Problem-solving in PBL

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ABSTRACT

This project focuses on students' proficiency to learn in a problem-based curriculum. We have developed a series of metacognitive workshops designed to make students more aware of the structure of a fruitful problem-solving rationale. A play exemplifying a condensed low-achieving tutorial was performed live by students, followed by discussions. In other workshops, the students analysed tutorial reports with reference to the problem-solving structure and also tried to write new cases from given curricular goals. The students exposed to the exercises displayed a higher metacognitive awareness than students not exposed and they also felt that their tutorial work had improved. In conclusion, it is desirable to boost students' metacognitive awareness and it is also possible to do so.

Keywords

Malmö University has used problem based learning (PBL) as a pedagogic model for the undergraduate curriculum for dentists since 1990, for dental hygienists since 2000 and for dental technicians since 2002.The curriculum is well established and the Malmö-model (Rohlin et al, 1998) has received great interest among educators all over the world.

The student-directed work in tutorials is the foundation of problem based learning in Malmö. In the tutorial, students identify their needs for further knowledge and formulate their learning goals. It is tutored by a facilitator (in Malmö denoted "tutor") who is a teacher with more or less experience and content expertise. Each course is one semester and covers various aspects of a common theme. The entire curriculum is based on patient problem-cases that cover the various aspects of dentistry. It is obvious that these cases must be well elaborated and relevant to ensure that the desired body of knowledge is gathered by the students. It is also obvious that a great responsibility is laid upon the students together with their tutors to elaborate the cases in such a way that the curricular goals are fulfilled.

From the patient-case, one or several problems are identified that will form the basis for discussion and learning. A couple of hypotheses are formulated that form explanatory theories for the problems posed. The students then identify their learning needs in order to thoroughly verify or falsify their hypotheses. After a couple of days of individual studies, the group again discusses and elaborates upon the solutions to the problems. Remaining questions will constitute further study goals and the basis for seminars.

The problems, hypotheses and study-goals have been sampled in a web-based database. The material regarding Course (semester) 4 has been analyzed with reference to the process of learning rather than the outcome. Generally speaking, most groups seem to function reasonably well from a group dynamic point of view. In addition, the students are well acquainted and trained in the PBL format by the time they reach their fourth semester. Nonetheless, we observed a lack of logic and explanatory coherence between the different steps in the problem-solving process. Learning in PBL is largely hypothesis-driven in that students formulate hypotheses that deal with the problems posed and serve as a base for study goal formulation. It may seem obvious that hypotheses would relate very well to the problems posed and that study goal would relate to the hypotheses but this was too often not the case. In fact, this shortcoming was an all-pervading characteristic of the reports and hence, we assume that it reflects a real problem concerning the work *per se*. These findings support our previous assumptions that the efforts of the tutorial group often render a meager knowledge outcome as compared to what might be anticipated from an educator's point of view and from the primary problem formulations.

We do not know the reason for the problems described above but sometimes suspect that students "perform" because they are expected to and not because they truly feel that they need it for their learning. This might relate to e.g. sub-optimal study techniques of the students, inadequate tutoring by the facilitators, badly formulated problem-cases or a combination of these factors. Irrespective of which, it is a serious problem in a PBL-based education if the tutorial group-based problem-solving do not result in fulfillment of curricular goals. If the students do not trust the group process to give a proper outcome, they will become poorly motivated to participate. As a consequence, students may seek other ways to define their learning goals aiming at making it through the exam rather than to learn what is needed for their future professional life.

It has been shown that student groups guided by experienced teachers perform better than student groups guided by senior students and that the tutor's subject expertise influences student achievement (Schmidt, 1994; Schmidt & Moust, 1995; Groves et al, 2005). Thus, it can be conceived that the tutor has a decisive impact on the outcome of the learning process. Ideally, all student groups are guided by tutors that have sufficient experience, expertise and pedagogic competence. In reality however, this is not the case and there is a continuous turnover of faculty staff. Therefore, we want to create a means by which students become less dependent on tutor performance and can rely more on their own problem-solving capacity.

