Using EPO to Stimulate Learning in the Health Sciences

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ABSTRACT

Maastricht University is renowned for its use of Problem Based Education as the primary educational form. This form of education was implemented as the primary educational model at the university's inception in 1976 and is still the basis for most education twenty-five years later. Although PBL has been immensely successful (Schmidt, 2001) it also has its drawbacks. Two major drawbacks are the paucity of 'real' collaboration and the 'downward' spiral of diminishing time on task possibly due to habituation. This article describes an educational experiment aimed at implementing a different type of education Project Centered Learning (PCL) for part-time students at the Health Sciences faculty supported by an Electronic Project Environment (EPO in Dutch). The results show that PCL is a good educational method for third year students in the Health Sciences and that the EPO offers a valuable support to the group work of these students who live all over the country. The study also reveals some aspects of PCL and EPO that need rethinking and possibly revision in further experiments.

Keywords

Collaborative learning, Project-centered learning, Computer Supported Collaborative Learning, Distributed learning groups, Part-time students, Health Sciences

Acronyms

PBE: Problem Based Education; PCL: Project Centered Learning; EPO: Electronic Project Environment [Dutch: Elektronische Project Omgeving]; MU: Maastricht University

INTRODUCTION

Problem Based Education (Barrows & Tamblyn, 1980) has been the central tenet of education at Maastricht University (MU) since its inception. It is based upon the idea that students should cooperate with each other in small educational groups in determining the learning goals while solving real life problems via a standard heuristic called the 'seven jump'. This approach has borne fabulous fruits for the students and its graduates (Schmidt, 2001) as well as for the university (Leeuwen, 1999). While still successful, it is beginning to show signs of aging. Students are becoming tired with the 'ritualistic dance' around the 'seven jump'. Teachers and departments are becoming aware that not all domains can be adequately served through asking students to solve fairly small and well defined, often convergent problems. Educational designers are beginning to question whether this objectivist vision still fits in the present and future world where the shelf life of knowledge is becoming increasingly limited. At the same time the amount of new information has increased so spectacularly that people must rely more on others to find the relevant information for solving new problems. To make thing even more complicated, these new problems are usually ill defined or even wicked (Rittel & Webber, 1969; Conklin & Weil, 1997), requiring excellent group decision-making skills.

An alternative, though in many respects similar, approach adopted at Knowledge Engineering department at MU is Project Centered Learning (PCL). PCL activates students to learn both the content and the processes (epistemology) of their chosen field by having them work collaboratively in teams on a project to deliver a product within a well-defined time span. The set-up is an embodiment of situated learning. Students are placed in authentic learning situations where they are expected to make use of the knowledge that they already have or that they gain in the course to work on projects similar to those that they will encounter upon graduation while working in their chosen profession. Not only are the projects authentic, but also the work situation is authentic. Students work in teams

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performing the roles that they would perform if they were actually in a working environment. The projects are, in essence, the motor driving student learning. They are the vehicles that allow and stimulate students to:

- *search*: to orient themselves in a situation and to analyze it so that they can identify and represent the actual problem;
- *solve*: to gather and choose relevant information, synthesize and generate solutions, make a choice as to the best or most adequate solution;
- *create*: to actually create a product; and
- *share*: to actually communicate findings in the form of a report, a presentation, an article, and so forth.

Salomon (1991) defined three major components of collaboration, namely sharing, interdependency and involvement. Brush (1998), reviewing successful strategies for collaborative learning reported in the literature also found three key components present in successful collaborative learning, namely positive interdependence, individual accountability, and collaborative skills. *Positive interdependence* is "the perception that you are linked with others in a way so that you cannot succeed unless they do (and vice versa); that is, their work benefits you, and your work benefits them" (Johnson & Johnson (1991, p. 127). This can be achieved, for example, by assigning unique roles to each member and/or by designing a learning task in such a way that it needs the participation and contributions of each member in order to complete the task successfully. *Individual accountability* means that each of the member's individual performances contribute to the determination of the group reward rather then it is based solely on the overall group performance leaving out the individual contributions. *Collaboration skills* are those skills needed when learners are learning within a group.

