding the learner who actually exert influences on the artifact and communicate with it. From the viewpoint of learning, this artifact is a supplier of information, enabling, in the learning situation, the transfer of information (Singley & Anderson, 1989) from the learning content (Tyrväinen, Järvenpää, & Sievänen, 2002). The artifact examined in this paper, designed on the premises considered meaningful by its designer, is the learning environment.

As mentioned above, the interesting issue here is the designer's conception of learning, because its influences the implementation and use of the learning environment. A further assumption is that it actually affects the way in which the user learns with the help of the learning environment. The current research is based in studies of different e-learning environments and the process of their development. The data about conceptions of learning has been gathered by studying information about learning conceptions and the theoretical backgrounds of learning. More data will be collected later by interviewing designers and content producers. This paper first introduces a number of learning theories. Because humans have different conceptions, there are differences also in how theories handle a particular concept. A well-known concept is accepted but different theories and different individuals can have different interpretations of and premises concerning it. This introduction to certain learning theories is followed by a discussion of the designer as a particular human role. The next section introduces the LM and explains why and how it was made, tested and used. The last part of the paper presents a pilot study and its results. The paper concludes with a discussion about the method and the implications of the pilot study.

Learning Theories

A branch of psychology, cognitive psychology, investigates humans' mental functions (Thagard, 1996), that is, how the human being adapts to their environment, processes knowledge and learns. Eysenck and Keane, (2000) define central cognitive actions as consisting of perception, attention, learning, memory, language, emotion, concept formation and thinking. Particularly in the past, research in the field of cognitive psychology has been the source of most of the concepts that are used in theories of learning. For example, in constructivism the concepts describing learning are based on influences from studies from the period of cognitive orientation, such as Piaget (1971). There are many different theories of learning. The following review of learning models is not exhaustive, but its purpose is to show that more work is needed before it is possible to adequately compare different learning models and theories.

The paper's discussion of the history of learning theories is general. Briefly, from 1950 to 1960 research on learning was dominated by the behaviorist tendency. Although this tendency began in the early 1910s, its influences are still to be seen in the learning materials used in school today. Behaviorism is also known as the objectivist model of learning and is mostly based on Skinner's (1935) stimulus-response theory. To simplify, the goal of teaching is to facilitate the transfer of knowledge from the expert to the learner. Although the objectivist model may be the most appropriate one in some contexts and although there are many different theories of behaviorism (e.g. Thorndike, 1913; Watson, 1913) and although behaviorism is still studied (Jonassen, 1993), models challenging objectivism have emerged, with constructivism one of them. Constructivism denies the existence of an external reality independent of each individual's mind. The learners create their own knowledge. The mind produces its own unique conceptions of events. Each reality thus constructed is somewhat different, based on learners' experiences and biases. More moderate constructivists do not preclude the possibility that there may be an objective world, assuming instead that each individual constructs own image of the objective world (Yarusso, 1992).

From the beginning of the 1960s, the focus of learning research shifted to humans' (learners') inner functions, such as their learning processes, learning strategies and cognitive structures and operations. The cognitive information-processing (IP) theory is another extension of the constructivist model, focusing on the cognitive processes used in learning. The cognitive conception of learning emphasizes that learning is active and creative work done by the learner. The learner interprets observations and new information on the basis of their earlier information and experience, in other words with the help of inner functions or models. The learner takes more responsibility for their learning, while the teacher becomes a guide rather than merely dispensing information. While the IP theory is an extension of constructivism (e.g. Lehtinen et al., 1989), the sociocultural theory is both an extension of constructivism and a reaction against some of its assumptions. Learning and knowledge are situated in their historical and cultural contexts rather being seen as the mere formation of abstract concepts (Piaget, 1971) to represent reality. The major implication of socioculturalism is that students should participate on their own terms. In summary, according to Järvelä and Salovaara (1997) recent conceptions of learning include constructivism (Bruner, 1966), socially shared cognition (Resnick Levine, & Teasley, 1991), sociocultural theory (Rogoff, 1990), social development theory (Vygotsky, 1978) and situated learning (Lave, 1988). Expansive learning (Engeström, 1987) and explorative learning (Hakkarainen et al., 1999) are other approaches currently being discussed.