The work by Ranney and Schank has shown that novice students have difficulties in discriminating between hypotheses and evidence. This may result in poorly formulated hypotheses and hence sub-optimal learning goals. The ability to identify and formulate hypotheses is however a trainable proficiency which may be supported by putting the hypotheses into a context (c.f. Ranney et al, 1994). Thus, we believe that it is worthwhile trying to improve this ability. Hmelo et al (1997) and Van den Hurk et al (2001) have studied and formulated criteria for the quality of student-generated learning issues in PBL. They found that students develop such skills over the years but often tend to define issues that are ambiguous and not very concise. An attempt to deal with this has been reported by Quinlan (2000), organizing workshops with tutors who in turn had exercises in generating learning issues with their students.

In the literature, there is support for a correlation between the meta-cognitive awareness of the students, the quality of their tutorial work and the outcome as measured by knowledge and learning capacity (Hammann & Stevens, 1998; Kincannon et al, 1998; Schraw, 1998; Segers et al, 2003). Hence, it seems worthwhile to try to improve student awareness of cognitive processes. Our intention has been to find a means to make students more aware of this link in such a way that they find it important and worthwhile to change their behavior.

The problems we have identified were probably multi-factorial and could be dealt with on different levels – curricular, teacher, cases, etc – but we chose to concentrate on the students and their perception of the course content. For such an effort to be successful, we assumed that it was important that the process was created by those who were supposed to benefit from it. Students also seem better suited to model cognitive and meta-cognitive skills (Schraw, 1998) and we strongly felt that a student perspective was important in order to create the notion that that the students own the tutorial process. It thus seemed crucial to find committed, self-aware and pedagogically interested students that could recognize the weaknesses of the educational system and the working procedures of the students.

One part of the project dealt with study material, i.e. problem cases. We wanted to revise those so that the students perceive them the way course planners intend. We presumed that good case constructs were essential if students were to become confident and self-reliant in their problem-solving process.

Self-directed and self-reliant learning is one of the corner stones in PBL. Although evidently a prerequisite in the learning context, students often rely too much on tutors and other external influences (e.g. lectures and exams) because they do not have sufficient confidence in the procedure to trust their own problem analysis (c.f Dolmans & Schmidt, 1994). A well-

functioning group process, where students dare to be curious, is important if they are to evolve in their learning and not seek inferior solutions and shortcuts. We have noticed that some senior students are inefficient and have problems getting substantial knowledge if not guided by a tutor. PBL may provide lesser content knowledge (Dochy et al, 2003) but compensate with better learning and retention of knowledge. Hence, it seems important that the learning really is good if PBL is to be justified. The problem of malfunction may be addressed in many ways but we have felt that a major reason for our problems is that the students have a too vague idea of how they should work through a case in order to attain a learning optimum. Therefore, we have focused our efforts on improving the students' meta-cognitive awareness.

Motivation enhances learning (Hammann & Stevens, 1998; Mayer, 1998). In the case of pedagogic discussions that doesn't clearly relate to passing an exam, we felt it even more important to find a form that would catch the students' attention. We decided on a humorous play (James, 2004) with a semi-authentic and thought-provoking dialog.

METHOD

The dental education at Malmö University is 5 years long and based on a PBL concept. We have a yearly admission and classes comprise approximately 40 students with a slight female preponderance. The class that has been the main subject of our efforts has 16 female and 20 male students with an average age of 26 (range 22-39). The project was carried out during their 4th and 5th semesters. Besides theoretical studies, the students have pre-clinical/clinical training for 8 and 16-20 hrs/week during their 4th and 5th semesters respectively.

