Choosing a supporting technology for learning: A preliminary approach

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CHOOSING A SUPPORTING TECHNOLOGY FOR LEARNING

A PRELIMINARY APPROACH

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Abstract

In this paper we attempt to reach a method for evaluating the fit of different supportive technologies with a course. To achieve this we make use of a categorization of important factors, to deduce the four learning models we use. Using these characteristics we analyze different supportive technologies and arrive at a method of choosing.

Keywords: behaviorism, cognitivism, social constructivism, connectivism, learning systems, e-learning, supportive technology

INTRODUCTION

Choosing the right supportive technology for education is not a trivial task. As shown in Abcouwer & Smit (2007) there is no natural fit between learning approach and supportive technology. In this article we suggest a different approach, based on a number of characteristics of learning, which can be supported differently by the different technologies.

APPROACHES TO LEARNING

The literature on learning approaches names several different approaches, of which the best-known are behaviorism, cognitivism and (social) constructivism. Connectivism is newly proposed, based on changes in society and new insights into the impact of ICT/internet on learning. Below we give a brief description of these approaches (Abcouwer & Smit, 2007):

> In ***behaviorism***, learning takes place in a repeated process of action and feedback. The best results are achieved by positive affirmation of behavior. Skinner's (1958, 1972) view on learning has been highly influential in the field of education. In his view, learning is the observable change in behavior. In education, the main characteristics of behaviorism are the focus on positive and negative affirmation of behavior, as well as a constant need for tests and feedback.
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> In ***cognitivism*** learning has been established as a response to behaviorism. Apart from the observable behavior that behaviorists believe in, internal processes are also important (Valcke, M.M.A., 2000). Therefore, this approach is focused on: knowing, obtaining knowledge, internal mental structures. The main focus is on guiding the student in using the right learning strategy and helping to relate new knowledge to existing knowledge. Guidelines for cognitive learning are: an active involvement of the student, hierarchical analyses, knowledge building on the basis of other knowledge, structuring, organizing and sharing knowledge, creating a learning environment

that enables and encourages students to make connections to existing knowledge and finally, using progress tests and final tests to monitor progress.

Constructivism states that people put a meaning on experiences in their own way (Bartlett et al, 2001, Cole et al, 2001). The approach starts from the idea that a person absorbs certain experiences into his already existing knowledge (assimilation). In addition, a person can rearrange his own concepts in such a manner that the new concept can be included (accommodation). Lev Vygotski and Jerome Bruner added the social component to constructivism. They assumed that communication represents a strong added value in the learning process (Bartlett et al, 2001).
Learning within social constructivism consists of creating and arranging concepts in the brain. Therefore it is not learning fragmented knowledge by heart but the development of meaningful concepts on the basis of experiences and a realistic context (Kral, 2005; Kolb, 1984, Cox, 2005). In this approach learning is made into a social activity, which is carried out together with others. By means of collaborating and communicating, the student is obliged to clarify his thoughts and he is confronted with the weaknesses of his ideas (Van Lehn et al, 1993). A more recent implementation of the ideas of social constructivism can be found in the Natural Learning approach as founded by Van Emst (2002).

Connectivism, as new learning approach, is proposed to explain the impact of new technology on learning. Learning has always been considered a process inside an individual, yet according to connectivism, learning is a process that may occur outside the individual, within an organization or database. Connectivism is based on theories on chaos, network, complexity and self-organization. The connections by which we can learn are more important than what we currently know, i.e. “the pipe is more important than the content of the pipe” (Siemens, 2004). The combination of ideas created by weak links can create new innovations and insights. Connectivism starts from the individual, whose knowledge is comprised of a network. The individual feeds this into organizations and institutions, which in turn feed back into the network, giving the individual the possibility to continue learning. This cycle is instrumental in successful learning.

The use of information and communication technology differs for each of these approaches. While it's clear that there is an increasing use of supportive technologies, a method for choosing is not available. Many institutions decide for a single supportive technology, Blackboard in our case. Based on Abcouwer & Smit (2007) it seems evident however that there is no natural fit. It is our impression that a development towards social constructivism and connectivism is taking place. These learning approaches require a focus on collaboration among students and a cooperative way of building knowledge. There is a growing awareness that knowledge isn't an absolute and objective phenomenon. Traditional e-learning environments tend to be unable to cope with these kinds of approaches, for us a reason to experiment with ICT environments that were not directly designed as e-learning environments. Another reason for our choice of the ICT environments was the availability and small-scale implementation. Due to the limitations brought up by our IS department we were not capable of experimenting with full-scale ELO environments.