Still, no particular theory has yet been accepted as the best approach, as a big theory or model of learning. Perhaps the reason for this lies in conceptions of the human being. Because the human being develops, their conceptions are transient, changing dynamically and turning into new conceptions. Thus, conceptions of learning are evolving all the time and new theories are going to arise. However, this discussion about dynamic learning theories will be continued elsewhere because research on learning is a rapidly and constantly developing area of education. For example,

metacognitive skills[1] are seen as very important assets in learning, especially when the learners themselves are directing their learning (Järvelä & Salovaara (1997), as they are in e-learning for example.

Designer's Role in the Development of an E-Learning Environment

To make the terms designer, design, development and developer transparency, the emphasis of this study is on the starting point of development, the design process. Despite being considered to start at the beginning of software development, design is seen also as reflective (Schön, 1987) and situated (Suchman, 1987) action in the same way as other, later phases of development. Design and development are activities, which bring into play the goal-setting and constructive aspects of a distinctively human mind (Eteläpelto, 1998).

In design and development of a new product the designers set themselves original goals and adopt novel ideas as guides for the future; in so doing they engage in an intentional activity which can affect our environmental and social conditions. This implies that when designers define the goals and objectives entailed by their task, they have to integrate into their activity a normative component (Eteläpelto, 1998). Design has also been understood as a process of converting information originally presented in the form of requirements into the form of specifications (Hubka & Eder, 1988). When the need for some new product is recognized, the designer's job is to identify what the new product must do and create something that will satisfy these requirements. When designing and developing e-learning environments, designers should take the users' conceptions of learning into account. Knowledge of theories of learning or drawing on a variety of learning models is considered to help designers and developers to understand users' conceptions (Häkkinen, 1996). Naturally, designers have their own conceptions that evolve throughout their life (e.g. during their education, at work and in their leisure hours). As like their experience of the subject evolves (Eteläpelto, 1998).

Schön (1987) sees designing as a kind of making, which involves complexity and synthesis. This means that unlike analysts or critics, designers put things together and bring new things into being; in so doing they deal with many variables and constraints, some initially known and some discovered through the design process (Eteläpelto, 1998). Schön perceives all human constructive and creative activity as design; for example, artists are clearly designers since they make things, songs, paintings and so on. Thus, design can be seen as a cognitive process characteristic of all humans, as was noted earlier in general and cognitive psychology (Goel & Pirolli, 1992; Miller, Galanter & Pribram, 1960). For example, when the designer provides a sketch of what could be and how it could be made, the content producer implements the design with the help of the sketch. The products of this cognitive process are external representations of how things could be put together; they can, for example, represent possible futures. In certain situations the designer and the content producer could be one and the same person, but in most companies design project involves several people working together.

[1] Metacognition is information about and awareness of cognition, for example about those mental processes which are used for gaining and processing information and about cognitive functions: perception, memorizing, thinking, problem-solving and learning. Metacognition can be also seen as a way of controlling and adjusting one's own cognitive actions while performing tasks: orientation to aim, choice of strategies, consideration of situational factors, evaluation of results and improvement of action (Eteläpelto, 1998).

Developing the Learning Matrix

It is possible to study different learning conceptions by conducting interviews and constructing classifications. However, after a study of previous research literature on good classifications of learning theories and of different learning conceptions there was still a need for a clear classification of differences in the conceptions and premises that underlie the learning theories. Such a classification was required as the basis for research questions and for analyzing the designer's conceptions of learning. The main lack was of a framework for mental structuring and for visualizing the relations between the different theories and conceptions involved. One of the few relevant approaches published was the study by Leidner and Järvenpää (1995). They reviewed different models of learning, the surface assumptions behind electronic teaching technology, and related those assumptions to the different models of learning. Leidner and Järvenpää stressed that their paper provides a theoretical foundation for future work. A first attempt to use their work as a foundation revealed a need for a slightly different approach to classification. This conclusion was arrived at because Leidner and Järvenpää categorized the theories according to particular set of dimensions. Those dimensions were not applicable for on-going research and for conceptions of learning. However, the idea of classifying conceptions in the same way as they classified theories seemed suitable for the purposes of the present study. Thus, the LM applies the idea of dimensions from Leidner and Järvenpää's model (1995, Figure 1. p. 271), combining and adopting elements from Häkkinen's (1996) work on teachers, users and designers and from Marton and others' work (1993) on learning conceptions.

