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Back To Basics, Understanding The Choice Of Supportive Technologies

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Abstract:

In this paper we attempt to break down the barrier of choosing a supportive technology for learning. We try to simplify the process by reducing it to a set of elementary steps. A perfect fit is difficult to achieve, in part due to the multitude of subjective interpretations. Having an in depth understanding in the different elements involved in choosing a appropriate technology, will make the decision process easier.

We propose to evaluate both the technologies and courses on basis of a rating on characteristics. This forms the basis for the matching. The closer the match, the more likely the technology will be appropriate.

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

I. Introduction

The last few years there has been an explosion of online technologies, many of which can be applied to learning situations. Especially in the web 2.0 approach, students are getting accustomed to easily adaptable environments, in which data/information can be easily shared and re-used. As a result students are accustomed to different ways of learning. Consequently choosing a supportive technology has become increasingly difficult. The 'right' choice is dependent on the teaching style and the learning style, as well as on choices made by the teacher. We attempt to break down this complex choice into easily understandable elements on which it is possible to make a balanced choice. This will give the educators the possibility to understand the elements on which different choices are based, while also showing that 'one size doesn't fit all'.

After previous articles (Abcouwer et al. 2006; Abcouwer et al. 2007; Abcouwer et al. 2008; Abcouwer et al. 2004) - we've realized that a more in depth understanding of the choosing process is needed. Therefore we proceeded along in theory well established lines, and went on to analyze the elements on which choices are based. It will be up to the teacher to evaluate which elements are more important than others. Or perhaps whether certain combinations can be made between choosing a learning technology and a mash-up.

Building upon earlier research we came to the conclusion that the elements of the choice need to be made more transparent. In this article we introduce a method for meeting the educational requirement for a Computer Supported Learning Environment (CSLE)

II. Positioning the research

As Coopman notes, the increasing use of Blackboard doesn't make life easier for a teacher in modern society. Finding a fit between technology and instructors goals isn't a straight forward process. As Coopman states: "the aims of Blackboard administrators and management likely conflict with many instructors goals. Although Blackboard designers structure the course platform for efficiency and profit, instructors and students need a course environment optimized for learning and performative teaching." (Coopman 2009 p.8)

As mentioned before, the number of available technologies is overwhelming as is the number of abbreviations to denote them. In literature you find terms like Learning content management systems (LCMS), Virtual Learning Environment (VLE), Learning Management System (LMS) and E-learning Environment (ELE).

In this paper we have selected a representative variety of these technologies and we will refer to them as Computer Supported Learning Environments (CSLE). Our focus is on finding a practical match between courses and CSLEs. We try to surface the elements of choice which are most important in deciding the technology best suited.

Overview of selected CSLEs

In order to accurately select a learning technology we will need to have scored as many as possible.

Before we come to decide which technologies to look at, it's important to note that we will just be looking at the link between the technology and learning approaches. As a consequence we are not looking at important issues such as for instance management functionality. For the purpose of this article we selected a number of technologies to be able to test our method. Since most LMS'es have been designed with one or more specific learning approaches in mind, we clearly have to look at other forms of collaborative technologies which are applicable in a learning context.

We are not exhaustively scoring all available technologies, but have selected a list of nine representative technologies which are listed below. We did try to have as much diversity as possible.

In table 1 we list the selected technologies. In a next phase we will need to expand this list.

Blackboard	Traditional LMS, with a very strict teacher student division. Mainly intended to be used for teachers to give information and keeping track of scores.
MediaWiki	Mainly used as a wiki, large collection of web-pages easily editable by it's users.
QuickPlace /Quickr	Groupware collaboration environment, can host several different types of group cooperation's. Not a traditional LMS, but has good features for collaboration, especially on a more interactive level. Also strong on security.
Moodle	An open-source learning CMS, or VLE. Aimed to be a complete LMS, similar to Blackboard. However as a result of the open-source nature can be easily extended using modules to include for instance a multitude of collaborative functions (as part of the social constructivist tradition)
Dokeos	LMS in the tradition of Blackboard. However Dokeos has some differences, especially in ease of use. It can create online content from existing powerpoints. Also features video-conferencing and online coaching. To enable a more one-on-one assistance of the student.
Sakai	Positioned as an enterprise ready collaboration and courseware platform, is aims to provide a full suite of tools both for teacher and student. Including portfolio and library tools. Again the open-source approach has led to huge library of extension and additions.
Sharepoint	Not a learning environment, but purely a tool for collaborating and sharing information and files within a group. Nowadays often made available as a part of the main installations of the windows servers. Biggest advantage is easy sharing of (office-) documents, and included meta-data. Tightly integrated with windows and MS-Office. Features version-management as well.
ATutor	Also an open-source learning CMS. Could be seen as a modernized Blackboard with additional features and extension in so-called modules. Specifically there is a more modern interface, as well as greater adaptability. This can be achieved through themes and modules. Last but not least it's one of the few that actually feature social networking capabilities.
OLAT	Online Learning and training. Despite it's long history it's utilizing AJAX/Web2.0 technology to make it more user friendly. Main focus is still course oriented.