In order to get a better understanding of success and failure we need to categorize the learning approaches in order to be able to link them to facilities as offered by ICT environments.

CHARACTERISTICS OF THE FOUR LEARNING APPROACHES

In this article, we will use a characterization as proposed by Abcouwer & Smit (2007), Abcouwer & Abcouwer (2006) and Van der Goot (2005). First we give a short description of the categories. In table 1 you will find a more extended description of the learning approaches along the lines of this categorization.

KNOWLEDGE CREATION

Questions like "is knowledge objective or subjective" or "is there a relation between knowledge and context" are answered differently in the ascribed learning approaches (Bartlett et al, 2001). For that reason, a difference is made between learning and teaching, focusing on the relationship between teacher and student in the knowledge creation process. (Cole et al, 2001).

COMMUNICATION AND FEEDBACK

Is the student forced to make his knowledge more explicit and to allow his fellow students to evaluate this knowledge (Bartlett et al, 2001) is an important question in this characteristic. The fact that *you learn more together than on your own* is important because collaboration means communication and discussion (Emst, 2002).

LEARNING CONTEXT

A learning context has to be created to enable the learning process (Emst, 2002). The approach to learning *from whole to part* versus *from part to whole*, also indicates the differences that exist between learning approaches. Better understanding of a subject is what is strived for (Jonassen et al, 1998).

OWN RESPONSIBILITY AND REFLECTION

The fourth category includes the characteristics that state whether or not the student should be given *own responsibility* for organizing his own learning process. *Reflection* is an integral part of this responsibility and therefore assigned to either the teacher or the student. It definitively isn't *only* a task for the tutor (Sorensen, 1999 and Van Lehn et al, 1993).

MULTIPLE INTELLIGENCE

Learning approaches appeal to intelligences in different ways, as proposed by the multiple intelligence theory. One of the founders is Howard Gardner (1985). Within this definition of intelligence, Gardner distinguishes eight types of intelligence (Gardner, 1999. Checkley, 1997). All these intelligences are more or less represented in every individual (Armstrong, 1994).

MOTIVATION OF THE STUDENT

Is the student intrinsically motivated or extrinsic, i.e. does the teacher play an active role in motivating the student? Or are mechanisms like adaptive self-efficacy and competence beliefs what motivates the students? (Pintrich, 2003; Dörnyei, 2000).

ROLE DIVISION

Two roles in the learning process need to be assigned: Learning-master and process-master (Emst, 2002). The learning-master is responsible for transferring knowledge to the student. The work-master is solely responsible that the student is making enough progress.

In table 1, we characterize the different learning approaches using the described categorization.

Table 1. Working towards characteristics, table of characteristics

	Behaviorism	Cognitive	Social Constructivism	Connectivism
Knowledge creation	Focus on internalization of objective knowledge Teacher guided learning Use of objective knowledge is determined by the learning process	Objective knowledge, knowledge scheme's Knowledge absorption Teaching Knowledge has an absolute value Knowledge areas are independent / not connected	Subjective knowledge Knowledge is influenced by culture, context, environment (self guided) learning Knowledge determined by its context	Rests in diversity of opinions Group guided learning Complete knowledge cannot exist in one single person
Communication and feedback	Teacher stimulates the individual pupil Communication focuses on the use of skills Feedback is based on observed behavior Fast feedback is essential for the learning process	Learning is an individual activity Communication is based on the exchange of facts Feedback and judgment uses absolute measurements of operational learning goals	You learn more in the group than on your own Aimed at individual learning processes Feedback is based on individual learning progress (learning delta) and doesn't use an absolute scale of knowledge	Cycle of knowledge development Learning is not an internal, individual activity Feedback originates from the network
Learning context	Teacher stimulates pupil Guiding is based on behavior Teacher sets learning goals	Absolute division between teacher and pupil From part to whole Knowledge is timeless Learning goals are absolute	Meaningful situation Aimed at construction and design Broad development takes central stage From whole to part Learning for now	No difference between student and teacher *From whole to part and part to whole* The process is the learning goal

Own responsibility and reflection	Aimed at behavioral change Monitoring progress by teacher Focus on skills of pupil	Limited own responsibility Monitoring progress by teacher Reflection is based on absolute measures	Student-follow-yourself approach Self evaluation Compare achievements with previous achievements	Self evaluation
Multiple intelligence	Focus on a limited set of intelligences based on the skills of the student	Appeals to a limited set of intelligences chosen by the teacher	Appeals to multiple intelligences based on personal preferences and interaction with others	Appeals to multiple intelligences based on personal preferences and interaction with others
Motivation of the student	Extrinsic	Extrinsic	Intrinsic	Intrinsic
Role division	Learning-master: teacher Process-master: teacher	Learning-master: teacher Process-master: student	Learning-master: teacher/student Process-master: teacher/student	Learning-master: student Process-master: student

As mentioned before, the choice of the environment was based on our practical experiences with the different environments and roughly defined requirements of the different courses, which resulted in four supportive technologies being utilized. Below we give a brief description of the ICT environments that we used to support learning.