The term Learning Matrix (LM) was chosen for three reasons. Firstly, Leidner and Järvenpää's work is used without modifications. Secondly, the dimensions selected for use in the study are associated with learning only. Thirdly, this serves the purpose of the LM by providing it with a detached perspective on the phenomenon studied. The matrix is a container where sets of learning theories are positioned according to their axioms and premises as found in the literature and identified with different theory names (see the dots in Figure 1). For example, the dot that represents behaviorism is a sum of conceptions of learning that are stressed in the theory involved. Each of the three axes describes one dimension (Figure 1). Three dimensions were selected for the purpose of visualizing the interview analyzed here because of their simplicity as a means of capturing most of the relevant differences. It is very difficult to present more than three dimensions in one figure, and more work is needed to achieve an enhanced view.

The dimensions of the LM were chosen using phenomenographical principles: each dimension extends between poles that represent two different conceptions of learning. This structure served also demonstration purposes. The conceptions that emerged from the literature were 1) learning is an individual process vs. learning is a social process and 2) learning is the adoption of knowledge vs. learning is knowledge creation (Häkkinen, 1996). The later dimension was also found to match the work of Marton and his colleagues (1993), who argue that learning, can be seen as either repetitive or transformative action. Some corrections were made to the LM after testing its suitability for the visualization of theories and conceptions from Isomäki and Häkkinen's work (Isomäki et al., 2001). The conceptions of learning that were placed on the LM were learning by using (BU), affective learning (AL), formal learning (FL), temporal learning (TL), demographic learning (DL), technology-driven learning (TD), contextual learning (CL) and simultaneous learning (SL). This served as a test, of whether these conceptions could be fitted into the LM. All conceptions fitted well with the exception of temporal learning. This was chosen as the starting point for setting the model's third dimension. It was selected also because more perspective seemed to be needed on learning and the time relation.

Positioning Existing Learning Theories into the Learning Matrix

Leidner and Järvenpää (1995) constructed their dimensions of learning theories by analyzing the more widely accepted theories of learning in terms of their premises. This study adopted the same basics for classification. Leidner and Järvenpää presented a summary of learning theories. This was supplemented in this study by an examination of the premises of 13 theories (Appendix 1.) from the literature. Among the many, theories in existence, the theories to be included in the LM were selected in three steps: 1) including theories that Leidner and Järvenpää had covered in their study (1995, Table 1 p. 270); 2) including the theories other than those discussed by them that were most prominent the literature (rB, sC, rC, Cg, mIP); 3) including three theories (he, t, si) that were arbitrarily chosen from the literature. The idea behind this arbitrary choice of three more theories was testing how suitable the dimensions of the model were for classifying arbitrarily chosen learning theories.

The theories were placed on the LM as indicated by their premises revealed against the dimensions chosen. That is, the theories were placed at a certain distance from the central point of the matrix (Figure 1). For example, a theory was placed two step to the right of the central point if it was found to emphasize that learning is knowledge creation (expressed in coordinates r2, 0, 0), as does the premise of constructivism: All (human) information construction takes place on the basis of earlier information and experiments (von Wright, 1992). This made possible a simultaneous presentation of the theories on the LM (Figure 1).

