Integrating E-learning and Classroom Learning; Four Years of Asynchronous Learning to improve Academic Competences

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ABSTRACT

In an ever-changing world, competencies to process information efficiently are essential. However, several researchers indicate that graduates have limited abilities to solve complex problems in reality. In this paper, a possible solution to increase competences in effective searching, analysing and comparing information is provided. In a blended-learning environment, students had to share information before coming to class. The results of an analysis of four consecutive years of computer-supported learning in a master-course indicate that students are willing to share information when conditions are favourable. In addition, a specific redesign of the task, control and social dimension let to increased knowledge sharing. Future research is necessary to assess whether this also has increased performance.

Keywords: e-learning, blended learning, academic competences, CSCL, PBL.

1. INTRODUCTION

In a world of increasingly complexity and information abundance, it is crucial for future professionals to have skills in finding, analysing and processing information from various sources in order to solve problems. In addition, competencies like critical thinking, continuous learning and reflecting are vital. However, some researchers argue that most business education institutes focus on training (future) managers in the use of theoretical models and analytical skills [1,2]. When confronted with practice, most graduates realise that theoretical models and their competences are insufficient to solve problems in real business life. For example, Arts et al. (2006)[2] have found that managers in their first years after graduation perform only slightly better than students in 2nd and 3rd year of study. Only after a couple of years of experience are managers making superior management decisions.

Higher education has been criticised for not adjusting its curricula to modern demands of society, whereby students apparently lack competences and (meta)cognitive skills to solve unknown problems. Kember et al. (1997) [3] indicate this might be due to the fact that graduates lack deep learning approaches. According to Nijhuis et al. (2005) [4], *deep learning* is "associated with an interest in the learning task, searching for meaning in the task and integration of task aspects into a whole". They argue that most students use a combination of deep and surface learning. The design of a curriculum and in particular the pedagogical approach influences the way in which students apply academic competences and use different learning strategies to solve a particular problem.

According to some researchers [5-8], one pedagogical approach that might be particularly suited to enhance academic competences and potentially deep learning is Problem Based Learning (PBL). In the last decades, an increasing number of institutes have adopted the PBL-method as main pedagogical approach. Although PBL is intended to enhance critical thinking and deep learning, most researchers find ambiguous results when comparing PBL to traditional classroom teaching [4,9].

In this paper, a specific redesign of authentic PBL completed with ICT will be analysed in order to stimulate students to search, find and share different articles, opinions and viewpoints. Several researchers have conducted experiments with sharing of knowledge using asynchronous online tools [10-12] in a blended-learning environment. As far as we know, limited research has been done in order to measure the (learning) effects of blended-learning for several years in a row. In this paper, four consecutive years of blended-learning are analysed. A Master course was redesigned in two phases of two years each: one phase of using a typical asynchronous online tool (discussion board) with small groups; and a second phase of using a discussion board specifically designed for PBL with larger groups. The redesign mainly focused on three elements: first, to stimulate students to find their own materials to solve problems; second, to stimulate students to share more sources and information with peers before the class meeting; and finally, to critically assess which information offered by students during discussions is most suitable for solving the task. Therefore, the following question will be tackled in this paper: How can a blended learning course be redesigned in order to induce sharing of knowledge with peers?

2. PBL IMPLEMENTED IN CLASS

Gijselaers & Schmidt (1990) [5] have identified three key variables in PBL that explain cognitive and motivational learning outcomes, namely: quality of PBL-problems; student characteristics; and skills of tutor. In turn, these variables influence the tutorial group process, number of self-study hours and learning effects. Their research showed that the role of the tutor and the task-design is essential for the learning process. More recently, Arts et al. (2002) [13] have shown that the variables of task-dimension, control and social dimensions are important in explaining cognitive and motivational learning outcomes in a problem-based learning setting.