Tabel 1 The technologies

Table of characteristics

In this article, we will use a characterization as proposed by Abcouwer & Smit (Abcouwer et al. 2007), Abcouwer & Abcouwer (Abcouwer et al. 2006) and Van der Goot (Goot van der 2004). For a more thorough description of these characteristics we refer to aforementioned literature. Here we give a very short description of the categories. In table 2 we summarize the learning approaches along the lines of this categorization.

Knowledge creation

"Is knowledge objective or subjective" or "is there a relation between knowledge and context" are questions that differentiate the learning approaches (Bartlett et al. 2007). It makes that a difference has to be made between learning and teaching (Cole et al. 2004).

Communication and Feedback

Whether or not making knowledge explicit and allow student to evaluate is an important difference in the learning approaches (Bartlett et al. 2007). Collaboration means communication and discussion (Emst 2002).

Learning context

A learning context has to be created to enable the learning process (Emst 2002). Learning *from whole to part* versus *from part to whole* indicates the differences that exist between learning approaches (Jonassen et al. 1998).

Own responsibility and reflection

This characteristic includes the state whether or not the student should be given *own responsibility* for his own learning process. *Reflection* is an integral part of this responsibility and therefore assigned to either the teacher or the student(Sorensen 1999; VanLehn et al. 1993).

Multiple Intelligence

Learning approaches appeal to intelligences in different ways, as proposed by the multiple intelligence theory (Armstrong 1994; Checkley 1997; Gardner 1993; Gardner 1999).

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? (Dörnyei 2000; Pintrich 2003).

Role division

Two roles in the learning process need to be assigned: (1) transferring knowledge to the student and (2) being responsible that the student is making enough progress (Emst 2002).

In table 2, we characterize the different learning approaches using the described categorization.

	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

Tabel 2 The characteristics

III. The method

To be able to choose a specific CSLE we propose to split up the process into three phases. In the first phase we rate the different CSLEs using the characterization as described in the previous paragraph. Normally spoken this is a one-time exercise but it is necessary to go through the process to understand the meaning of it. In the second phase we propose to rate the course using the same characterization.

Using these two ratings we match the courses / technologies in phase three. The three phases will be discussed in more detail below.

Rating Computer supported learning environments (CSLEs): techno-cube's

Rating isn't a straight forward exercise. For example the open source systems can't be characterized as one single system, due to the fact that it is open source a lot of add-ons are available that enriches the functionality.

In our scoring we used the CSLEs as they are available. We tried to minimize the number of add-ons. However in cases where the technology has to be extended before it can be used, we've considered the most common implementations.

The scoring itself is also difficult because the characterization doesn't offer an absolute scale. It is always a subjective choice that has to be made whether a characterization fits, partially fit or doesn't fit at all.

To deal with this problem of subjectivity the researchers scored each CSLE individually. The final scores shown here are the result of a comparison of the individual scores. In cases where differences occurred we investigated further, to reach an judgement. This doesn't solve the objectivity/subjectivity issue entirely but can be seen as a first step to a more objective characterization of the different CSLEs. Ideally all available technologies should be scored and available for everybody to use. So that using this method will consist of evaluating the requirements/rates for a course and matching.

As an example, the scoring of one of the technologies – Blackboard, well known and often used - is illustrated below in four tables.