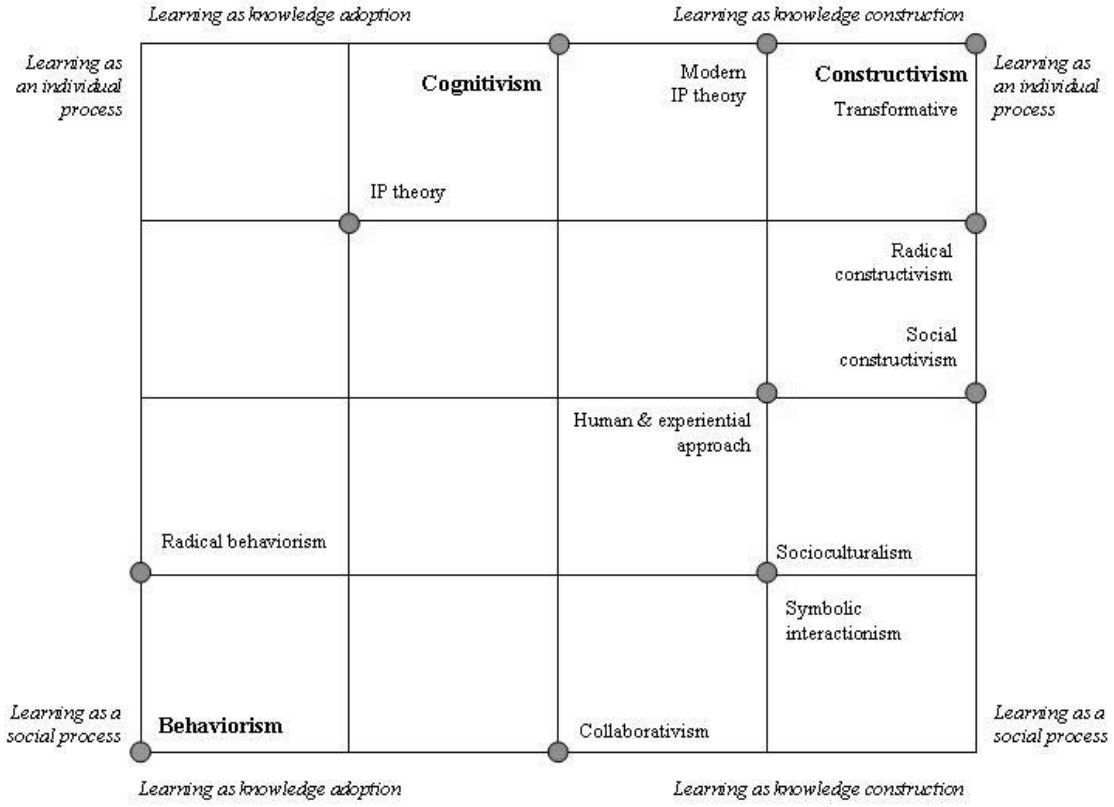

Figure 1. LM with theories of learning, placed according to their premises

Developing the LM and the Wellness of the Model: An Analysis

The development work on the LM was done for two reasons. The first reason was to be familiar with learning theories and the second reason was to construct an informal model that could be translated into an operational research tool. The work of developing the LM achieved these aims. More work would make it possible to integrate the LM into for example, database and a web survey sheet enabling the online mapping of conceptions. This will be discussed in more detail in the last chapter. The first two dimensions of the model were taken from literature. They can be criticized for having been taken for granted but as a baseline for this work, classification had to start somewhere and something had to be adopted as a formal basis. The dimensions set fro the model are general and it obvious that they will leave exclude premises from theories that cannot be fitted into the matrix, as can be predicted tests carried out. The basic premises of different learning theories were taken from literature and analyzed. The analysis was biased by the researcher's own conceptions of learning. An attempt was made to reduce the bias through active interaction with the professionals and by trying to identify those conceptions of learning. According to the gathered feedback (discussions) and self- analysis, researcher's general conception of learning seems to be experiential and constructive. Further, the researcher attempted to answer questions involving learning conceptions using a constructionist approach. Despite the good intention the answers were strongly biased because the researcher had gained the same knowledge as was used in building the LM. In conclusion no obvious way was found to handle bias.

As was already told, tests were carried out before the LM was used as a descriptive tool. The test with Isomäki and Häkkinen's (Isomäki et al., 2001) collection of designers' conceptions of learning revealed a good fit with the LM. With one exception, as mentioned earlier, the conception of temporal learning had no elements that could have been used for linking it with the LM. As Isomäki and Häkkinen (Isomäki et al., 2001, p.175) argue that the differences between particular groups and their time conceptions should be recognized, the LM needed a dimension for describing conceptions that involve temporal learning.

Interview and Data Analysis

The aim of the first empirical interview was to study and understand the interviewed designer's conceptions of learning and to test the LM. Furthermore, there was a need to understand the specific e-learning development process itself. Accordingly, some data were gathered that could provide an overall view of the whole process. Issues involved in the development process are not discussed in this paper. Most of the 45 interview questions were divided into five different sets. After a preparatory training discussion the interviewee was asked about the process of developing a learning environment. This was followed by questions about the designer's conception of learning and, in a third round, questions about the kind of learning environments that are familiar to the user. The last questions were intended to uncover the primary focus of the development process, for example, whether there was any priority between aspects such as learning, product quality, and development time. The concluding questions asked the interviewee to add anything that he thought important concerning the interview topics.

The interviews consisted of a video meeting between the interviewee and the interviewer. The interviewee had 14 years' experience of teaching and of developing e-learning environments. All the research data were collected through this interview, conducted over an Internet connection. The videoed data were transcribed and subjected to a qualitative text analysis (McKensen & Wille, 1999), made mostly using the ATLAS.ti qualitative data analysis tool 2. The answers to questions about conceptions of learning were fitted into the LM. The analysis of the answers to the open questions was time-consuming, but it was known beforehand that individual answers would emerge. An e-learning environment familiar to the designer was used before the interview, and questions about the environment were general ones.