The *task dimension* is divided into instructional procedures, problem descriptions and data sources. According to several researchers [6, 14], problem selection is the most influential component that affects the group process and learning activity. According to Gijselaers (1995) [5], tasks should be "ill-structured", whereby an obvious answer to a problem in the task is not immediately clear. In this way, students are trigged in activating prior knowledge. If the group is incapable of

answering the task, each member of the group searches for additional information and discussed his/her findings in the next meeting (post-discussion phase). In this way, group members profit from different views and insights within the group.

Recent research [4, 9, 15] indicates that students find it difficult to share views and insights with each other. For example, De Grave et al. (1996) [9] argue that, in several PBL curricula, brainstorming in the pre-discussion phase is poor. A possible explanation for this poor brainstorming is the selection of the particular task. In addition, due to expanding number of students enrolled in higher education, most institutes adjusted the traditional idea of PBL in order to prevent a cost-explosion. Most tasks have become well-structured, focussing on analysing and applying theory, calculus and asking for clear (unique) answers [4]. In addition, some courses have pre-described required readings, in contrast to the original idea of PBL where students had to find their own sources.

Why are teachers "deviating" from the traditional PBL model of finding own sources? First of all, most students find it difficult to search for information themselves without explicit guidance. Second, when considering large scale courses, offering sufficient copies of articles/books with contrasting viewpoints at the library becomes unpractical. Third, assessment of knowledge is "easier" to implement for a teacher if all students have read the same material. Therefore, most groups focus on explaining what is said in e.g. chapter 12, paragraph 4 rather than trying to connect different concepts, criticising or finding alternative viewpoints.

As some PBL-courses pre-determine the required literature, ask for unique solutions to problems and have assessments that focus on reproduction of knowledge, students adopt a learning attitude focussing on surface rather than deep learning [4]. The *control dimension* of PBL, the degree to which students themselves can decide what, how and when to learn, has therefore become low. However, various researchers have argued that a higher degree of student control leads to more active, independent and motivated students.

The *social dimension* of learning is crucial in order to ensure that students can benefit from insights of group members. Solving learning tasks together with fellow students, in comparison to individual learning, has a positive effect on individual cognitive performance [6, 8]. One limiting factor in beneficial mutual knowledge sharing is a lack of *common ground* [16]. When an individual learner has a lack of knowledge, skills or differences in prior knowledge among members are large, neither the group nor the individual learner can benefit from knowledge transfer.

Besides the importance of appropriate design of the learning environment (task dimension, control dimension, social dimension), Bromme, Hesse & Spada (2005) [17] argue that in groups an *unshared knowledge barrier* might arise that can hamper constructive group learning. Not all students have an incentive to share knowledge with their group [6]. In traditional PBL, students search for information after the pre-discussion and report their findings in the post-discussion of a task. However, the incentive to share knowledge with peers might be minimal. "A potential knowledge provider has no private benefit from contributing, because she has the information anyway, independent of whether she contributes or not" [18]. A so-called *public-good problem* can occur, where despite the fact that an individual benefits from the public good (in our case group learning), his personal benefit to contribute to the group learning process is smaller than his individual costs. If all individuals follow this paradigm, no one will contribute to the construction of group knowledge. Alternatively, when some (altruistic) group participants do search for articles and share information with group, others can benefit from their efforts without that the altruistic participants get something in return (free-rider problem).

3. PROBLEMS WITH IMPLEMENTATION OF PBL

The problem of overcoming barriers to sharing of knowledge might be tackled by specifically redesigning how PBL is implemented. For example, specific redesigning of PBL with use of ICT has lead to some promising results, where students have performed better on final exam [13] or were more motivated to continue to study as they collaborative worked online [19].

A first problem to be overcome the tendency of teachers to pre-describe a standard textbook or a list of fixed references, thereby hindering possible learning effects of students discussing different viewpoints. A possible solution is using the internet. Internet offers an almost infinite amount of sources, which do not cause congestion at the library, but do allow for different viewpoints, multi-media visualisations and (potentially) rich discussions in class. In addition, search-engines allow for rapid finding, comparing and analysing. Finally, several cutting edge research activities are first published online and only later in books.