EDUCATIONAL SUPPORTIVE TECHNOLOGIES

In our research we used the following ICT-environments (descriptions from Wikipedia and relevant documentation):

Blackboard Inc. develops and licenses software applications and related services to over 2200 education institutions in more than 60 countries. These institutions use Blackboard software to manage e-learning, transaction processing and e-commerce, and online communities. In our research we only used the Blackboard Academic Suite, consisting of

- The *Blackboard Learning System*, a course management system
- The *Blackboard Community System*, a community and portal system
- The *Blackboard Content System*, a content management system

Blackboard is the only environment that we used that fits in the traditional definition of an e-learning environment. It is widely used but it's main focus is on the interaction between teacher and pupil. Interaction between students, especially the sharing of information, is only facilitated partially.

QuickPlace is a proprietary web-based collaborative software application distributed by the Lotus Software division of IBM. Lotus QuickPlace is a self-service web tool that provides non-technical professionals the ability to easily create a browser-accessible workspace to support a task, project, or initiative. QuickPlace also integrates with IBM Lotus Sametime providing presence awareness of other users online and available for conferencing.

The look and feel of QuickPlace is similar to a one-page-at-a-time portal experience (rather than multiple applications or portlets on one page), with the ease of adding material in the way of a wiki.

QuickPlace in not really a Learning Environment, but the ease of use and its focus on collaborative working makes it very suitable in a learning context.

A **blog/forum** is a website where entries are commonly displayed in reverse chronological order. "Blog" can also be used as a verb, meaning *to maintain or add content to a blog.* Many blogs provide commentary or news on a particular subject; others function as more personal online diaries. A typical blog combines text, images, and links to other blogs, web pages, and other media related to its topic. The ability for readers to leave comments in an interactive format is an important part of many blogs while the forum allows for real discussion. In a Blog/forum environment there is no real distinction between teacher and pupil. The real focus in environments like these is sharing information en experiences.

A **wiki** is software that allows users to easily create, edit, and link pages together. Wikis are often used to create collaborative websites and to power community websites. Wikipedia is one of the best known wikis. Wikis are used in many businesses to provide affordable and effective intranets and for knowledge management.
In a wiki environment the focus is on knowledge and knowledge sharing. The added knowledge doesn't have a strict owner. Combining knowledge of individuals leads to better knowledge, that is the adage.

To link supportive technology to characteristics we scored it on every characteristic one row at a time using the terms mentioned in table 1. Based on this score we determined the most appropriate learning approach on each characteristic. Per cell the best-suited learning approach is mentioned in table 2. This exercise resulted in table 2.

Table 2. Linking technologies to characteristics

	BB	QP	Blog/Forum	Wiki
Knowledge creation	Beh	Beh/Soc Const	Soc Const	Conn
Communication and feedback	Beh	Cogn	Conn	Conn
Learning context	Cogn	Soc Const	Soc Const	Conn
Own responsibility and reflection	Cogn	Soc Const	Conn	Conn
Multiple intelligence	Cogn	Cogn	Soc Const	Conn
Motivation of the student	Beh/Cogn	Cogn/Soc Const	Soc Const/Conn	Soc Const/Conn
Role division	Beh	Cogn/Soc Const	Cogn/Soc Const	Conn

The first thing to notice is that it's not a clear one-on-one match. The relation is not "written in stone", it is a initial finding that needs further exploration. Not a single supportive technology matches perfect with a learning theory. The broad overview of the relation is summarized in table 3. It means that we need to use the characteristics to link a specific course to a supportive technology. This is the main reason we need the characteristics to be able to make a better founded choice.

Table 3 Overview of the relationship between supportive technology and learning approach

	BB	QP	Blog/Forum	Wiki
appropriate	Beh: + Cogn: ++ SC: -- Conn: --	Beh: +/- Cogn: + SC: + Conn: -	Beh: - Cogn: +/- SC: ++ Conn: +	Beh: - Cogn: - SC: + Conn: ++

Looking merely at the learning theories, Blackboard and QuickPlace seem most appropriate for courses using the behaviorist approach. Cognitivism fits slightly better with Blackboard then with

QuickPlace, but both are possible. A Blog/Forum approach fits mainly with social constructivism, while a wiki seems to match well in the case of connectivism.