	Behaviorism	
Char.	Description	
KC	Focus on the internalization of objective knowledge Normally spoken it is the teacher who decides what material is placed in Blackboard *Decision*: The behaviorist approach to learning is highly supported by Blackboard.	2
C & Fb	Feedback to the student is one of the tasks of the teacher The focus is mainly on objective knowledge. It is not completely clear whether skills of the pupils are discussed Feedback is not only based on observed behavior, but merely focused on objective knowledge Blackboard facilitates fast feedback which is essential for the learning process *Decision*: The focus in Blackboard in not fully in line with the behaviorist view on communication and feedback	1
Lc	Organized around the Teacher – pupil relationship. Guiding in Blackboard is based on what the teachers sees from the pupil in terms of knowledge In Blackboard it is the teacher who sets learning goals *Decision*: although guiding is not exactly in line with the behaviorist approach Blackboard fits quite well with it.	2
OR &Refl	Main focusing on change of knowledge, not on behavioral change The role of the teacher in monitoring the progress of the student is not central in Blackboard. Blackboard facilitates the teacher in making knowledge available. Blackboard doesn't focus on skills of pupil. *Decision*: The behaviorist approach to learning is not in line with Blackboard.	0
MI	The latest releases of Blackboard do facilitates the use of a growing differentiation in media. But this doesn't mean that different intelligences are stimulated. How students use these intelligences is not stimulated by the teacher. *Decision* : The behaviorist description of MI is only limited valid for Blackboard.	1
Motiv	In Blackboard the motivation of the student is extrinsic, teacher initiated. *Decision*: The Blackboard approach is in line with the behaviorist approach to learning	2
RoleDiv	Learning-master: teacher Process-master: teacher *Decision*: Because the teacher is the person who is mainly responsible for the learning process in Blackboard this fits good with this approach	2

Tabel 3 Behaviorism

	Cognitivism	
Char.	Description	
KC	Objective knowledge, knowledge scheme's; Knowledge absorption; Teaching; Knowledge has an absolute value; Knowledge areas are independent / not connected All these characteristics fits well with Blackboard. *Decision*: Blackboard fits well with the cognitive learning approach	2
C & Fb	Learning is an individual activity. In Blackboard only limited facilities are available for monitoring the learning process and these facilities are focused on content not on process. This is well in line with the cognitive approach to communication and feedback. *Decision*: Blackboard fits well with the cognitive learning approach	2
Lc	Absolute division between teacher and pupil; From part to whole; Knowledge is timeless; Learning goals are absolute All these characteristics fits well with Blackboard. *Decision*: Blackboard fits well with the cognitive learning approach	2

OR &Refl	Limited own responsibility; Monitoring progress by teacher; Reflection is based on absolute measures All these characteristics fits well with Blackboard. *Decision*: Blackboard fits well with the cognitive learning approach	2
MI	Appeals to a limited set of intelligences chosen by the teacher Especially the fact that the appeal on different intelligences matches good with common practice in a Blackboard environment. *Decision*: Blackboard fits well with the cognitive learning approach	2
Motiv	In Blackboard the motivation of the student is extrinsic, teacher initiated. *Decision*: The Blackboard approach is in line with the cognitive approach to learning	2
RoleDiv	Learning-master: teacher Process-master: student New releases of Blackboard facilitates in en growing manner the influence of the student in the learning process. *Decision*: Blackboard fits well with the cognitive learning approach	2

