Integrating assessment tasks in a problem-based learning environment

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The purpose of this study was to get more insight in the effects of written assessment tasks integrated in a problem-based learning environment. Both the influence on students’ performances and students’ perceptions were investigated. Students’ final exam results were used to find out whether students who make the assessment tasks do better than students who do not. Answers from questionnaires and semi-structured interviews were used to discover the most important concerns in students’ and teachers’ perceptions of the assessment tasks. The results indicate that making the assessment tasks had positive influence on the students’ overall performance. From the questionnaires and interviews it appears that both the students and the teachers see the benefits of the assessment tasks. It is concluded that small steps in the change of the assessment system can result in relatively big changes in students’ learning and results.

Introduction

The implementation of powerful learning environments in line with constructivist learning theories point to the necessity of reconceptualising the nature of assessment. It is generally believed and shown that assessment has an important impact on instruction and learning (Gibbs, 1999; Scouller, 1998). The alignment between the learning environments’ objectives and the assessment is a ‘magic bullet’ in improving learning (Cohen, 1987). The direct and indirect impacts of assessment may be either positive or negative (Crooks, 1988). The main purpose is to make the assessment congruent with the instruction and align the assessment to what students should be learning (Biggs, 2003). Faced with such powerful contexts, assessment should be used strategically, designed to have educationally sound and positive influences. The traditional view that the assessment of students’ achievement is separate from instruction and only comes at the end of the learning process, is no longer tenable. As assessment, learning and instruction become more and more integrated, there is a strong support for representing assessment as a tool for learning.
Birenbaum (1996) has made a useful distinction between two cultures in the measurement of achievement. In the traditional so-called testing culture, instruction and testing are considered to be separate activities. The assessment culture is a consequence of the need to make learning and instruction more in congruence with assessment (Segers et al., 2003).

Bridging the gap between new developments in the assessment culture and the daily educational and assessment practice raises a number of difficulties (Black & William, 1998). For one, assessment is still seen as separate from learning and instruction by many teachers (Torrance & Pryor, 1995). In order to bridge this gap, Gibbs and Simpson (in press) present a framework based on theory and research on strategic changes in assessment. The framework can be used to identify the potential for improving student learning by making principle changes to assessment. The framework consists of five dimensions, under which assessment supports student learning. First, the design of the assessment can be used to influence the quantity and distribution of student effort. This is the case when the assessed tasks capture sufficient study time and effort and distribute this effort evenly across the topics and weeks. Second, the quality and the level of the students’ effort can be influenced by assessment. When the tasks engage students in productive learning activities and communicate clear and high expectations to the students, assessment supports student learning. The three last dimensions concern the importance of feedback in the design of assessment as a tool for learning. The third dimension stresses the quantity and timing of the feedback. Feedback should be provided quickly enough to be useful to students and should be given often enough and in enough detail. Fourth, the quality of feedback is important. Feedback should focus on learning, be understandable for students and linked to the purpose of the tasks and the criteria. Finally, students’ response to feedback should be taken into consideration. Feedback should be received by and attended to the students and students should act upon the feedback in order to improve their tasks or their learning.

However, the integration of assessment, learning and instruction remains a challenge for most teachers. A progressive step in the desired direction would be to integrate teacher-made written assessment tasks in the learning process (Struyf et al., 2001). The central question in this study is whether integrating several well-designed teacher-made written assessment tasks in the learning environment can result in improvements in the overall student performance. It is expected that students who complete such assessment tasks during a course will have higher grades on their final exam compared to students who do not participate in such assessment tasks.

From empirical studies regarding the effects of integrated learning-assessment environments, it is known that these environments do not always demonstrate the expected learning outcomes (Segers, 1996). Recent research shows that the way the learning environment is perceived by the students, rather than the factual curriculum, affects to a large extent how students cope with the learning environment and consequently their learning results (Segers & Dochy, 2001). It follows that educational interventions will be ineffective unless they modify students’ perceptions.
This means that investigating the way the learning environment is perceived by the students seems to be crucial for interpreting their learning outcomes (Segers et al., 2003). Therefore, students’ and teachers’ perceptions are also taken into account in this study.