CASES AND LEARNINGSTYLES:

To be able to choose a supportive technology for a specific course we need to identify the learning style of that course, on the basis of the characteristics above. During recent years we experimented with four different courses of our IS curriculum in several consecutive years. For a more extended description of the courses see Abcouwer & Smit 2007). Based on the characteristics of the learning styles we identified for every course the learning style that fitted best. Below you find a short description of these findings.

Business Information Management. This course is scheduled in the second year of the curriculum. The student should obtain insight into the business-ICT relation of modern organizations and gain an understanding of the ICT paradox, in which ICT can act both as catalyst and as hindrance for future developments in the organization. At the end of the course, they should be able to apply the concepts and models covered in this course in actual business situations. The course itself can be best characterized as using a behaviorist approach. The focus is mainly on transferring knowledge from the teacher to the student, where the teacher is leading. The approach to knowledge is rather absolute, we enforce the students to learn our view on Information management and train them in that respect in a behaviorist way by using pre-defined business-cases.

Information Management. In the IM course, a third year bachelor course, we chose a business perspective for studying the Business-ICT relation. From this perspective, the students *examine* business requirements on information/communication and how these can be translated into technology solutions. In the course, we used a social constructivism approach to learning. After a short and highly intensive introduction on IM, students are supposed to choose their own research theme as a “meaningful situation” based on their own interests. They work together in groups. This way of working means that the students interact highly. They do not learn solely from the teacher but also from each other.

Information Architecture & Information Infrastructure. In the IA & II course, the main focus is on the technology issue in the business ICT relationship. The students look at the business side of this relation asking themselves what structural impact technology has on the business. Because

the issues discussed in this course are relatively new to the students, this course uses a cognitive and partly social constructivist approach to learning. During our experiments the course was scheduled as a third year bachelor course. Over the years, the course migrated to a more cognitive approach, especially after it was rescheduled to a second year bachelor course.

Information management in practice. This masters level course aims to apply all of the knowledge and theories which have been learned during their master phase (and before). There is a strong emphasis on teamwork and helping each other, both between students and the participating organizations, creating out-of-the-box solutions for every day IM-problems. The most functional metaphor for this was found in confronting the concepts of 'thinkable', 'feasible' and 'achievable' (Maes et al, 2005). The central idea is that organizations often tend to think in terms of 'feasible', whilst it might be more useful to start with 'thinkable' and then turn to what can be actually achieved. During the course, the student is stimulated to actively share insights and knowledge.

The course is best characterized by a connectivist approach. Both students and teachers take the roles of learning-master and process-master, thus leading to a lack of role-division.

TOWARDS A METHOD FOR CHOOSING SUPPORTIVE TECHNOLOGIES

Based on the insights as described before, we suggest the following method for choosing a supportive technology for a specific course:

Step 1. As a starting point we choose table 1. For every cell in table 1 we score the degree of fit between the course and the characteristic. We score on a scale of 3: fits (1), partly fits (0.5) or doesn't fit (0). Combining the scores will give you insight in the most appropriate learning approach(es) for that course.

Step 2. In table 3 you can find a first indication of the technology that is most suitable. For a more fine grained approach you should score in table 2 the characteristics of your course based on the learning approaches as identified in the previous step. This will give you an indication of the most appropriate supportive technology.

This approach of choosing a supportive technology doesn't leads to the perfect fit, it is an indication which technology might fit. It doesn't exempt you from using your common sense. Ultimately this method tries to offer a better way of choosing, but it's not a cooking-recipe.

INSTANCES OF THE COURSES AND THE USE OF SUPPORTIVE TECHNOLOGIES

Over the recent years we worked intensively with different supportive technologies in the various cases. In total we base our experiences on the use of supportive technologies in different instances of courses. Different supportive technologies have been applied for the same course in consecutive years. The choice of the technology was not based on the proposed method of choosing. Therefore the different combinations of courses and supportive technologies make it possible to get a first indication whether the approach of choosing is valuable. Below you find short description of our experiences:

Business Information Management.

Based on the earlier description this course is mainly Behavioristic. This means that the choice for Blackboard of QuickPlace would follow.