Tabel 4 Cognitivism

	Social Constructivism	
Char.	Description	SC
KC	Subjective knowledge: not true for Blackboard, the basic idea is that the knowledge on Blackboard represents the "truth" Knowledge is influenced by culture, context, environment: also not true in a Backboard environment. There is only limited (self guided) learning Knowledge determined by its context *Decision*: There is no fit between Blackboard and the social constructivist approach to learning.	0
C & Fb	You learn more in the group than on your own. Blackboard badly supports group learning. Aimed at individual learning processes. This is what Blackboard facilitates. The focus in communication and feedback is in the individual Student-Teacher relation. Feedback is based on individual learning progress (learning delta) and doesn't use an absolute scale of knowledge. Blackboard fits well with the first part of this issue but uses an absolute scale of knowledge. *Decision*: The support of Blackboard on this issue is rather mixed. In our view the focus on group-learning and the absence of an absolute scale of knowledge are the most important issues in this theme. It makes that our final decision here is that there is no fit between Blackboard and the social constructivist way of learning.	0
Lc	Meaningful situation: Based on the principal focus on knowledge a meaningful situation in which uncertainty and doubt are central issues, Blackboard doesn't fit well with a learning context as meant in the social constructivist approach to learning. Aimed at construction and design. Blackboards main focus is on absolute knowledge and facts. Not knowing which is the basis for construction and design does not fit with Blackboard. From whole to part. The social constructivist approach to learning starts often from a broad view on reality. Within this view smaller solution are building blocks to solve problems. The focus in Blackboard is on courses and subject areas. Combining these building blocks can be helpful to solve issues. In that respect Blackboard starts from a focus on the subject areas. This doesn't fit with the social constructivist focus on problem solving (the meaningful situation) . So: no fit. Learning for now. This issue is related to the earlier remarks. The focus on generalized and objective knowledge makes the difference, so also here: no fit. *Decision*: There is no fit between Blackboard and the social constructivist approach to learning.	0
OR &Refl	Student-follow-yourself approach; Self evaluation; Compare achievements with previous achievements It is quite clear that all these issues focus on the important role of the student. In Blackboard the role of the student is less important compared with the role of the teacher. *Decision*: There is no fit between Blackboard and the social constructivist approach to learning.	0
MI	Appeals to multiple intelligences based on personal preferences and interaction with others	0

	Here again, the focus on the student is crucial. Blackboard uses a different focus. *Decision*: There is no fit between Blackboard and the social constructivist approach to learning.	
Motiv	Intrinsic. Motivation in Blackboard is mainly extrinsic. *Decision*: There is no fit between Blackboard and the social constructivist approach to learning.	0
RoleDiv	Learning-master: teacher/student Process-master: teacher/student Although in Blackboard the teacher plays the central role, in our view the social constructivist approach to learning doesn't deny the important role of the teacher. We were in doubt on this issue. In an certain sense a balance between teacher and pupil is crucial. It makes that our final judgment is not a clear yes or no. Based on our doubt, the decision is: *Decision*: There is a limited fit on this issue with the Blackboard approach	1

Tabel 5 Social Constructivism

	Connectivism	
Char.	Description	Cn
KC	Rests in diversity of opinions; Group guided learning; Complete knowledge cannot exist in one single person Blackboard starts from the believe of absolute knowledge. *Decision*: no fit	0
C & Fb	Cycle of knowledge development; Learning is not an internal, individual activity; Feedback originates from the network The Blackboard focus on the teacher student relation denies the learning role of the group. *Decision*: no fit	0
Lc	No difference between student and teacher *From whole to part and part to whole* The process is the learning goal In the Blackboard worldview the teacher represents the knowledge (which is true). Unvertainty doesn't play a role here. *Decision*: no fit	0
OR &Refl	Self evaluation According to Blackboard knowledge has an absolute measure. So – to put it boldly – self evaluation is ridiculous. *Decision*: no fit	0
MI	Appeals to multiple intelligences based on personal preferences and interaction with others See above. *Decision*: no fit	0
Motiv	Intrinsic *Decision*: no fit	0
RoleDiv	Learning-master: student Process-master: student According to Blackboard the student doesn't play a leading role. *Decision*: no fit	0

Tabel 6 Connectivism

It is clear that rating isn't an exact science. On certain issues the rates are debatable. On this moment the scores are only based on the input of the two researchers in this project. In our view further research on this scoring process is an absolute necessity. A clear-cut questionnaire would help in making the process of scoring more transparent.

The results of this analysis can be put together in a simple matrix. We call this matrix the Techno-cube. For Blackboard this cube is represented in figure 1

Blackboard

Char.	B	C	SC	Cn
KC	2	2	0	0
C & Fb	1	2	0	0
Lc	2	2	0	0
OR &Refl	0	2	0	0
MI	1	2	0	0
Motiv	2	2	0	0
RoleDiv	2	2	1	0

Figure 1

Using the same method we scored the other technologies. The results of this scoring is represented in figure 2