Although both PBL and PCL make use of sharing, they share in different ways. Sharing can be perceived of in the sense of possessing content in common where all participants have the same things (as in: we share common goals) or in the sense of distributing content across people/groups where different participants may possess different things (as in: we share the responsibility or we share an orange). PBL is an example of the former whereas PCL is an example of the latter. They also differ with respect to interdependency and involvement. In PBL, the total result of the group is not really dependent on any one of the members. All of the students are carrying out the same tasks (defining the goals, searching for resources, solving the problem). If one or more students don't do their work, the team as a whole doesn't suffer. Furthermore, the final grade for the course is based upon a final examination and not on a product that the group produced. In PCL the students fulfill different, interdependent roles and carry out different tasks. If one student does not do his or her work the group suffers in its work (process) and in what it delivers (product). Finally, since each of the student's has different responsibilities for different parts of the whole, there is a stronger measure of individual accountability, thus making free-rider behavior less likely.

This contribution describes an experiment in which a commercially available electronic project environment was used to facilitate this project-centered approach with two groups of third year part-time students at the Health Sciences faculty at MU. The primary goals of the experiment were to *increase collaboration* between geographically dispersed part-time students (some of whom work in shifts), to encourage increased and more *active studying behavior*, and to *reduce* the number of *campus based meetings*.

Part-time students are geographically dispersed and work differing shifts, and therefore do not have many opportunities to work with other members of the group in-between the meetings. They also only meet once a week as opposed to the normal twice a week meetings of the full time students. One of the effects noted (anecdotally, though not empirically researched) is that students tend to postpone their individual work until the end of that week, often in the train on their way to the meetings and have hardly any contact with each other between the meetings. Not only does this restrict the possibilities for collaboration, but it also erodes the amount of time spent studying (Van Berkel & Van den Hurk, 2001). To stop this erosion process and to encourage collaborative learning the Health Sciences faculty decided to experimentally introduce PCL for its third year part-time students.

To support these geographically and temporally dispersed students, a tool was sought that could support teams working in projects at any time and from any location, requiring only a MS Windows based PC with an Internet connection. Prior to selecting a tool, a functional analysis based upon CATWOE – a soft systems methodology developed by the University of Lancaster (Checkland, 1981) - was performed of the tasks and activities in project-centered learning (Kirschner, Plugge, & Lutgens, 2000), including the tasks and activities of the tutors guiding the group. Based on these findings Projectplace™, a commercially available electronic project work environment, was selected (http://www.projectplace.com). This environment is based on the Basic Support for Cooperative Work project of the German National Research Center for Information technology. (Appelt, 1999; Bentley et. al, 1997)

METHODS

Participants

Twelve third year part-time students from the Health Sciences faculty (3 males, 9 females) took the course *Making decisions about healthcare*. The students were randomly divided into two groups, each consisting of six persons. Group 308 (who named themselves *Breathless*) consisted of four females and two males. Group 309 (*E-Team*) consisted of five females and one male. Additionally, a tutor and a technical assistant was assigned to each group. Breathless had a faculty member and the E-Team a senior Health Science student as tutor. The technical assistants were faculty members from the department of Medical Informatics. None of the participants had worked in a project environment before. All students - except one - had a personal computer with Internet at their disposal. The student lacking the facilities was provided with equipment for the duration of the experiment.

Project environment

The project environment (Projectplace™) consisted of a personal and a group space. Although students could use the personal space, only the group environment was investigated during the experiment. The group space contained a document archive, discussion forum, project calendar, task and Gantt planning facility, contacts, participant's directory, wastebasket, group announcements, and web based help system. The 'owner' of the group also had an administrative tool available. All participants had round the clock support by the environment's provider. The environment is accessible through a web browser, with additional drag-and-drop support for users with Microsoft Internet Explorer. In addition to the project environment, the participants were expected to use their regular email account and their personal applications for document editing.