Interview Questions about Learning

Eight questions were mainly about learning (Questions 15-19 and 28-29). Seven questions (21-27) covered temporality in conceptions of learning. They were asked because the third dimension of the LM was included and need testing. When the designer was asked to describe his own conception, there were first general questions about learning and finally more precise questions covering three main approaches to learning: behaviorism (Q18), cognitivism (Q19) and constructivism (Q20). They were not considered leading questions because they were asked after the general ones. During analysis, 26 sentences from eight answers to questions about learning were considered. Among them, 22 were selected for examination and 4 rejected (two for being contradictory with each other, one for being unclear as to content and one for being, actually, about the results of learning). Of all these sentences, 6 had a strong emphasis on learning being a social (d2), 5 a strong emphasis on learning being an individual process (u2). One sentence was considered to emphasize learning as an individual process (u1), but less strongly. Three sentences about learning as a social process expressed a conception of learning as the application of knowledge in practice (d2). Three other sentences were strong statements of the same conception (0). Five sentences gave strong expression to the view that learning is about the construction of knowledge (r2). One sentence expressed the idea that learning is an individual process and knowledge creation but not as strongly (r1, u1) as the other sentences. One very clear sentence was not included in the LM because it did not answer the question asked (-). From the answers to the seven questions about temporal learning, 18 sentences were considered. Eight sentences stated explicitly that learning is subjective to time and thus that learning is a very individual process and that time is a central component in it (u2, i2). Seven sentences linked motivation to learning under a schedule (i2) and emphasized that chronological order was needed when learners are required to learn several subjects. Three sentences stressed that different learning situations demand different amounts of time and different learning skills. Below are some of the questions (Q) and answers (A) related to learning (Q [number] refers to the interview question and A [number] to the interviewee's answer):

Q15: "In your opinion, what is learning?"

A15: [Silence] "It's impossible to classify what is learning." However, as this was not a question asking for strict classification but for a personal conception, he went on to explain:

A15: "I could say that learning takes place in interaction, it is one of the starting points" & "… e-learning is more rewarding in interaction."

Later, when the interviewee answered another question, he said:

A17: "...very often the best projects are those were there is interaction in a team, between people."

When the interviewee was asked (Q17) to tell how he thinks people learn, he replied that the tendency to manage and control learning is the wrong way to deal with this issue when developing learning environments and that people tend to learn different things in different ways. He seemed to be emphasizing that a dynamic conception of learning should be supported in e-learning. The questions about theories shifted the focus of the interview to the designer's metacognitive1 skills.

Q20: "In your opinion, what do you see as the most convenient way to learn?"

A20 "…I do much self-learning in hobbies (e.g. as a football coach) and at work (development manager)…" "…I try to meet people and negotiate with them…" "...in practice."

Obviously, metacognitive1 skills were present and the emphasis was on social learning that takes place in practice. Before discussing the designer's conception of learning, one aspect of the interview setting should be pointed out. In this interview, the questions could have been better set be-

cause the analysis revealed poorly designed questions (3), questions too open or difficult to answer (4) and questions that asked the same things in different ways (5) among the questions used (45). This shortcoming will be remedied in further interviews with other designers.

The Designer's Conception of Learning and Testing the LM

When the interview answer were mapped into the LM (Figure 2) among the previously placed theories, general conceptions (Marton et al., 1993) of learning and IS designers' conceptions of learning (Isomäki et al, 2001), some observations were made. Views that learning is an individual process matched three conceptions that Isomäki and Häkkinen found (demographic learning and affective learning) associated with functions internal to the individual mind. Views that learning is a social process similarly matched simultaneous and contextual learning. This was to be expected because the same person that analyzed the interviewee's answers/sentences placed the results of Isomäki and Häkkinen in the matrix. However, there were no sentences that would match technology-driven learning or formal learning. As was said before, the interviewee disliked formal methods, making this lack of a match understandable. Similarly, the interviewee's educa-