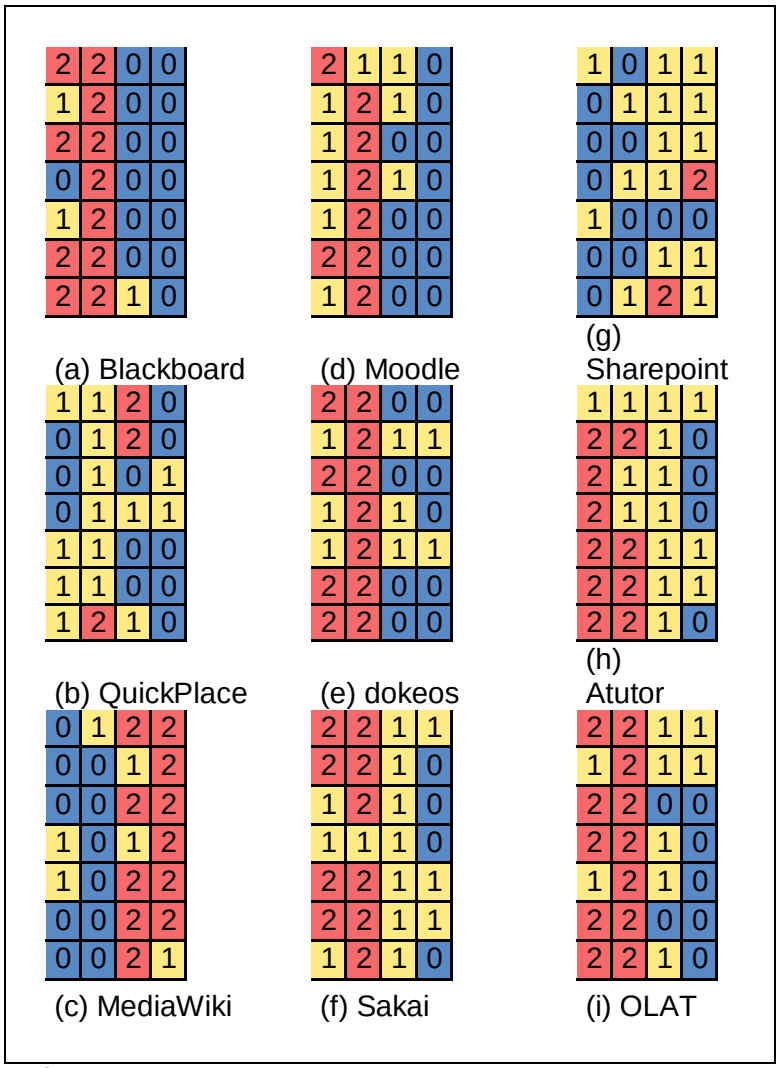

Figure 2 Nine techno-cubes

The thus developed representations will be used in matching.

Scoring the courses: course-cube's

Now that we have scored the CSLEs we need to score the different courses to be able to evaluate this method. For many faculty their main approach to teaching is focused on knowledge transfer. Due to the new opportunities offered by modern CSLEs a renewed focus on teaching may emerge. The process of scoring is based on the principal insight of the faculty in the combination of student-learning and faculty teaching. Also this scoring is likely to be subjective. Both, for helping the faculty and to make the results of the scoring transparent and comparable for research purposes, we are currently developing a standard questionnaire. For the sake of this article we have scored the courses manually, much in the same way as the scoring of the technologies.

It appeared to be another risk in this scoring process that a faculty doesn't make a clear choice but rather takes a 'have-it-all' approach. To prevent this we set a maximum score of five[1]. This ensures that real choices have to be made. Part of the fine-tuning and operationalization of this research will be to formalize the questionnaire and to structure the scoring process.

The courses were scored along the same table of characteristics that we used for scoring the CSLEs. The results of this scoring was also represented visually in a cube. See an example of one of our courses in figure 3. The representation of the scoring of the courses leads to the so called course cubes. After having done this the next step is matching the technologies with the courses.

Method of choosing

The method of matching a course to a specific CSLE is not an easy one. And if there's no perfect match, we can easily see on which area there would be a discrepancy. This is due to the fact that different characteristics may be of different importance for the specific course. We identified three methods of choosing.