Educational Design

The original problem based course was redesigned to conform to a project centered approach. The modifications consisted mainly in defining three subprojects (replacing the traditional problems), of which the final project also required an integration of the previous two subprojects. Each subproject ended with a joint report and an oral presentation by the members of the group. No changes were made in the supporting literature. The course lasted for 64 days; each subproject approximately 3 weeks. The meeting schedule was changed from once every week to once every two weeks. All meetings took place on a Friday.

Since PCL was aimed at group collaboration and the distribution of tasks, the assessment method was changed into a group and individual assessment. The course chair judged the report and the presentation to assess group performance, and the individual reflection reports to evaluate each participant's contribution to the group work.

Measures

To evaluate the experiment, three measurements took place: pre-experimental, intermediate, and post-experimental (all questionnaires). Each questionnaire were used to measure distinct aspects of the experiment and were not intended as repeated measures. They were intended as measurements for comparison with two future experiments as well as comparison with previous PBL courses.

Pre-questionnaire

The first questionnaire consisted of 44 items (4 binary and 40 5-point Likert-scale items). Of the Likert-scale items, 20 were taken from the Computer Attitude Scale (CAS) (Nickel & Pinto, 1987), and 12 from the Computer Understanding and Experience Scale (CUE) (Potosky & Bobko, 1998)

Intermediate questionnaire

The intermediate questionnaire consisted of 22 open reflective questions to formatively evaluate the course with respect to educational design, group collaboration, group and individual portfolio, supervision, electronic project environment, electronic course book, work load, and questions concerning their general opinion.

Post-questionnaire

The post-questionnaire consisted of 137, primarily 5-point Likert-scale, questions on general educational topics, preparatory information to students, educational design, project assignments, collaboration, portfolio, supervision, computer facilities, electronic course book, workload, preferred study location, and general open questions.

Environment Activity Log

Additional to the questionnaires, data was gathered from the daily activity logs produced by the electronic project environment. The log contained items such as: section used (forum, archive, etc.), activity (reading, posting, replying, etc.), the persons name, date and time of the action, title or name of the object handled.

RESULTS

Pre Questionnaire

None of the students had studied the topic of the course before, but all were interested in the subject ($M = 4.64$, $SD = .50$)[2]. Few had experience working together on a single end product ($M = 1.73$, $SD = .43$), and had been judged on a group product ($M = 1.55$, $SD = .52$). Furthermore, none of the students had experience with portfolio assessment. The level of willingness to help and cooperate with other students was high ($M = 4.45$, $SD = .52$), and students liked the idea to try out a different educational form ($M = 4.45$, $SD = .52$). Finally, students also liked having control over their own study approach ($M = 4.55$, $SD = .69$). This seems to contradict the willingness to collaborate with their peers, which diminishes the opportunities to control your own study approach.

Table 1 Result of the CAS and the CUE

	N	*min*	*max*	*M*	*SD*
CAS negative attitude	12	1.31	3.15	2.27	.56
CAS positive attitude	12	2.86	4.29	3.64	.41
CUE self assessment	12	1.92	3.25	2.59	.46

A paired sample *t*-Test showed that the students had a significantly higher positive than negative attitude towards computers ($t = -7.097$, $df = 11$, $p < .0001$). The students also regarded themselves as moderately experienced with computers. No student regarded her/himself as computer illiterate or expert.

Intermediate Questionnaire

The results of the intermediate questionnaire showed that there were no pressing problems with the set-up of the experiment. Students reported that the groups functioned well after initial problems of finding proper procedures for decision-making, communication, making appointments, and assigning tasks. All students reported having to break with their normal routine due to the educational set-up. As one student remarked: “I can no longer plan my own schedule on the basis of my work roster, it’s almost the other way around. I’m now dependent on the group planning. That means a different rhythm and sometimes more time pressure.” The interdependence was also evident on the content of the study: “If someone in the group studies in a different way, or with less depth, you now notice that more than with PBL”. Students also noticed that making decisions or reaching consensus is much more difficult electronically than face-to-face. For this reason, both groups decided to plan weekly meetings again, only this time they themselves could decide on the place, time, and topic.