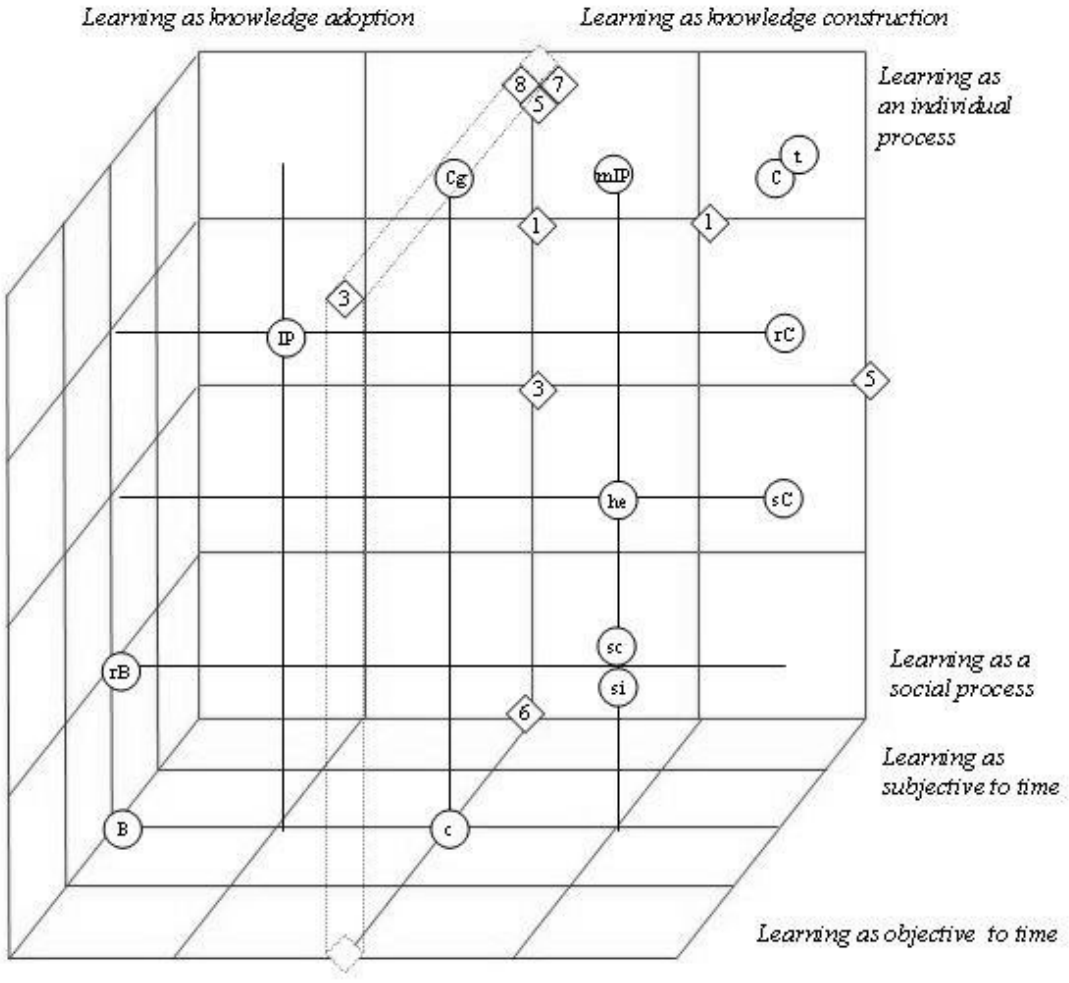

Figure 2. Different learning theories (circles) and a designer's answers (parallelograms) placed in to the LM. Numbers in parallelograms indicates the amount of sentences related to particular point in the LM.

tional background lacked a technological orientation even if he emphasized that there are times when a new technology attracts their attention if it seems useful for developing environments. Thus, technology-driven learning was absent in his answers. As regards the designer's conception of e-learning, he was not quite sure if people really learn over the net (the e-learning environment), saw interaction as an important aspect of self-directed learning and said that e-learning was something that their customers thought that they needed. The interviewee was worried because the management point of view has become more prominent in e-learning, as has the assumption that human learning can be controlled when old learning models are strengthened and used in e-learning. When the designer was asked about whether learning was an individual process (Q28), he agreed. He also thought that individual learning was better in the long term than situational learning. He criticized formal learning methods and thought poorly about predictions about typical learning. He saw learning as more subjective than objective to time and said that time is essential in learning.

To sum up, it was concluded that the interviewed designer saw learning as the transformation of thinking. No strong difference between seeing learning as an individual or as a social process was found. The designer considered individual learning more important in the longer term, but thought that social learning made it easier to achieve results.