A second problem mentioned before is a lack of willingness to share information (public good problem). However, there are several ways to reduce this problem. First of all, by offering reward (positive feedback, participation grading) to students, the benefit of sharing knowledge to other group members increases. In addition, if in the learning environment each contribution can be assessed on its merits (as well as free-riding behaviour), the costs of contributing lowers. In a virtual learning environment (VLE), students have several possibilities to easily share knowledge [19]. In addition, in *Computer-supported Collaborative learning* (CSCL), researchers (e.g. [10-12]) analyse what the most efficient way of knowledge sharing in a blended or virtual environment is. A frequently used tool is an asynchronous discussion board, where students can post messages, attachments and relevant links and react to each others contributions. When students are encouraged to share their sources and findings in a VLE, others can (potentially) benefit from activities of others. As a discussion board visualises who has contributed and who has not, an easy mechanism to identify free-riders becomes available for students and teachers.

A final problem is that some students are unable to critically assess which idea or article is relevant, what the weak points of an argumentation are and how it relates to different concepts. As a result, if students do find a lot of alternative sources and come to class but are unable to find common ground [16] or are unwilling to share knowledge [17], the benefit or discourse is reduced. If students are required to share their construction of knowledge in a virtual learning environment, the public good problem of knowledge sharing might be reduced. At the same time, by searching for possible connections between various ideas, concepts and theories, deep learning might be supported or enhanced.

4. REDESIGN OF PBL USING ICT

In a graduate course taught at Faculty of Economics and Business at Maastricht University, students were required to actively find, share and combine various concepts and ideas. The course Network Economics is a multi-disciplinary course, taking elements from economics, business, informatics, graph theory, social network theory and biology. Therefore, the course provides an excellent opportunity to share different viewpoints as all students can contribute with parts of their (diverging) prior knowledge.

First, the task structure was redesigned. *Tasks* were written in an open-ended, ill-structured form without explicit required literature, in line with Gijselaers (1995) [6]. Students were expected to brainstorm on the task online as recommended by Arts et al. (2002) [13]. At the same time, students had to search information for themselves using Internet and had to share their research findings with their peers in an online community. Afterwards, in class the students reflected on their findings and tried to connect the different concepts, articles and viewpoints. As an encouragement to share information, 10% of the final grade was based on online participation.

Second, the set-up of the course allowed for more *control* of the learning process by students than in comparable courses that were previously followed. The members of the group decided both online and in class in which direction the discussions were going. The topics discussed by the group members during the online brainstorm and pre-discussion phase largely determined the direction of the discussions in class.

The *social dimension* was changed in a manner that students pre-discuss the task, find and share literature. The assumption was that students can profit more from prior knowledge of peers if they have more time to reflect. In addition, more time in class will become available for thorough and elaborate discussions. At the same time, as students are stimulated to submit and challenge multiple ideas in the online environment, the group will be stimulated in class as there are more viewpoints to a solution of a task, thereby increasing cognitive and motivational aspects.

5. METHODOLOGY

In a way, by offering two networks instead of one (one online and one class-network), the PBL system was redesigned as a *Network PBL* (N-PBL). In order to analyse the structural effects of N-PBL, the effects will be measured by following the redesign of the course Network Economics in four consecutive years. In the period 2003-2006, more than 200 students were enrolled. In order to prevent any effects by comparing results from different instructors, in this paper we will only use data from groups taught by one tutor. This tutor has taught for all four consecutive years and had two groups of +/- 12 students per course per year. He is an experienced tutor and has already taught the course before the redesign. In the year 2003, a standard discussion board (Blackboard) was introduced as a tool to facilitate the movement of the pre-discussion and knowledge sharing to an online environment. As the effects of implementation of a redesign take time [4], the same design was used in 2004. We therefore refer to these two years as the *phase I redesign of N-PBL*.