Post Questionnaire

With respect to the post-questionnaire, we will limit ourselves to the most salient results. These will be grouped around the following topics: general information, educational model (PCL), the projects, collaboration, and the project environment. Where possible, the results will be compared with the answers of previous generations of students who had followed the course when it was in its problem-based form.

General

Part of the post-experiment questionnaire consisted of general questions about the course as a whole. These questions are important to determine the general position of the students and to be able to compare some aspects of the study with an earlier variant of this course in PBL form. Table 2 shows the results of some of the general questions, along with the student appraisal scores available from the earlier PBL version.

As stated earlier, the type of task students are expected to carry out in PCL (produce a group product – in this case a policy paper) is more complex and less well defined than those in PBL (defining the learning objectives based upon a case description and then achieving them through independent study and discussion). Judging by the results (item a), and compared to the PBL version of the course from the year before this is definitely true. Important here is that

[2] Scale runs from 1=strongly disagree to 5=strongly agree

the students found what they studied to be highly useful and felt that they had learned a lot (more than the previous PBL cohort). Finally, their positive judgment with respect to the content and relevancy notwithstanding, they did not say that the present set-up made it easier for them as part-time students.

Table 2 Results with respect to the general questions (1 = strongly disagree, 5 = strongly agree)

		N	*M*	*SD*	*PBL*
a)	The learning objectives were clear from the beginning	12	2.33	.49	4.0
b)	The things studied are useful for my education.	12	4.92	.29	-
c)	I learned a lot	12	4.75	.45	4.3
d)	The content was difficult	12	3.50	1.00	-
e)	The subjects covered were interesting	12	5.00	.00	-
f)	The block was well organized	11	3.00	.89	4.0
g)	The set-up made it easier for me as part-time student	12	1.42	.67	-
h)	This block cost me more time than I had expected	12	4.42	.90	-

(- means: not available)

Finally, the amount of study time was significantly higher with PCL: 20.13 hours per week (*SD* = 3.1), of which 8.25 hours in the EPO (*SD* = 3.3). For the same course in PBL in the previous cohort this was 10.5 hours per week. This shows that the EPO played a crucial role in the additional time spent.

Educational model (PCL)

The students were very positive about PCL. The reader must remember that MU students are not traditional students who follow traditional education. These third year students already had two years of PBL, seen by many as an innovative form of education itself. Table 3 presents the most salient results with respect to the model.

Table 3 Results with respect to the educational model

		N	*M*	*SD*
a)	I enjoyed the block.	12	4.08	.79
b)	PCL stimulated me combine theory and praxis	12	4.42	.67
c)	PCL motivated me	12	4.08	.51
d)	I appreciated using PCL as an alternative to PBL	11	4.64	.50
e)	I experienced the study load as higher than that in PBL.	12	4.75	.87
f)	PCL appeals more to relevant professional skills than PBL	12	4.58	.79

These results clearly show that the students enjoyed PCL as an alternative to PBL. It motivated them and stimulated them to combine theory and praxis, and it also appealed to more professional skills than PBL. As intended, they also considered the study load to be higher than in the regular PBL.

The projects

As stated earlier, the projects used were larger, more complex, and meant to stimulate discussion because they were less well defined and more complex than the problems traditionally used in PBL. Table 4 shows the appraisal by the students with respect to a number of items meant to determine whether this was actually the case.

Table 4 Results with respect to the projects

		N	*M.*	*SD*	*PBL*
a)	The size of the projects was not a problem.	12	2.08	.79	-
b)	The projects stimulated discussion	12	4.33	.49	4.0
c)	The projects stimulated independent study	12	4.17	.49	-
d)	The projects were stimulating	12	4.33	.65	-

The students clearly experienced the size of the projects as a problem. An often-heard complaint was that they found it difficult to adjust their ambition to the available time to complete a subproject, i.e. reduce the scope. However, the students found the projects stimulating and that they encouraged ample discussion. Interestingly, the students also believe that the project stimulated independent study, even though they were all very dependent on each other.