We gained experiences during 2 instances of the course. During the first instance we worked with Blackboard. During the second instance also QuickPlace was used. Under normal circumstances, Blackboard should fit in well. The reason why we chose to make additional use of QuickPlace was its higher degree of user-friendliness.

Information Management.

Based on the earlier description this course is mainly Social constructivistic. This means that the choice for a Blog/Forum environment would follow, but the use of QuickPlace or a wiki should be appropriate also.

We experimented during three instances of the course. On that moments we didn't have the insight in the relationship between learning theory and supportive technologies so the choice of the supportive technologies was made using some rules of thumb. During the first session we used Blackboard. Blackboard was chosen because it is the official e-learning environment of our University. In line with the social constructivist approach to learning we offered the students a knowledgebase with relevant scientific articles. It was our intention to let the students expend this knowledge-base with articles they found during their research. In that respect Blackboard appeared to have mayor shortcomings. Blackboard does not facilitate students to add new information to the

knowledge base. This right is solely given to persons who are granted the instructor role. The discussion board facility of Blackboard appeared not to be a solution. Especially when building a knowledge-base with students, reviews of the different sources of knowledge are a major objective and this knowledge base should be used in future courses, but copying the content of a course to a new Blackboard instance deletes all the discussions. That was a reason to switch over to QuickPlace. This environment uses a very flexible authorization system that better facilitates the communication and feedback in the learning process. Although the results were encouraging, the students complained because they were not allowed to use their standard username / password combination. Our University doesn't allow us to link QuickPlace to the central LDAP system to use the standard usernames. Another problem we were facing was the use of Java en ActiveX in the version of QuickPlace we used. The security policy of our university limits the use of these technologies.

The use of the social constructivistic approach to learning appeared to be too "guidance-intensive". Although the students were enthusiastic about their learning process, we were forced to switch back to a more behavoristic / cognitivistic learning approach. This meant that we stopped experimenting with Supportive Technologies. It means that we were not able to experiment with a Blog/Forum type of technology.

Information Architecture & Information Infrastructure.

Based on the earlier description this course is mainly behavioristic. This means that the choice for Blackboard of QuickPlace would follow.

Throughout the years, we used the Blackboard environment. In the second year we experimented with the use of QuickPlace, but technical limitations especially around Java en ActiveX made us decide to go back to the use of Blackboard.

Information management in practice.

Based on the earlier description this course is mainly Connectivistic. This means that the choice for QuickPlace, Blog/Forum and Wiki is possible. Blackboard is absolutely not appropriate.

During the years we've progressed from at first using QuickPlace, to a Blog/Forum solution and currently a wiki-technology. QuickPlace while being a very easy environment for small groups to work together and exchange information, didn't serve as well for facilitating an exchange between the groups. Relatively quickly each was working in the own corner without much interaction with others. The interaction between all students improved after switching to a Blog/Forum environment, however the groups found it hard to cooperate among themselves. While this environment lend itself well individual postings and responses, there was too little structure for the groups to be able to cooperate and exchange information. Clearly not an ideal situation – as also follows from table 2. Finally we've chosen for a Wiki, which really worked very well. Groups and students utilized the full control they had in the environment structuring the way they wanted, while still linking to and partaking in the contributions of others.

While each of the technologies has their merits, so far the wiki-technology seems to be most suitable. It should be noted that just using a supportive technology is not sufficient, the whole group-dynamics have to support the use of it.

SOME CONCLUDING REMARKS

This paper is based on cross-referencing the categorization we used to describe the learning models in table 1, with the supportive technologies. By linking a course to a learning approach a choice of a supportive technology pops up using this cross reference. We experienced that it is not easy to score a given supportive technology in the table with the characteristics, as the factors influencing the choice are not easily read from our experiences with the software or the relevant software-documentation. In essence it's important to use and experience a certain technology before being able to adequately evaluate the different characteristics. Also the categorization of the courses using the ascribed characteristics appeared not to be very simple. In most of the cases courses use a mix of different learning styles.

Suggesting that our approach will lead to a single supportive technology to be used is a bridge to far. Even though, the suggested approach appeared to be helpful in understanding the relation between courses, learning styles and supportive technologies. It made clear that the "one technology fits all" approach, common in most of the Universities, doesn't meet the complex relation between courses, the used learning approach and the supportive technology that is used.

This research is limited in certain areas. Currently we only utilize a limited number of cases and supportive technologies to ground the suggested method of choosing. In future research we need to expand both the numbers of technologies and the number of cases, so that a more detailed picture can arise. Research in this direction is already ongoing. In future publications we will elaborate on these topics.

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