1. **Arithmetic choice**
   In this approach a straight forward calculation will be made. Compare every box in the matrix. Subtract every value in the course matrix from the corresponding box in the CSLE matrices. Summarize the absolute value of the subtractions. The higher the score the worse the fit between the technology and the course. If the summarized value is 0 (zero) there is a perfect fit.
2. **Weighted arithmetic choice**
   In this approach the importance of the different characteristics are taken into account. To be able to score in this process of choosing, the faculty will have to indentify the importance of the different characteristics. A three value scale will be used. (Important, somewhat important, not important). During the process of comparing the same calculation has to be made. The results of the subtraction will be multiplied with the importance factor (important = 1, less important = 0.5, not important = 0) and the results of the calculations will be summarized again. Here the same conclusion can be drawn. The higher the score the worse the fit. Using this approach the delusive fits are expelled.
   This approach and the first one are adapted from Parker (Parker et al. 1989)
3. **Visual matching and face validity**
   Both aforementioned methods of validating suggest that the process of choosing can be approached mathematically. It is hardly possible to prove the outcomes of these processes. This is based on the partially subjective way of scoring both the CSLEs as the courses. This made us look for a different method of matching in literature. The method of visual matching combined with that of face validity appears to be a psossible approach for choosing.
   Visual matching is used as a method of learning for children with a disability (Kelly et al. 1998) and with autistic children (Mitchell 1997). We are using this technique based on our belief that our subconscious is well able to match patterns. By using the shaded boxes people are able to identify the best matches without the need for scientific proof.
   Originated from the research field of simulation, the concept of face validity (Banks et al. 1984;

[1] 2 = important, 1 = less important, 0 = not important

Shannon 1975) can be used. We define face validity is a property of a process intended to match something. The process is said to have face validity if it "looks like" it is going to identify a good matching with it is supposed to match (definition based on the definition of Banks (Banks et al. 1984). Generally face validity means that it "looks like" it will work, as opposed to "has been shown to work". The faculty is asked to compare the boxes of his score and find the visual best fit with the boxes of the CSLEs. They will be able to visually identify the discrepancies in the boxes. At that point the teacher can decide that this discrepancy is not very relevant for this particular course or approach. If it is relevant it could lead the teacher to deciding to search for a technology which will support this area better.

The above described methods of choosing may easily lead to contradictory results. Based on our current knowledge it isn't possible to scientifically proof which method is best. Based on our experience it is our impression that the last method, although the less prescribing, doesn't lead to inferior results. The darkest and lightest area's are where the most significant differences should be found. Most probably these areas play a major role in the more intuitive method of choosing of visual matching. This method also emphasizes the partly subjective side of choosing.

Below we will describe three cases which we used to test the different approaches in choosing. For the three courses the results of the three analyses are described.

IV. The cases

As cases we scored three of the courses in our business-study curriculum. The courses were: Information Management (IM – 3rd yr Bachelor), Information Architecture and Information Infrastructure (IA – 2nd yr Bachelor) and Information Management in Practice (IMP – a Master course). For a description of the courses see below. The results of the scoring in course cubes is represented in figure 4

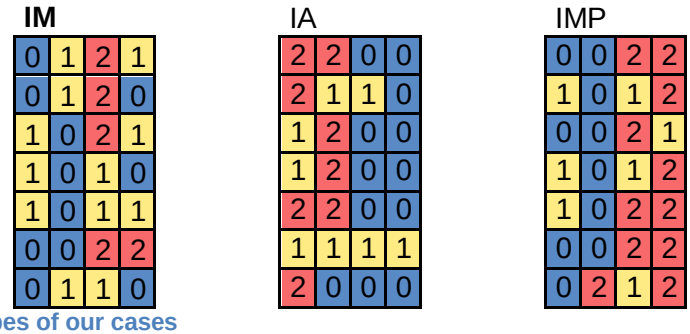

Figure 3 The course-cubes of our cases

Course : 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. When we score the course according to our method, it becomes clear that we use 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.

Matching the course with the suggested CSLEs the most appropriate choice appears to be:

Using method 1: MediaWiki / Sharepoint / QuickPlace

Using method 2: SharePoint / QuickPlace/Blackboard

Using method 3: MediaWiki / Quickplace

Our past experience

In individual sessions of this course in the past, based on gut feeling we used Blackboard and Quickplace. Blackboard does not facilitate students to add new information to the knowledge base of course material. This right is solely given to persons who are granted the instructor role. In this respect, using the discussion board facility of Blackboard is not 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.

To us, this was a reason to switch over to Quickplace. In this environment you can create special sections where a complete independent authorization system is active. This much better facilitates the communication and feedback necessary for this learning approach.

Based on our current insights it was predictable that Blackboard should not fit. The fit between Quickplace and this course is much better. Based on our method of choosing we should advise the faculty to experiment with MediaWiki or Sharepoint in future editions of the course.