Collaboration

As stated earlier, a major difference between PBL and PCL is that PCL should stimulate a type of sharing in which different participants fulfill different roles and work together to achieve a collective end-product (interdependence, accountability). Table 5 shows the opinion of the students with respect to the collaboration.

Table 5 Results with respect to the collaboration

	N	*M.*	*SD*
a) I enjoyed the collaboration	12	4.25	.97
b) In each subproject the roles were clear to me	12	4.42	.90
c) All three projects came to a successful completion	12	4.08	.90
d) Everyone in the group participated actively	12	4.17	1.19
e) The collaboration was motivational.	12	4.50	.67
f) I disliked being dependent on others	12	3.92	.90
g) Physical contact was also needed for successful collaboration	12	4.83	.39
h) I appreciated not having to attend a group meeting every week	12	2.33	1.15

The results show that the students enjoyed the collaboration and found it motivating. They also felt that everyone in the group participated actively and that the projects were completed successfully.

The students were convinced that physical contact was also needed for successful collaboration (item g), and that they would rather keep the weekly group meetings, instead of the bi-weekly meetings. This shows that the students feel that electronics should *not replace* face-to-face meetings, but should be used as an *additional* means of collaboration. This was also what they did after just one week: both groups independently decided that they would meet every week, albeit not on the campus, but at the home of one of the participants.

Table 6 Results with respect to the environment

	N	*M*	*SD*
a) Learning to use ProjectPlace (PP) was easy	12	4.17	.83
b) PP has a clear layout	12	3.92	.79
c) Using PP is efficient	12	3.25	1.22
d) PP aided my productivity	12	3.17	1.19
e) PP allowed me to work when I wanted to	12	3.67	1.15
f) PP requires me to plan my activities better	12	3.83	1.19
g) PP is handy to communicate with team members	12	3.92	.79
h) The following facilities aided working in the projects:			
– PP Discussion forum	12	4.83	.39
– PP Document archive	12	4.83	.39
– PP Planning system	12	3.83	1.34
– PP Agenda	12	2.08	1.24
– PP Wastebasket	12	2.08	.90
– PP Daily report	12	1.83	1.03
– Email	12	3.83	1.34
i) PP misses the following functions:			
– showing who is on line	12	4.25	.75
– off-line working possibilities	12	4.25	1.22
j) Without PP it would have been just as easy to work on the projects	12	1.92	.79
k) Email is enough to support PCL	12	1.92	.67
l) It was useful to work with PP	12	4.50	.52
m) It was fun to work with PP	12	4.50	.52

The electronic project environment

Another important part of the questionnaire was an assessment of the EPO implementation used, i.e., Projectplace™. These questions (Table 6) were inserted to find out which features were important to the students during their project. It was not meant as a product evaluation, but as a means to determine what main features are required for electronic support in PCL.

Learning to use the environment was relatively easy (a). While students did not report a strongly experienced increase in effectiveness and efficiency (c, d) they felt that the environment aided them in doing exactly what the university wanted to achieve, namely allowing students to work together in a distributed way at the moments they themselves find convenient (e) and to communicate with the other students more (g).

According to the students, the most important functions were the discussion forum, archive, planning, and the environment's own email function; the least important were the wastebasket, agenda and daily report. What students would like to see added is a widget to let them see who is on line at any one time. This wish confirms Kreijns & Kirschner's (2001) theory in which they suggest a widget to provide the student with a sense of group awareness about the others in different contexts while at the same time enabling the student to communicate with them. Additionally, the students would like to have the option to work off-line to reduce the telephone costs.

Finally, appreciation of the EPO was quite high (l, m), while the inadequacy of standard tools (j, k) was emphasized.

Activity Log

The daily activity log of the EPO provided information about most activities performed by the students. We mention a few interesting findings here. Table 7 shows the main student activities by group (with their own chosen names). The most frequent activity was reading, followed by writing and other activities.