Conclusion and Discussion

In future, better dimensions could be set properly and with more accuracy by studying premises that may have been left out of the model. The LM's scale of difference is arbitrarily defined and lacks deeper analysis. Despite the lack of strictness, the LM provides a general overview of differences between learning theories from a point of view based on the dimensions chosen. The method is useful for visualization of conceptions. Naturally, more research and work is needed to improve the method.

As Leidner and Järvenpää (1995, p. 271) consider that no particular model (theory) of learning is the single best approach and that different learning approaches are valid, it is concluded in this study that the interviewed designer's unique conception of learning is valid. Thus, it might be impossible to construct a learning environment that would support only one particular learning theory. It is more important to recognize designers' different underlying learning conceptions than to justify focusing on some particular learning theories when developing particular types of learning environment. While designers of and content producers for e-learning environments involved in their development do have different conceptions of learning, the question is whether those conceptions interact or do not interact in the development process. It is suggested here that there could be intermediaries to foster interaction between conceptions, such as the mediator in Vygotsky's (1978) basic mediational triangle, perhaps as a tool that could help the parties to understand different conceptions of learning. As is seen in real life situations and as has been pointed out by Vygotsky (1978) for example, the obvious tool is communication between the participants (e.g. in face-to-face situations), but it could be asked whether such communication could be enhanced by using technology that would provide support by visualizing the participants' different conceptions. It is unlikely that this would lead to a neglect of other forms of communication; instead, it would enhance communication as a whole and, further, promotes learning during the development process itself. A tool that would support communication during the development process should also be included with the actual product. For example, collaborative tools for e-learning environments are important because they are artifacts used to interact within the social context offered by the learning environment to support discussion and thinking. Or as Järvelä and Salovaara (1997), using Vygotsky's definition put it, in IS development, social interaction is the basis for the most top-level methods and relationships between the participants. If the LM could be developed into such an operational tool to support the visualization of different learning per-

spectives, what further applications and research issues might emerge? In the next stage of the present research project LM will be used to analyze other interviews with designers and content producers and tested for functionality by means of a web survey. Among the research issues that will arise and need to be dealt with are the validity of the researcher's interpretations of the quality of the interview answers (e.g. how the researcher's own conceptions affect their interpretations), the level of generalization of the interpretations established in the LM (e.g. is a given interpretation satisfactory) and technical issues (e.g. how the data could be interpreted quicker).

At the core of the LM, which is a human artifact, are the conceptions related to its development. As in natural human operations (e.g. in development), we tend to forget to think enough about the consequences of our actions. Agreements about the generalization of interpretations must be made visible before any real support for communication can be achieved. In the same way as the designer said at first that it is impossible to define learning, it is emphasized here that it is important to at least try to achieve a certain degree of understanding of different conceptions of learning because they are intentional in the sense of guiding people in their daily activities and also allow for the world to be perceived as personally meaningful (Säljö, 1996). And if we want to develop a meaningful artifact for people to use, it might be helpful to understand the underlying conceptions involved. Possible further applications of the model might include LM gadgets integrated into communications devices for the visualization of other people's conceptions or LM browsers for browsing, transforming and agreeing about conceptions under discussion. Such visual information would support awareness in the same way as visualization tools are designed to support awareness in collaborative environments (Leinonen, Sievänen, Järvelä, & Häkkinen, 2003). Although it seems that e-learning environments do not satisfy users, they can be very universal and fulfill most customers' needs.

Leidner and Järvenpää (1995) emphasized that academic institutions typically lag behind businesses by roughly a decade in the adaptation of new technologies (they refer to U.S. Congress, 1988). This paper is similarly concerned about the same topic. The challenge is not about what are the promising technologies to be used but about what will be the future technologies to be used and which are the organizations that will be the first to use them when they are applicable. And perhaps we should try to see farther, beyond imagination. Change is much easier to accept and understand when there is a strong vision about what is going to come next. The value of the privilege of doing research should not be assessed in terms of its productivity but, instead, in terms of a humble approach to research and exploring new areas. Of course, different conceptions and knowledge should be shared to start the discussion and pushing us deeper into the future.

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Biography

Ari Sievänen is a doctoral student working in the Faculty of Computer Systems and Information Systems in the University of Jyväskylä. His multidisciplinary research of learning conceptions in the development of e-learning systems links to the areas of information systems, education and cognitive psychology.