Course: Information Architecture & Information Infrastructure

In the Information Architecture & Information Infrastructure (IA & II) course, a second year bachelor course, the main focus is on the technology column of the AIM model. The students look at the business column from this perspective asking themselves what structural impact technology has on the business. When we score the course it is quite clear that a more cognitive approach of teaching is used.

Matching the course with the suggested CSLEs the most appropriate choice appears to be:

Using method 1: Blackboard / Moodle / Dokeos

Using method 2: Moodle / Blackboard / Dokeos

Using method 3: Blackboard / OLAT / Sakai

Our past experience

Throughout the years, we used the Blackboard environment. There was no reason to switch to a different environment. Originally, the IA & II course used the same learning environment as the Information management course, namely Blackboard. However, because of the more cognitive approach the limitations of the Blackboard environment were less of a hindrance. Looking at this course along the lines of our current insights, the use of Blackboard appears to be appropriate.

Information management in practice

In this masters course the students have to define a meaningful assignment for themselves. This is done in close collaboration with the group as a whole. The teachers are part of this group. The aim is find a real-world issue in which something related to information (in the widest sense) can be applied/used. During this process it's the aim to find other solutions then the obvious, and it might lead to a total redefinition of the actual problem at hand.
Beforehand we do not know what exactly will happen during the course, nor what will be the outcome.

Matching the course with the suggested CSLEs the most appropriate choice appears to be:

Using method 1: MediaWiki / Sharepoint /Quickplace

Using method 2: SharePoint / Quickplace / Blackboard

Using method 3: MediaWiki

Our past experience

Initially we've started using Quickplace, which worked rather well. However in time there was a wish to change and see if we could find a better match. At that point in time we tried to use a blog and wiki. While it worked, there was a general dis-satisfaction. Mostly due to the lack of overview. Next we've used MediaWiki for some years. Interesting was that from a student perspective there was a fit, even though initially students always had to get used to the freedom. For the teachers MediaWiki proved to be even more troublesome in keeping track. This led us to switch in favor of a pure blogging solution based on WordPress[2]. Based on our current insights we should advise the teachers to chose for MediaWiki again. Incorporating WordPress in our research might also be useful to decide whether this is an appropriate technology.

V. Conclusion

The description of the CSLEs illustrates that a clear cut description in terms of the characteristics of learning is not a simple task. The same issue arises when scoring the courses. This makes this procedure really complex. This complexity makes it valuable to structurize the process of matching.

To summarize the results of our research we will focus on the different items point by point.

With respect to the CSLEs:

- Birdseye view the technologies either have in behaviorist/cognitivist focus approach or a social constructivist/ connectivist focus.
- On details there are significant differences between the CSLEs, so only looking on learning approach is not sufficient for choosing a CSLE.

With respect to the courses:

- It is difficult to use a single learning approach. In most cases there will be some sort of mix.
- Even when using this method of choosing, the teacher decides the focus. This doesn't match well with social constructivism and connectivism where the students also influence their own learning process.

With respect to the matching:

- Matching some cases is surprisingly consistent, but in others vastly different. However there is no basis, yet, on which to prefer one method over the other.
- The visual method doesn't seem to lead to worse results. Advantage of the visual approach is that it doesn't lead to a false sense of security.
- Evaluating this method should be done by participatory observation, while choosing a technology.
- Based on our current insights the changing focus on teaching may lead to the necessity to re-evaluate the ratings.

Finally, although we are aware of the fact that most institutions have a one-size-fits-all-policy regarding learning technologies, studying different CSLE's also taught us that if we don't provide the right tools students will start using generally available environments. These systems are outside the reach of the

[2] The last is not part of the main CSLEs Technologies we scored.

institution and teacher. For us, this once more shows the necessity of a more fine-grained approach to using CSLE's in teaching.

In our view the most valuable outcome of this approach is that it leads to a better understanding of the basic elements on which the choice of a CSLE is based. In future research we will include other technologies, work on a better underpinning of our results.