Table 7 Main student activities

		All			Reading			Writing			Other[3]		
	N	Total	*M*	(%)	Total	*M*	(%)	Total	*M*	(%)	Total	*M*	(%)
Breathless	6	2058	343	(100)	1081	180.2	(52.5)	531	88.5	(25.8)	446	74.3	(21.7)
E-Team	6	1410	235	(100)	725	120.8	(51.4)	375	62.5	(26.6)	310	51.7	(22.0)

Table 7 also shows that the Breathless team was more active in the EPO than the E-Team. This does not mean, however, that Breathless was performing better. It could also be that the E-team was more efficient.

Table 8 Use of EPO facilities by group

	Breathless		E-Team		All	
Document Archive	1104	(53.6%)	749	(53.1%)	1853	(53.4%)
Discussion Forum	726	(35.3%)	474	(33.6%)	1200	(34.6%)
Tasks	211	(10.3%)	167	(11.8%)	378	(10.9%)
Recycle Bin	6	(.3%)	18	(1.3%)	24	(.7%)
Project Calendar	11	(.5%)	1	(.1%)	12	(.3%)
Bulletin Board	0	(0%)	1	(.1%)	1	(0%)
All	2058	(100.0%)	1410	(100.0%)	3468	(100.0%)

Table 8 shows the use of the EPO facilities by each team. The figures confirm the preference of the students also shown in Table 6, i.e. the popularity of the archive, forum, and task planner.

Table 9 Number of forum messages and replies (Students only)

	Postings	Postings with Reply	Replies	Mean Replies per Posting	Maximum Replies per Posting
Breathless	123	67	163	2.43	7
E-Team	82	61	146	2.39	13
Total	205	128	309	2.41	13

Table 9 shows that the E-Team had a significantly lower forum message frequency than Breathless. However, the average number of replies is almost equal for each team. This means, that the Breathless team had more messages without any follow-up, i.e. one-way communication or notification style.

[3] Examples of other activities are: changing a document description, creating, rejecting, reassigning or confirming a task, and moving a document.

Table 10 Average number of actions performed in EPO per weekday by team

	Weekday						
	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Breathless	28.0	35.6	33.6	47.7	43.7	17.4	20.9
E-Team	12.9	30.8	26.2	44.1	22.2	9.7	9.7

The average number of actions[4] of each group per day of the week (Table 10) shows that both teams had their peak activity during the middle of the week, while Friday (meeting day) and Saturday produced the least activity. The table also shows that the Breathless team displayed more last-minute work than the E-Team, i.e. activity on Thursday, the day before the meetings. Furthermore, the data very clearly show that the students are active in the EPO throughout the whole week.

The activity during the project weeks also showed a difference between the two groups (Table 11) The Breathless group displayed a rather constant activity, while the E-Team displays definitive pauses in their work (weeks 14 and 18). These pauses correspond with the start of a new subproject, as in week 11.

Table 11 Number of action performed in EPO per week by Team

	Week								
	11	12	13	14	15	16	17	18	19
Breathless	21	273	301	278	197	250	229	251	256
E-team	21	200	228	98	168	145	224	96	230

DISCUSSION

The results show that the experiment was successful in many ways, while at the same time providing insight into the problems of PCL that need to be resolved.

First, there is the pleasure the students reported about working in teams on a project. They enjoyed working together on an end product, it stimulated them to combine theory and praxis, it motivated them, et cetera. A skeptical reader will now probably say: “This is probably due to a simple Hawthorn effect”. In part, this is probably correct. As the saying goes: *variety is the spice of life*. This means that the positive attitude of the students can be party explained by the so-called Hawthorn effect. Normally, researchers try to eliminate or compensate for this effect. However, in education it is one of the ways to make education a joy for both students and staff. In our opinion, getting people to work harder by paying attention to them is a legitimate means for improving education. In this case, the attention came from both the faculty and the students themselves. One of the positive effects in this experiment was that although the students thought that the course cost them more time than expected, and reported that the study time was higher than in PBL, they reported to have learned more, and that it stimulated discussion more. It also appealed more to relevant professional skills than PBL.