The aim of the project was to focus on students' proficiency to learn in a problem-based curriculum. The following hypotheses were formulated at the beginning of the project and will be further commented in the Results section:

- Students can improve their learning by developing their problem-solving abilities
- The problem-solving ability of the students can improve by making them more aware of the structure of a fruitful problem-solving rationale
- Teachers will improve as facilitators by enhancing their understanding of students' thinking
- Students' learning will improve if they are given better opportunities to interact/communicate with different resources (disciplinary experts, professionals, other students etc...)
- Letting students revise problem-cases, and thus adapting the cases to a learner's perspective, will enable the students to learn more and better from the cases

The project can be divided into the following periods:

- Forming the project group
- Period of planning
- First seminar: Tutorial play
- Second seminar: Designing a case
- Third seminar: Character of a problem
- Fourth seminar: Case play

- Evaluation
- Implementation
- Reporting

Forming the project group
One or two students from each of the semesters 2, 4, 6 and 8 in the dental education programme were selected for participating in the project group. The students played a decisive role in further planning of the project. At the seminars they, besides acting in the plays, also presented the ideas and purposes of the project and facilitated discussions. Further, the students took an active part in formulating questions for the evaluation form. During the project period more than fifteen meetings, to discuss the progress of the project and to plan seminars, were held.

Period of planning
After the project idea had been were presented, 4-5 meetings were held to discuss on how to best realise and implement the idea of stimulating metacognitive reflection in the tutorials. An analysis of the tutorial reports on the website was made and the questions that were raised in the application formed a base for the discussions:

- How do we formulate fruitful problem-definitions from a case?
- What is a hypothesis supposed to deal with?
- How should a hypothesis be formulated in order to provide an incitement for desired studies?
- What type of learning issues must be set in order to deal with the hypotheses?
- What needs to be elaborated upon when summing up a case?

First seminar - tutorial play
Eventually the first seminar evolved into a play based on authentic material from a former Course 4 tutorial gathered from the website. One major concern when starting the project had been that there were shortcomings in the logic of the problem-solving process. A synopsis was written based on such problems, hypotheses and learning issues without obvious logic coherence together with stereotyped characters. The intention was to make the students recognize the situations and begin to reflect. The play was rehearsed and also recorded on a video by a student from the faculty of Art, Culture and Communication, at Malmö University. He also recorded the group discussions among the students after they had seen the play.

The students of semester 4, in total 36 students, were divided into two groups. For each group the play was performed live. After the play, the students were given some tasks to elaborate on, in groups of 4-5. The seminars were concluded with a general discussion. The film of the tutorial play was shown for the tutors of the course at a separate occasion, where the discussion focused more on the role of the tutor.

Second seminar - designing a case
One thought we had was that if the process was good and the result still had shortcomings, it could be explained by the character of the cases. They are designed by teachers/experts and sometimes they may fail to fully consider the perspective of the students. Our 2nd seminar was based on the idea that if the students were given the goals they would be able to design a problem-case that would be adequately percieved from a student's point of view. Together with

the students in the project group we choose two cases relevant for the Course 4 level. Again, the students were gathered in small groups. The groups were given the objectives of one case each and were asked to write a case either as a play or as written text, aiming at the given objectives. They were then asked to perform or present their cases to each other and to evaluate whether they clearly addressed the given objectives.

Third seminar - character of a problem
The planning for the following seminars took another direction than what was planned from the beginning. As it turned out to be less fruitful than expected for students to design cases, the project group decided to focus on developing students' skills in analyzing their own work in the tutorials. The third seminar gave feedback on the two previous ones by showing the film from the first seminar and then discussing whether the students had changed their performance in the tutorials or not.

When analysing material from many different tutorials we had noticed that the problems either were formulated in general terms or specifically addressing the case. From two different cases, we selected all the problems specified in the different tutorials of one class. One of the cases generated problems that were primarily general and the other one problems that were clearly addressing the case. Previous evaluations had also shown that the case generating general problems had been rated low whereas the other had been well received. For the third seminar, problems from these two cases were mixed and presented to the students who were asked to sort the problems into two categories: general and specific. A discussion with the students, on the impact a problem formulation may have on the problem-solving process to follow, was thus initiated.

Fourth seminar - case play
In the discussions with students, both in the project group and in the seminars, the need for variation had been expressed. Most of the cases are text-based and presented on a sheet of paper, sometimes supplemented with a clinical photo or radiographs. To boost the interest and stimulate work, another play was written. It was based on an existing case dealing with a patient with severe oral pain, and replaced the original paper version. The project group students performed the case-play immediately before the groups started to elaborate on the case in the tutorial.