VI. Appendices

Appendix 1 Information Management

IM

Course cube

Char.	B	C	SC	Cn
KC	0	1	2	1
C & Fb	0	1	2	0
Lc	1	0	2	1
OR &Refl	1	0	1	0
MI	1	0	1	1
Motiv	0	0	2	2
RoleDiv	0	1	1	0

Importance cube

B	C	SC	CN
0	1	0,5	0
0	0	1	0,5
0	0	1	0,5
1	0	0,5	1
1	0	1	1
0	0	1	1
0	1	0	0

Results of matching

Method	1			2
MW	14		Sharepoint	15
Sharepoint	17		Qp	16
Qp	20		BB	21
Sakai	24		MW	21
Atutor	24		Moodle	22
Moodle	29		OLAT	22
OLAT	31		Sakai	23
Dokeos	32		Atutor	23
BB	35		Dokeos	27

Appendix 2 Information Architecture & Information Infrastructure

IA & II

Course cube

Char.	B	C	SC	Cn
KC	2	2	0	0
C & Fb	2	1	1	0
Lc	1	2	0	0
OR &Refl	1	2	0	0
MI	2	2	0	0
Motiv	1	1	1	1
RoleDiv	2	0	0	0

Importance cube

B	C	SC	CN
0,5	1	0	0
0,5	1	0	0
0	1	0,5	0
0	1	0	0
0,5	1	0	0
1	1	0,5	0,5
0,5	0	0	0

Results of matching

Method	1			2
BB	13		Moodle	13
Moodle	13		BB	17
Dokeos	14		Dokeos	18
Sakai	14		Sharepoint	19
OLAT	17		Qp	20
Atutor	18		Sakai	20
Qp	22		Atutor	20
Sharepoint	29		OLAT	21
MW	40		MW	26

Appendix 3 Information Management in Practice

IMP

Course cube

Char.	B	C	SC	Cn
KC	0	0	2	2
C & Fb	1	0	1	2
Lc	0	0	2	1
OR &Refl	1	0	1	2
MI	1	0	2	2
Motiv	0	0	2	2
RoleDiv	0	2	1	2

Importance cube

B	C	SC	CN
0	0	1	0,5
0,5	0	1	1
0	0	1	0,5
1	0	0	1
0	0	1	1
0	0	1	1
0	0,5	0	1

Results of matching

Method	1			2
MW	7		Sharepoint	14
Sharepoint	18		Qp	15
Qp	29		BB	24
Sakai	33		MW	24
Atutor	33		Moodle	24
Moodle	38		Atutor	26
OLAT	38		OLAT	26
Dokeos	39		Sakai	28
BB	44		Dokeos	29

Appendix 4 The visual matching

The technologies

2 2 0 0 1 2 0 0 2 2 0 0 0 2 0 0 1 2 0 0 2 2 0 0 2 2 1 0	2 1 1 0 1 2 1 0 1 2 0 0 1 2 1 0 1 2 0 0 2 2 0 0 1 2 0 0	1 0 1 1 0 1 1 1 0 0 1 1 0 1 1 2 1 0 0 0 0 0 1 1 0 1 2 1
(a) Blackboard	(d) Moodle	(g) Sharepoint
1 1 2 0 0 1 2 0 0 1 0 1 0 1 1 1 1 1 0 0 1 1 0 0 1 2 1 0	2 2 0 0 1 2 1 1 2 2 0 0 1 2 1 0 1 2 1 1 2 2 0 0 2 2 0 0	1 1 1 1 2 2 1 0 2 1 1 0 2 1 1 0 2 2 1 1 2 2 1 1 2 2 1 0
(b) QuickPlace	(e) Dokeos	(h) Atutor
0 1 2 2 0 0 1 2 0 0 2 2 1 0 1 2 1 0 2 2 0 0 2 2 0 0 2 1	2 2 1 1 2 2 1 0 1 2 1 0 1 1 1 0 2 2 1 1 2 2 1 1 1 2 1 0	2 2 1 1 1 2 1 1 2 2 0 0 2 2 1 0 1 2 1 0 2 2 0 0 2 2 1 0
(c) MediaWiki	(f) Sakai	(i) OLAT

The courses

IM	IA	IMP
0 1 2 1 0 1 2 0 1 0 2 1 1 0 1 0 1 0 1 1 0 0 2 2 0 1 1 0	2 2 0 0 2 1 1 0 1 2 0 0 1 2 0 0 2 2 0 0 1 1 1 1 2 0 0 0	0 0 2 2 1 0 1 2 0 0 2 1 1 0 1 2 1 0 2 2 0 0 2 2 0 2 1 2

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