This appeal to relevant professional skills is also a problem in this PCL experiment. The students reported to have learned a lot of practical skills and attitudes that are important, but that the theoretical knowledge acquired was fragmented. This sense of knowledge fragmentation was unanimously reported during an evaluative session with the students. The cause behind this feeling of fragmentation is the division of labor during the project. Each student studied a different part of the subject and had to rely on reports from others. This is very different from PBL, where each student is expected to study all parts of the same subject, the only possible difference being the sources used or the depth of the studying. This was discussed earlier in relation to the two ‘meanings’ of sharing, namely possessing content in common where all participants have the same things (as in: we share common goals) versus distributing content across people/groups where different participants may possess different things (as in: we share the responsibility or we share an orange). PBL is an example of the former whereas PCL is an example of the latter. Modern knowledge management in companies and institutions is rapidly changing to the latter.

An electronic project environment proved to be a very good means of supporting asynchronous collaboration, except for reaching consensus and making group decisions. The results clearly show that the students appreciated the EPO capabilities to exchange documents, discuss problems and plan their activities. However, an EPO cannot

[4] Example actions are: opening a document, copying, writing, planning, etc.

replace the richness and effectiveness of face-to-face meetings, which was **NOT** a goal of the experiment. This is evidenced by the fact that the students reinstalled the weekly meetings on their own initiative. Face-to-face meetings are more suitable to satisfy the social and emotional needs of the team members (Benbasat en Lim, 1993). Physical proximity influences the amount of time required to accomplish a task in a positive way (Benbasat & Lim, 1993; Galegher & Kraut, 1994; Tan et al., 1993). The reason for this is that the use of a less rich medium demands more coordination, and it simply takes more time to exchange thoughts and reach agreement by typing than by talking (Straus & McGrath, 1994). This is supported by Rourke (2000), who remarks that "if students are to offer their tentative ideas to their peers, if they are to critique the ideas of their peers, and if they are to interpret others' critiques as valuable rather than as personal affronts, certain conditions must exist. Students need to trust each other, feel a sense of warmth and belonging, and feel close to each other before they will engage willfully in collaboration and recognize the collaboration as a valuable experience" (no page, html source). Clearly, in this type of short-lived group, physical contact facilitates the achievement of the necessary 'trust'.

It is interesting to note, that the students' mediocre computer skills did not affect their achievements in a negative way. They experienced EPO as a useful tool and fun to work with. In other words, contrary to what is often reported, computer skills are not a dominant factor of success in using an electronic environment.

Finally, the results showed that the students clearly had to get used to this open-ended type of education. They were of the opinion that the course less well organized, but this can at least partly be explained by the fact that they had to learn how to plan their study, they had to spend more time studying, and that it broke up their normal studying routine. This was, however, exactly one of the objectives of the experiment.

CONCLUSIONS

Overall, the students evaluated the general aspects of the course positively. PCL as an educational model, the project work and the collaboration among students were all appreciated highly, as well as Projectplace™ as an electronic learning environment. The experiment succeeded in increasing time spent on studying and in spreading study activities across the whole week. In general then, it can be concluded that this experiment met its objectives. PCL turned out to be a good educational method for third year students in the Health Sciences and the EPO offered a valuable support to the group work of these part time students who lived all over the country.

This study also showed that there is room for improvement. The fragmentation of the acquired knowledge that some students reported, the lack of clarity of the learning objectives in the beginning, and the size of the projects are elements of the educational method that need rethinking and possibly revision in further experiments. This experiment entailed many innovations at the same time, and it may well be that the call on the students' skills of self-direction has been too drastic and may need some systematic and gradual increase in the future (see Vermunt & Verschaffel, 2000).

Some questions remain. For example, this study was done with a relatively small number of part time students who lived far apart from each other. This does not mean that the EPO works in the same way for full time students who often live in the neighbourhood of the university and meet each other frequently in the faculty buildings. A next experiment will address this issue, and is meant to extent and upgrade the present findings. We will build an EPO into a course for a larger group of full time students and study the effects in a similar way as we have done in the current study.

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