Evaluation
During the project a specific website for the project has been available for the project group. Notes from the meetings in the project group, tasks for seminars and other documents have been gathered there. The first seminar has been documented by two films: the tutorial play and the group discussions after the play. The students and the tutors involved have been interviewed and the students also filled out a written evaluation form.

The impact of the seminars was evaluated by asking the students to fill out a questionnaire (Appendix 1). The forms were collected during on-going work in the tutorials. Some comments were then also given orally during a short interview.

Two students of the project group have made an additional study on how students learn and deal with their learning tasks. They have compared students at different levels and also at two different dental schools, Malmö and Pretoria, South Africa.

We have assessed the meta-cognitive awareness among the students at the faculty by means of a Metacognitive Awareness Inventory (Schraw & Dennison, 1994). This was done one year after the seminars. Data from this inventory are presently being analysed.

Implementation
The project has been implemented in the curriculum, based on results from the evaluation (see below) and discussions in the committee for undergraduate education at the faculty. A seminar combining parts from the first and the third original seminars has been developed, where the results from the evaluation were taken into account as well as comments from the course director. We used the film version of the tutorial play because it proved difficult to maintain a group of students that would perform the play each year. The seminar has been performed twice since the original experiment and the evaluation strongly support the continuation of these metacognition-stimulating activities.

Reporting
- Parts of the project have been reported by the students on a pedagogic congress, ADEE 2005, Athens, Greece (Appendix 2)
- Parts of the project have also been extended to an elective study of two students, in which they have compared dental students' awareness of their own learning in the dental schools of Malmö and Pretoria, South Africa (to be presented in May 2006)
- The project, as a whole, will be presented at "The Learning Conference 06", Montego Bay, Jamaica (Appendix 3)

Web site
The students have a course specific web site with a module handling tutorial reports. Our intention has been to develop this site. However, during the process and discussions with the students in the project group, the direction of the project changed from working with and analysing the learning management system to discussions in workshops based on web-based material. This change was also due to the overall evaluation of learning management systems that was performed at Malmö University.

RESULTS

First seminar - tutorial play
The tutorial play was attended by most of the students. Our direct impression was that the students had a good time and became enthusiastic in the discussions that followed the play. A film has been made from this seminar. For future seminars, we also made a film out of the play, which was shot separately.

92 % of the students felt that the seminar should become a permanent feature in the curriculum and they expressed comments like:
- "Revealing indeed and funny"
- "I realized what the meetings really are for and that it is important how you act in the group"

- "I recognized all the characters, including myself in the person who wanted to get it overdone with. I have thought about that but probably, I haven't changed very much. It's good to become aware of it though"
- "Gave me many thoughts. Made me aware that the tutorials often are too much a matter of routine"
- "Good. Got some insight in how it really comes about, which one is not aware of when one is in the middle of it"

Second seminar - designing a case

The seminars dedicated to case writing were not successful. To begin with, the seminars were too late in the semester, i.e. too close to the exam, which made it difficult to gather the students. Secondly, the students found it very difficult to construct cases themselves. Our intention was that the students, with their raised conscience about how to elaborate a case, would be able to make a case that would be interpreted such that the curricular goals would be fulfilled. This goal proved difficult to reach. Only 22 % of the students thought that the seminar should become a permanent feature in the curriculum and they had comments like:

- "This didn't give me anything, I just understood how complicated the process is"
- "This wasn't very fruitful"
- "Discovered that it is VERY difficult to write good cases"

The need for revision of cases was however brought up to discussion in the committee for undergraduate education and a plan for handling this task has been delegated to a group consisting of teachers and students at the faculty.

Third seminar - character of a problem

The workshop was rewarding but it was felt that it could be contained within the tutorial play seminar. 83 % of the students felt that the seminar should become a permanent feature in the curriculum and they had comments like:

- "This gave me insight about the difference between problems and learning issues. Valuable discussion"
- "Good to start thinking about how the problem statements may influence learning"
- "Have never thought about how one can express a problem wrongly. This was good, I learned something"

Fourth seminar - case play

The case-play replaced the ordinary case and was performed with all students and tutors present. 79 % of the students found that the live case presentation added important aspects to the case.