In the present study, the case of written assessment tasks integrated in the learning-environment of a European Law School, using problem-based learning is analysed. First, the characteristics of the problem-based learning environment and its assessment will be summarised. Second, the effects of the assessment tasks on students’ performance will be presented. Finally, students’ and tutors’ perceptions of the learning-assessment environment will be taken into consideration in order to get more insight into the effects.

Problem-based learning

Although originally developed for medical training in Canada, the orthodox version of problem-based learning (PBL) has been modified and applied globally in many disciplines (Gijselaers, 1995). Problem-based learning is at present receiving more and more attention in various programmes of higher education. In the literature, PBL has been defined and described in different ways. In spite of the many variations of PBL that have evolved, a basic definition is needed to which other educational methods can be compared. Based on the original method as developed in McMaster’s University, Barrows (1996) developed six core characteristics of PBL. The first characteristic is that learning needs to be student-centered. Second, learning has to occur in small student groups under the guidance of a tutor. The third characteristic refers to the tutor as a facilitator or guide. Fourth, authentic problems are primarily encountered in the learning sequence, before any preparation or study has occurred. Fifth, the problems encountered are used as a tool to achieve the required knowledge and the problem-solving skills necessary to eventually solve the problem. Finally, new information needs to be acquired through self-directed learning.

In the law school, in general students work in small tutorial groups (12–18 students) and meet twice a week under the supervision of a teacher (tutor) but chaired by a student member of the group. Each session, students are confronted with a range of tasks or problems, which they analyse and try to solve by formulating ‘learning goals’ for their self-study. In the next session students report their findings on the basis of the materials they looked for, found and studied and start with analysing new problems. Besides this, students are enrolled on a weekly basis in somewhat larger ‘practical groups’ (24–36 students) and have one lecture a week. For a more extensive description of the legal curriculum and the problem-based approach in the law school, see Moust (1998) or Pletinckx and Segers (2001).

Assessment and PBL

A wide range of assessment methods has been used to assess students’ learning
in PBL, ranging from traditional multiple-choice exams over essay exams to new modes of assessment such as case-based assessment, self- and peer assessment, performance-based assessment and portfolio assessment. Recently, many educators and researchers have advocated new modes of assessment in order to be congruent with the educational goals and instructional principles of PBL (Segers et al., 2003). It is generally recognised that a seventh characteristic should be added to the six core characteristics of Barrows (1996). Essential for PBL is that students learn by analysing and solving representative problems; consequently, a valid assessment system evaluates students’ problem-solving competencies in an assessment environment that is congruent with the PBL environment. This means that the assessment in PBL should take into account both the organisation of the knowledge base, and the students’ problem solving skills (Segers et al., 2003).

Recently, a meta-analysis of the effects of PBL (compared to more traditional educational methods) included the method of assessment as a moderator variable, suggesting that the more an instrument is capable of evaluating the students’ competence in knowledge application, the larger the ascertained effect of PBL would be (Dochy et al., 2003). A further exploration of the effect of what is measured with the assessment on the effects of PBL (Gijbels et al., 2003) showed that there is a difference in the reported effects of PBL between the different measurement-levels used in the study. As expected, the effect of PBL is larger compared to conventional education when the assessment method is focusing on ‘the understanding of principles that link concepts’. Contrary to studies suggesting that the effects of PBL are larger when the more complex levels of the knowledge structure are being assessed, the effect size for ‘application’ (linking of concepts and principles to application conditions and procedures) was not statistically significant. These results implicate a challenge for PBL to pay more attention to ‘application’ in both the teaching and learning environment as the assessment.

In the law faculty, for each course, a table of specification using Bloom’s (1956) taxonomy is created in order to guarantee that each subject matter is assessed on the desired level. Generally, assessment takes place immediately after each course by means of multiple-choice and/or essay questions. For more information about the assessment system in the law school, see Driessen et al. (1999) or Driessen and Van der Vleuten (2000).