According to Kirschner et al. (2004)[10], the design of an asynchronous learning tool is crucial for the performance of a group. Therefore, in the years 2005- 2006, the groups used a programme designed especially for PBL, called Polaris [19]. The tool is scaffolded in such a way that students are required to fill in a subject, context of message and the main question/answer. In addition, the students can indicate whether the message is a discussion or a supplement and add attachments and references in a separate field. In order to increase social awareness and at the same time reduce potential free-riding behaviour, the forum shows who has (not) read a particular message. Finally, students can indicate with a so-called "agree-button" whether they agree with a particular statement. In this way, students can easily see which messages/articles received most positive feedback. A second redesign was the adjustment of the group size of the online network. In 2005-2006, the two groups of the tutor were merged together for the online part, while the groups were still meeting separately in the face-2-face regular classes. We therefore refer to these two years as the *phase II redesign of N-PBL*.

All messages in the discussion boards used in these four consecutive years were saved for later analysis. In particular, the number of posts, the number of references and the number of attachments containing articles were analysed. In addition, for the groups using Polaris, also the number of reads and number of agrees were analysed.

6. RESULTS

The redesign of PBL into N-PBL led to five results. First of all, after the introduction of an online discussion form, which enabled the students to communicate with each other during the independent learning phase (phase I of redesign), the number of messages containing one or more references increased from zero to an average of 2.7 per student in 2003 (see table 1). Besides references, students were also able to add attachments. Although these attachments mostly were articles of journals, they also contained information created by the students themselves (for instance a summary of an article or a presentation). In 2003, the average number of messages per student containing an attachment was 4.8. The average total number of messages per student in 2003 was 9.8. In the second year of phase I, the number of messages with reference and total number of messages posted per student were similar to those in 2003. Although the number of messages with attachments declined in 2004, this decline is insignificant at an Independent Sample T-test at 5% level ($F = .061$, $t = 1.886$, p-value = 0.066). We therefore can assume that the outcomes in years 2003 and 2004 are similar and therefore can be aggregated.

Second, the redesign of PBL in 2005 (phase II), where a discussion form designed especially for N-PBL was used and the group size was increased, led to more knowledge sharing. In fact, the number of messages containing one or more references tripled, from 2.4 on average in 2003-2004 to 8.4 in 2005. In addition, the total number of posts increased from 11.4 on average in 2003-2004 to 34 in 2005. The number of messages with attachments increased only slightly. In the second year of phase II, the number of messages with references, attachments and total messages remained on average the same. Although the standard deviation is large, an independent sample T-test of 2005 vs. 2006 confirms that the sample is similar; therefore we can aggregate both years together.

Table 1 Mean number of messages with reference(s), messages with attachments, and posts per student

Year		Messages with reference(s)	Messages with Attachment(s)	Total # Messages
2003	Mean	2.7	4.8	9.8
	N	23	23	23
	SD	2.4	3.7	6.4
2004	Mean	2.2	2.7	13.0
	N	25	25	25
	SD	3.0	3.8	14.5
2005	Mean	8.4	3.9	34.0
	N	22	22	22
	SD	10.0	5.7	39.0
2006	Mean	9.9	3.4	34.4
	N	16	16	16
	SD	8.1	3.5	28.5
Total	Mean	5.4	3.7	21.5
	N	86	86	86
	SD	7.2	4.3	26.8

Third, when comparing the phase I (standard discussion forum, average group size ≈ 12) with phase II of the redesign (PBL discussion forum, average group size ≈ 19), it is clear that more knowledge is shared in phase II. The average number of posts per student increased from 11.4 to 34.2 and this change is highly significant (F = 24.870, t = -4.270, p-value = 0.000). The average number of messages with references posted by a student increased from 2.4 to 9.1. Again this increase is highly significant (F = 46.076, t = -4.742, p-value = 0.000). As is already clear from table 1, the number of attachments posted by students has not increased.