- "One gets a better picture of the problem, more realistic. One gets away from putting too much emphasis on words, which one easily does with the written cases"
- "Nice with a change in the case presentation routine"

Implementation
Comments after the tutorial play film were similar as after the first occasion. The overall impression was that the students in all programmes – dental, dental technicians and dental hygienists – appreciated the seminar and regarded it fruitful.

General observations
31 % of the students expressed that they themselves had become more aware of how they worked and how to work effectively in the tutorials. 64 % of the students also felt that that the tutorials had changed and become more effective since the seminars.
The students from the project course valued the tutorial group significantly more than the students in the senior students that hadn't been exposed to the project. They also scored significantly higher concerning how they valued the activities in the tutorial with regard to elaboration of knowledge, sharing information with fellow students and different perspectives on the learning issues.

Web site
We have evaluated how the web site has been utilized by studying log files and discussing with students. We have found that problem formulations, hypotheses and learning issues do not seem to be very interesting to neither students nor teachers. When students have been given the opportunity to affect the site by themselves, they have been more interested in making résumés of conclusions and important issues (Franklin, Larsson, Warfvinge & Wretlind, manuscript in preparation). Teachers on the other hand, have had problems in assessing hypotheses and learning issues without access to the oral discussions. They have stuck with the explicit questions forming the basis for expert seminars. Therefore, we are currently developing a web system that puts greater emphasis on reflection. The current web site has nevertheless provided valuable information on tutorial work and weaknesses.

DISCUSSION

The overall purpose of the project was to increase students' reflection on their learning process. We think that this, on the whole, has been achieved. We wanted to make the students more independent and self-reliant in order to manage well without constant support, i.e.from a tutor. This was supposed to be achieved via a better awareness of the learning process and also by improving the study material so that the cases were appropriately perceived with regard to the learning objectives. Results from the questionnaire revealed that the project students to a larger extent used the tutorial group, which may indicate some kind of independence from the tutor. We do not know to what extent the students' ability to reflect was affected, but we are presently assessing all students at the faculty regarding that, by means of a Metacognitive Awareness Inventory (Schraw & Dennison, 1994). The project was never intended to evaluate effects on learning outcome and although we cannot state any firm conclusions on this, previous research has shown that awareness of the learning process affect learning in a positive way (Hammann & Stevens, 1998; Kincannon et al, 1998; Schraw, 1998).

Presenting the seminar on Course 4 was probably wise. The students were familiar with the PBL-procedure and had now and then experienced a detrimental monotony and were thus motivated for a change. The play made the students recognize themselves in a somewhat absurd situation,

which made them laugh providing a good climate for further discussions. Also the fact that we, as representatives of the faculty, were concerned with their situation as students and learners, contributed to a positive response as did the good will provided by the students in the project group. By raising the issue we initiated a metacognitive discourse among students and their tutors. In contrast to what has been claimed by Quinlan (2000), it was probably also important that the seminars were separate from the ordinary tutorials; it was easier to focus on the process without being forced to proceed and deliver. It is imperative though to choose the time for the seminar carefully in order to make the students come.

We abandoned the idea concerning the reconstruction of cases by student groups because it turned out to be too complicated in this setting although others seem to have succeeded (Agbor-Bayee, 2002). This was due to many factors: we had hoped that the students would be able to design cases relevant from their perspective but it became apparent that one needs a wider framework of knowledge than the students at this level had attained, in order to construct good cases. It is also not entirely clear what constitutes a good case, although Schmidt & Moust (2000) have demonstrated the importance of quality in problems-cases. Instead of having a group of students revising the cases we believe that it would be more effective to establish a permanent group of teachers and students handling the revision. This process has been initiated.