**Research questions**

In order to get more insight in the effects of written assessment tasks integrated in the learning environment on students’ performance, two research questions are formulated. First, do students who perform the assessment tasks do better in their final exam compared to students who do not? Second, what are the most important concerns in students’ and teachers’ perceptions of the assessment tasks?
Methodology

Participants

A total of 205 students, following a course on public law in the second year of their law study, participated. Out of these 205 students, 164 students completed all six assessment tasks. These students will be considered as the participants in the ‘assessment task’ condition. The remaining 41 students didn’t complete the six assessment tasks and are as a consequence considered as the participants in the ‘no assessment task’ condition. A total of 10 staff members involved in the course participated in the study by completing the questionnaires and being interviewed.

Procedure

The research was carried out within the context of a compulsory second-year law course. The study was carried out to evaluate the introduction of assessment tasks in the faculty. A total of six assessment tasks were distributed over different topics and weeks in the course. Assessment in the course was twofold. The final exam consisted of 40 multiple-choice questions and took place at the end of the course. During the course, students had the opportunity to complete the six assessment tasks on a voluntary basis, which could result in an extra ‘bonus point’, added to the score of the final exam. Both the assessment tasks and the multiple-choice questions asked several cognitive activities from the students in line with the instructional goals of problem-based learning.

The design of the assessment tasks was to a great extent in line with the framework presented by Gibbs and Simpson (in press). Students were stimulated to produce qualitative learning activities by giving the one extra ‘bonus-point’ only if all six assessment tasks showed to be of sufficient quality and effort. The feedback students got from their tutor or from the plenary discussion in the tutorial group could help them to make their next assessment task better and to get a better understanding of the learning materials to be studied in order to pass the final exam at the end of the course.

Two methods for collecting data were employed: a quantitative and a qualitative approach. The quantitative approach will be presented first. Variables included are students’ prior assessment scores, six assessment tasks, a multiple choice final exam and closed questions for both staff members and students.

Prior assessment scores

Since differences in performances between students performing and succeeding in all the assessment tasks and students not doing so might be due to differences in prior academic achievement rather than in doing or not doing the assessment tasks, the average scores of the students’ previous academic exams were taken into account. Prior academic achievement is shown to be a good predictor of performance (Curall & Kirk, 1986; House et al., 1996). As stated by Young (1993) ‘the one aspect of student
Performance on which there is general consensus on importance is academic achievement, typically measured by the grade point average. In this case the grade point average (GPA) consisted of the scores students earned in the six previous final exams they took.

**Assessment tasks**

With each of the six assessment tasks, the students were asked to write an essay in which they had to go through a process of evaluation, synthesis, analysis or understanding of the study material or had to write down in detail the solution of a problem as presented in a case (see Figure 1). In order to succeed, each of the six assessment tasks had to be of sufficient effort and correctness. The tasks were discussed in the same way as the other problem tasks in the course after the students handed in their assessment task. In this way the students got some plenary feedback. One week later, the students received back their assessment task from the tutor, with the necessary feedback.

**Final exam**

The objectives of the final exam are threefold and derived from Bloom’s taxonomy (Bloom, 1956): to investigate the student’s ability to recall information (in terms of Bloom: knowledge; defined as the remembering of previous learned material), to understand basic concepts and principles (comprehension; defined as the ability to grasp the meaning of material) and to apply information, concepts, and principles in new situations (application; refers to the ability to use learned material in new and concrete situations). The final exam consisted of 12 knowledge-based questions (30%), 14 comprehension-based multiple choice questions (35%) and 14 application-based multiple choice questions (35%). Out of these questions, two knowledge-based, four comprehension-based and four application-based questions were orientated towards the topics related to the assessment tasks. The final exam was being found valid by the course supervisor. On average students scored 26.01 out of 40 on

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**Case: Assessment-task**

Neighbour Smith from the previous case also received an announcement of the given (limited) construction permit to Miss Jones on the 3rd of February 2003. He fears to have not that much light in his neighbouring garden, if the warehouse for flowers arises. He wonders whether he can stop the start of the building, although he is not involved in the ongoing procedure between the Miss Jones and the local authority. Moreover, it shouldn’t be going to cost a lot, since he’s on social security. On the other hand, he is so untrained, that he could use legal aid.