Finally, the distribution of the number of messages within the network of students has changed over time. Figure 1 depicts a histogram for the aggregate number of posts in phase I. The majority of students post between 0-20 messages during the course. There are a couple of frequent contributors, posting 20-50 messages. Nonetheless, the distribution of figure 1 is like a normal, yet right-tailed bell-shaped curve.

In contrast, the distribution of number of posts in phase II is shifted to the right and the standard deviation has increased in figure 2. Three groups can be identified: one group posting 0-20 messages, one group posting 20-60 messages and a final group posting 80-140 messages. The first group of low-contributing students in phase II is smaller than in phase I. The middle group of 20-60 posters is similar in both phases. Only in phase II a group of high-contributing students has emerged. The distribution of messages with references is similar to those of total posts. In contrast, distribution of the messages with attachments is very similar in both phases. 15 students did not post any message in phase I whereas only one student did not post any message in phase II.

Figure 1 Histogram number of posts in phase I (2003-2004, n=48)

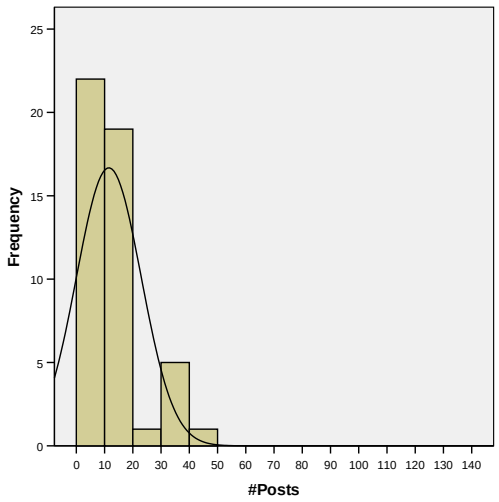
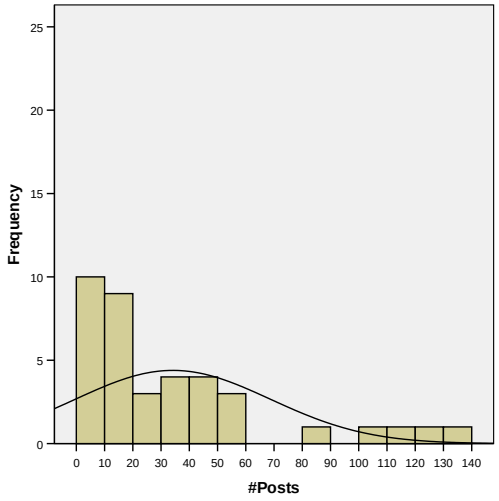


Figure 2 Histogram for the number of posts in phase II (2005-2006, n=38)



7. DISCUSSION

In a Network PBL (N-PBL), students can share knowledge with their peers both in an online as well as face-2-face environment. The results of four consecutive years of discussion-board usage in a blended learning environment seem to indicate that an increased usage in phase II of the redesign of the master course has occurred. In phase II, a discussion form was implemented which was designed especially for PBL as well as the size of the group increased in comparison to phase I. The total number of posts shared in both years in phase II are significantly larger than the total number of posts shared in the two years before. In other words, the willingness to share information increased when the discussion board is redesigned to the specific characteristics of the learning environment.

Despite the fact that redesigning a PBL-course to N-PBL led to more active knowledge sharing, the question remains whether this is due to the redesign of the course or whether other parameters have changed as well. First of all, the technology to search for good references has also changed; Scholar.Google.com and other tools are now available to everybody with internet access. Secondly, it might have been the

case that students in years 2005-2006 were more familiar with computer-supported collaborative learning environments. Thirdly, to what extent the students are able to critically assess which information is most suitable for solving a task is beyond the scope of this article. Finally, the question whether increased sharing of knowledge let to higher cognitive learning will have to be researched in the future.

Additional research should be conducted to verify that the results we show are explained by the changes in the design. Although individual students are unable to individually assess all information critically, we assume that collectively the group of students can. The data and literature study relevant to this hypothesis will be published in future research.

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