The fact that the work in tutorials and reflections on learning among students tend to be less important to senior students is intriguing and will initiate further analysis. One explanation to this could be that the students on higher levels are more pragmatic and better at finding whatever information they think they need. However, there is also concern that they may have attained a short-cutting attitude that will primarily take them through the exam rather than maximise their learning. It thus seems as if the cognitive awareness among students declines by the years, instead of the opposite. We believe that this is deleterious to the learning outcome and has to be dealt with. This work has shown that is possible to do so and also that the students appreciate it.

The project has given valuable information on the state of the educational affaires and on how student reason and think in our PBL-setting. To provide and stimulate opportunities for reflection is a challenging task that should leaven education and this project has provided means by which we will further develop and maintain quality in present and future courses.

APPENDIX 1

Form for the evaluation of the project

BASGRUPPSTEATER (25/3) - teater på basgrupp med efterföljande diskussion kring hur problem, hypoteser och inlärningsmål hänger ihop

Om du inte deltagit:

☐   Har det inte känts motiverat?

☐   Legat fel i tiden

☐   Annan orsak……………………………………………………………………………

Om du har deltagit:

Vad gav detta seminarium dig (inspiration, insikt, gåshud, träsmak, eftertanke, engagemang…) ?
……
……
……
……………………………………………………………………………………..

Bör övningen vara en del av det som ska permanentas i utbildningen?   ☐ Ja   ☐ Nej

Hur kan den i så fall utvecklas?
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………………………………………………………………………………………………

SKRIVA EGNA FALL (13-14/5) - arbete med fall som fungerat mindre bra. Skriva om och göra teater av…

Om du inte deltagit:

☐   Har det inte känts motiverat?

☐   Legat fel i tiden

☐   Annan orsak…………………………………………………………………………

Om du har deltagit:

Vad gav detta seminarium dig (inspiration, insikt, gåshud, träsmak, eftertanke, engagemang…) ?
………
………
………
……………………………………………………………………………..

Bör övningen vara en del av det som ska permanentas i utbildningen? ☐ Ja ☐ Nej

Hur kan den i så fall utvecklas?
………
………………………………………………………………………………………………

ARBETE MED PROBLEMFORMULERINGAR (19 & 28/10) - titta på film från vårens övningar. Arbete med att jämföra problemformuleringar för olika fall (Familjemiddagen och Väntrummet)

Om du inte deltagit:

☐ Har det inte känts motiverat?

☐ Legat fel i tiden

☐ Annan orsak…………………………………………………………………………………

Om du har deltagit:

Vad gav detta seminarium dig (inspiration, insikt, gåshud, träsmak, eftertanke, engagemang…) ?
………
………
………
……………………………………………………………………………..

Bör övningen vara en del av det som ska permanentas i utbildningen? ☐ Ja ☐ Nej

Hur kan den i så fall utvecklas?
………
………………………………………………………………………………………………

FALLTEATER (20/10) – fallet "svår tandinfektion" spelades upp i D4 som ett rollspel.

Om du deltagit:

Tillförde teatern något? ☐ Ja ☐ Nej

Om ja (sätt kryss):

☐ Mer intressant
☐ Lättare att förstå
☐ Mer nyanserat
☐ Roligare
☐ Övrigt?…………………………………………………………………………..
…………………………………………………………………………..

Om nej:

☐ Förvirrande
☐ Otydligt
☐ Oseriöst
☐ Negativt att bara se en gång
☐ Övrigt?…………………………………………………………………………..
…………………………………………………………………………..

ALLMÄNT

Behöver man väckas ur en "basgruppsslummer", dvs finns det anledning att diskutera hur man arbetar i basgruppen?

Nej!	Lite	Förmodligen	Ja!
☐	☐	☐	☐

Är i så fall basgruppsteater ett bra sätt att vakna?

Nej!	Inte särskilt	Ganska	Ja!
☐	☐	☐	☐

Känns det angeläget att diskutera basgruppsarbete ur ett **lärande-perspektiv**?

Nej!	Inte särskilt	Ganska	Ja!
☐	☐	☐	☐

Tycker du att de basgrupper du varit med i tidigare har arbetat effektivt?

Nej!	Inte särskilt	Ganska	Ja!
☐	☐	☐	☐

Tycker du att du - innan våra seminarier - varit medveten om hur man gör för att arbeta effektivt i en basgrupp?