Give your advice to neighbour Smith, write the necessary documents (maximum 2 A4).

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**Figure 1. Example of an assessment task**
the exam (SD=5.06). The internal consistency reliability coefficient was also measured and found appropriate (coefficient alpha=.74).

**Closed questions**

The students’ and tutors’ survey consisted of three parts. The first part of the survey (both students and tutors) consisted of four questions concerning their view of working with the assessment tasks during the course. The items (e.g. ‘During the course it was made possible to make (assessment) tasks embedded in the curriculum’) were rated on a 5-point Likert scale (1=disagree completely, 5=agree completely). The reliability of this part, questioning whether the assessment tasks were perceived by the students and tutors as intended by the designers of the assessment tasks, was high (coefficient alpha=.78). The second part of the survey (both students and tutors) was developed to measure the students’ and tutors’ perception of different quality aspects of the (problem-based) learning environment, especially the assessment. The items are based on the characteristics of the learning assessment environment and on the expectations of the staff concerning students’ learning activities. This part of the questionnaire consisted of 15 items on a 5-point Likert scale concerning mostly the motivational aspects of the assessment tasks (e.g. ‘The use of assessment tasks stimulates me to work systematically’). The reliability was high (coefficient alpha=.84). The third part of the survey (only for students) concerned the time students spend on the assessment tasks and their self-study activities.

**Qualitative instruments**

The qualitative aspect of this study took the form of an open-ended questionnaire for both staff and students and a semi-structured interview with each staff member. For example, the students were asked to reflect on the assessment tasks embedded in the curriculum and doing assessment tasks as part of the curriculum in general. The aim was to get more insight in the most important concerns in students’ and teachers’ perceptions of the assessment tasks.

**Results**

The research questions will be reported one by one after the summary of the data of the prior assessment scores of the students in both the ‘assessment task’ and the ‘no assessment task’ condition.

**Previous performance**

The difference between the previous final exams mean scores of the two assessment groups is significant \( (t(70.64)=-3.36, p < .05) \) meaning that the two groups indeed differ in academic achievement. The group of students doing the assessment tasks did significantly better on their previous final exams. In order to make both groups
comparable, analyses of covariance (ANCOVA) are used as method of analysis in order to answer the first two research questions. Preliminary analysis of the data involved inspection of normality and homogeneity of variance assumptions. Normal plots, stem-and-leaf plots and the calculation of skewness and kurtosis were used to check the normality of distribution. To test the equality of group variances the Levene statistics was calculated. A preliminary analysis evaluating the homogeneity-of-slopes assumption indicated that the relationship between the covariate (the GPA) and the dependent variable (the final assessment) did not differ significantly as a function of the independent variable (assessment task). All assumptions for the analysis were met.

**Effect of participating in the assessment tasks on the final exam**

The ANCOVA was significant ($F(1,202)=9.63$, $MSE=10.39$, $p < .01$, partial $\eta^2=.05$). This means that, after correction for differences in students’ prior performances, students who perform and succeed in all six assessment tasks perform better on the final exam. The strength of relationship between the condition (assessment tasks or no assessment task) and the result on the final exam, however, was small, as assessed by a partial $\eta^2$, with the condition accounting for 5% of the variance of the dependent variable, holding constant the GPA. In order to investigate whether this effect is the result of a better preparation of the students for those topics treated with the assessment tasks only, our first research question is further divided into two more detailed research questions: first, do students who have completed and succeeded all the assessment tasks perform better on those questions in their final exam that are related to the topics treated in the assessment tasks? Second, do students who have completed and succeeded in all the assessment tasks perform better on that part of the final exam that is not related to the topics treated with the assessment tasks compared to students who did not complete or succeed in all the assessment tasks?

**Effect of participating in the assessment tasks on related final exam questions**

The results of the ANCOVA show that, after correction for differences in prior performances, there is a significant difference in outcome on that part of the final exam orientated towards the topics related to the assessment tasks between the two assessment groups ($F(1,202)=11.18$, $MSE=2.18$, $p < .01$, partial $\eta^2=.05$). Students who took the assessment tasks and met the criteria of these tasks performed significantly better on the questions in the final exam related to the topics treated in the assessment tasks.