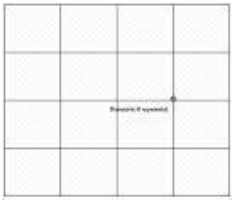
Appendix 1: Table 1

The LM coordinates come from a simple classification of directions as left (l) – right (r), up (u) - down (d) and in (i) – out (o). These expressions involve no negative emphases. The number (from 0 to 2) behind the letter indicates distance from the central point of the matrix, which depends on the premises matching the dimensions represented.

Table 1: Mapping learning theories into the LM

Learning theory (abbreviation)	Examples of premises	Location in LM (LM coordinates)
Behaviorism (B)	Learning is the uncritical absorption of objective knowledge (Leidner & Järvenpää, 1995) Learning can be intensified by remodeling learners' behavior during the learning situation (Thorndike, 1913) Learning remodels human behavior (Thorndike, 1913) Information is constant but individuals use it in various ways (Thorndike, 1913)	(l2, d2, 0) 
Radical behaviorism (rB)	Student personality is the student's personal history of confirmation (Skinner, 1931) The purpose of education is to produce eligible changes in behavior (Skinner, 1931)	(l2, d1, 0) 
Constructivism (C)	Learning is a process where an individual constructs knowledge (Leidner & Järvinen, 1995) All (human) information construction takes place on the basis of earlier information and experiments (von Wright, 1992; Bruner, 1966) Knowledge is relative, achieved through individual perception (Bruner & Haste, 1987; Wood, Wood, & Middleton, 1978) Learning comes easily to a specialist who cannot use the knowledge and skill in new and different contexts if they become used to a certain thinking culture (Brown, Collins & Duguid, 1989)	(r2, u2, 0) 

Social constructivism (sC)	In learning, the learners' own constructions are important (Bruner & Haste, 1987) Learning is the result of the learners' own action (Bruner & Haste, 1987) Learning is situated to a context (Glaser, 1991) Social interaction has a central role in learning (Glaser, 1991)	(r2, 0, 0) 
Radical constructivism (rC)	Learning aims for understanding (Glasersfeld, 1987) Knowledge is not passively received but actively built up by the cognizing subject (Glasersfeld, 1987) The function of cognition is adaptive: it serves the organization of the experiential world, not the discovery of ontological reality (Glasersfeld, 1987)	(r2, u1, 0) 
Cognitivism (Cg)	Learning is the processing and transfer of new knowledge into long-term memory (Leidner & Järvenpää, 1995) Learning is an active, constructive and goal-oriented human mental process (Shuell, 1986) Earlier information is the learner's most important resource in the learning process (Ausubel, 1968) Pregiven material helps the learner to connect earlier information and the new thing to be learned (Ausubel, 1968)	(0, u2, 0) 
Information processing (IP) theory	The input-output process, people's cognitive operations, can be compared with computer operations (Searle, 1980)	(l1, u1, 0) 
Modern IP-theory (mIP)	Individuals receive, qualify, analyze and construct information through complex thinking processes (Straker, 1996) Information is received actively (Straker, 1996)	(r1, u2, 0) 
Sociocultural approach (sc)	Learning is subjective and individualistic (Leidner & Järvenpää, 1995) In learning, the zone of development is sociocultural (Vygotsky, 1978)	(l1, d1, 0) 

Collaborativism (c)	Learning emerges through shared understanding among two or more learners (Leidner & Järvenpää, 1995) Learning involves interpersonal social processes undertaken to carry out a problem-solving task (Slavin, 1987)	(0,d2) 
Humanistic and experiential learning (he)	The human learns things that they find meaningful; we cannot teach another person (Rogers, 1969) In learning, the teacher resembles most a coach (Kolb, 1984) Learning takes place in what is known as reflective practice (experiences) between learners and during coaching discussions (Schön, 1987) Rational decisicion-making is involved both in learning and in the scientific method (Revans, 1982) Learning is action that involves responsibility and needs real problems to be solved (Revans, 1982)	(r1, 0, 0) 
Transformative approach (t)	Adult learning is an individual process (Mezirow, 1990) Learning is a social process that takes place in the head of the individual (0) (Mezirow, 1990) Learning is unconscious socialization (d1) (Mezirow, 1990) The original motive for learning is to understand experiences (Mezirow, 1990) Creating meanings is at the core of learning (Mezirow, 1990) Critical reflection is the inevitable condition for learning (r2,u2) (Mezirow, 1990)	(r2, u2, 0) 
Symbolic interactionism (si)	Meaning is a symbolic product of social action, an interpretation not a reaction (r1,d2) There is a need to adapt functions together (r1,d1)	(r1, d1, 0)