Nej!	Inte särskilt	Ganska	Ja!
☐	☐	☐	☐

Är du numera uppmärksam på detta?

Nej!	Inte särskilt	Ganska	Ja!
☐	☐	☐	☐

Tycker du att basgruppsarbetet har förändrats och blivit mer effektivt efter seminarierna?

Nej!	Inte särskilt	Till viss del	Ja!
☐	☐	☐	☐

Tycker du att den här typen av övningar bör komma vid någon annan tidpunkt i utbildningen?

Tidigare	Bra så här	Senare	Inte alls
☐	☐	☐	☐

HUR GÅR VI VIDARE? – VAD TYCKER NI?

BASGRUPPSTEATER – på kurs 4

      Nej   Tveksamt   Ja, men… (se nedan)   Ja

      ☐   ☐   ☐   ☐

Kommentar:…………………………………………………………………………………………

…….

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…….

FALLTEATER – 1-2 gg per kurs

      Nej   Tveksamt   Ja, men… (se nedan)   Ja

      ☐   ☐   ☐   ☐

Kommentar:…………………………………………………………………………………………

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APPENDIX 2

Abstract of poster presented the Annual Meeting of the Association of Dental Education in Europe, Athens, Greece.

Problemsolving in problem-based learning

Adler M, Adregård S, Andersson J, Daneskog H, Ståhlnacke I, Warfvinge G, Wretlind K, Yazdankhah M.

AIM
This paper is part of a larger project aiming at improving students' learning by stimulating meta-cognitive reflection. This text is supporting two videos. The attending students study within a PBL curriculum in their 4th semester and are thus quite familiar with the problemsolving procedure. Some statements among students and facilitators had revealed that the performances in the tutorials sometimes have the character of "lets do the procedure (PBL) so that we can go home and study…" and the students tended to forget why they formulated problems and hypotheses.

MATERIAL AND METHOD
A play exemplifying a condensed tutorial was written, based on problems, hypotheses and learning issues collected from a group of former semester 4-students. It was performed live in front of approximately 20 students that were also familiar with the case. After the performance the students were asked to discuss what had happened in small groups and to relate it to their own tutorials. The play and the following discussion were recorded and will be shown at the ADEE 2005.

RESULTS
In a follow-up-evaluation the students were asked to give their opinion in a questionnaire:
Here some examples on comments that the students made:
- Good. Got some insight in how it really comes about, which one is not aware of when one is in the middle of it.
- Revealing indeed and funny.
- I realized what the meetings really are for and that how you act in the group is.

CONCLUSIONS
A majority of the students reacted positively and also recognized themselves in some of the characters. More than ninety per cent suggested the seminar to become a permanent part of the curriculum. The students felt that, after the play-experience, they got a better insight in their own role as members of a PBL-group.

APPENDIX 3

Paper to be presented at the Learning Conference 06, Montego Bay, Jamaica

Meta-Cognitive Awareness in Problem-Based Learning
Assoc. Prof. Gunnar Warfvinge & Assoc. Prof. Katarina Wretlind

This project focuses on students' proficiency to learn in a problem-based curriculum by making students more aware of the structure of a fruitful problem-solving rationale. It does not explicitly deal with what is learned although this may be influenced as a desirable spin-off effect.

We have noticed that performance in study groups sometimes have the character of "lets do the procedure (PBL) so that we can go home and study…" and students tend to forget why they formulate problems and hypotheses. To deal with this problem we have developed a series of meta-cognitive workshops. A play exemplifying a condensed study group was performed live to groups of students, followed by discussions in small groups. In other workshops, students analyzed reports with reference to problem-solving structure and also tried to construct new cases from given curricular goals.

The project was evaluated with regard to meta-cognitive awareness among students that had and had not been exposed to the exercises.

Keywords: PBL, Meta-cognition, Vocational Education
Stream: Curriculum and Pedagogy, Student Learning, Learner Experiences, Learner Diversity, Adult, Vocational, Tertiary and Professional Learning
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