**Effect of participating in the assessment tasks on non-related final exam questions**

The results of the ANCOVA indicate that, after correction for differences in prior performances, there is also a significant difference in the outcome for that part of the
exam not orientated towards the topics related to the assessment tasks \( (F (1,202)=3.97, \text{MSE}=6.46, p < .05, \text{partial } \eta^2=.02).\) Apparently, working with assessment tasks has a positive influence on the performance not only of the related topics but also of the non-related topics. Although the statistical significance is smaller than with the related final exam question (significant at the .05 versus the .01 level) and the partial \( \eta^2 \) is relatively small (meaning that participating in the assessment tasks accounts for only 2\% of the variance of the final exam if the prior performances of the students are held constant), there is statistically significant evidence that working on the assessment tasks had a positive influence on the performance not only on the specific questions but also on the whole final exam performance.

**Students’ and teachers’ perceptions of the learning assessment environment**

In order to search for explanations for the results of these studies, students’ and tutors’ perceptions of the learning assessment environment are explored. This is also used as the input for recommendations for the improvement of educational practice. First, we will report the results of the closed questions.

**Closed questions**

In the tutors’ view, the assessment tasks were embedded very well in the curriculum. All students who took the assessment tasks shared this point of view, and were also positive about the way it was embedded. Both students and tutors shared the opinion that by taking the assessment tasks more insight was gained into the extent of understanding the course material. There was, however, no significant correlation found between the assessment score and the perception of students on working with the assessment tasks during the course.

Students and tutors thought the assessment tasks were meaningful because they stimulated some desired learning activities. However, their opinions differed regarding the extent to which the learning activities were stimulating desired learning activities. Students were positive about the overall stimulus from the assessment tasks. They spent more time on the study material and in their view they worked more independently and more systematically as a result of the assessment tasks. Students found themselves more capable in the case of problem-solving processes, critical thinking and reasoning. In a nutshell, according to the students, because of the assessment tasks they mastered the study material better, despite the fact that doing these tasks was at the expense of the preparation of the group sessions. A small negative but significant correlation was found between the two items asking whether doing the assessment tasks was at the expense of the preparation of the tutorial and practical group sessions and the final exam score (respectively: \( r = - .26, p < .01 \) and \( r = - .27, p < .01 \)). This suggests that students with better time management performed slightly better on the final exam. Students preferred to work with assessment tasks in the future, highly motivated by the prospectus of the bonus point. In the view of the tutors the use of assessment tasks especially (or only) stimulated
independent activities and reasoning. In contrast with the opinion of the students, the tutors did not think the students generally mastered the study material better.

Students who took the assessment tasks and met the criteria reported having spent substantially more hours on self-study per week for the tutorial groups (M=18.44, SD=9.6) than the students who did not take or turn in the assessment tasks successfully (M=13.04, SD=8.60). However, there was no significant correlation between the amount of reported self-study hours and students’ score on their final exam.

Qualitative data results

The open-ended questions and the interviews were found to have many features in common. Five important issues emerged: the learning effect, time management, the bonus point system, the usefulness of the assessment tasks, and the feedback.

The learning effect

The learning effect of the assessment tasks was very obvious for both students and tutors. As students stated: ‘working with the tasks was very stimulating to work more intensive with the learning material’. Consequently, the students were, according to the more experienced tutors, better prepared for the tutorial groups. This resulted, according to the tutors, in better, more in-depth discussions. Because of this effect, tutors argued for the use of assessment tasks strategically (also taking their time schedule into account; see feedback) in case of difficult tenets.

Feedback

Tutors reported that assessing a piece of work and giving appropriate feedback was only possible by checking it thoroughly. Furthermore they thought it was important for students to receive sound and detailed feedback. They found it inappropriate not to check students’ work thoroughly and only look for evidence of sufficient effort, as was proposed at first. However, for many tutors this resulted in a larger than planned amount of time for the tutors to evaluate the tasks. The presence of a well-constructed correction model was, according to the tutors, very helpful, and took less time to give their feedback. Students also reported finding the feedback useful.

Time management

Students spent more time on the learning material related to the assessment tasks. Though they spent more time on these tasks, they did not spend much more time overall. Taking the assessment tasks was mostly at the expense of students’ preparation of other tutorial or practical group sessions as stated by the students themselves and as observed by the tutors. Because of the assessment tasks tutors spent more time evaluating the tasks, processing the results and managing the data.
Consequently, for some tutors this meant they were less prepared for the tutorial group sessions and for other tutors this meant they worked overtime.

**Bonus point system**

The students were very positive about the bonus point system. Nevertheless, they suggested a major change in the system. Their main consideration was about the way the bonus point was awarded. They thought that awarding a part of a bonus point for each assessment task was a fairer system than awarding a single bonus point for the total six assessment tasks. In this way, students in circumstances beyond their control wouldn’t be excluded from getting a bonus point. The tutors had two major concerns about the system. The first was about the weight of the bonus point, and the second concern was about the number of tasks. Several tutors suggested decreasing the number of assessment tasks (three instead of six). In the eyes of the tutors the main benefit of this operation is that it reduces the amount of hours correcting/evaluating the assessment tasks and so this would not be at the expense of the preparation for the tutorial group sessions.

**The usefulness of the assessment tasks**

For students the criteria of the assessment tasks were not all stated clearly and concretely enough. At first, most students didn’t know exactly what was expected. Frequently students asked questions about its form and the content criteria. The tutors’ additional explanations and guiding had to set this problem right. Other indicated problems were more structural problems with the timing of the assessment tasks: the spacing of the six assessment tasks over the eight weeks was sometimes poor, as was the tuning between the assessment tasks presented in the practical course book and the subject matter treated at that moment in the tutorial group. In other words, there was a need for especially constructed assessment tasks, capable of promoting long-term learning effects, and containing an amount of topics handled in the previous settings. Although the present assessment tasks meet these requirements to a large extent, improvements could be made.

**Conclusion and discussion**

By introducing teacher-made assessment tasks in a problem-based learning course, the PBL learning environment becomes more in alignment itself. The five dimensions in the framework under which assessment supports student learning (Gibbs & Simpson, in press) seem to be recognized by students and teachers in the assessment tasks. When corrected for differences in prior academic performance, students who did all the assessment tasks successfully during the course performed better on their final exam compared to students who did not do or succeed in the assessment tasks. The fact that students not only performed better on those parts of the final exam which were related to the assessment tasks, but also on non-related question, indicates
that the introduction of the assessment task helped students to address more appropriate student learning activities, going beyond the six assessment tasks and its content. The way in which the assessment tasks seem to have influenced the general learning approach of the students should be the subject of further research.

From the closed questions it is clear that, in general, both students and tutors were happy about the way the assessment tasks were embedded in the curriculum. Students reported studying more, and studying more critically and more systematically as a result of the assessment tasks. It is suggested that students with better time management perform slightly better on their final exam.

Also, the qualitative data seems to suggest that both the students and the teachers see the benefits of the assessment tasks. Students are driven by the extra bonus point to complete the assessment tasks in the first place. Tutors are concerned about the feasibility of the whole project. As with the students, they perceive a time management problem: how to manage to give feedback on all the assessment tasks. The presence of a correction model is helpful, but in the future the use of self- and peer assessment can be considered to benefit the learning of students and the time management of tutors.

Several remarks can be made on this study and the implementation of the assessment tasks. First of all, the students were free to participate in the study. One could assume that only the better students would be willing to spend extra time on the assessment tasks in order to gain an extra bonus point. Although the groups were corrected for their prior academic achievements, this study was far from a randomised trial. Other factors, such as students’ motivation, could have had an influence on students’ choice to participate in the assessment tasks. Another possible moderating variable that has not been taken into account is teacher time: students participating in the assessment tasks received more teacher time by means of the personal feedback on each assessment task. Finally, the perspective of the bonus point did motivate the students to participate in the assessment tasks, but also hindered them seeing the assessment tasks as a tool for learning.

In spite of its limitations, this study is in line with Gibbs and Simpson (in press) and supports the framework they have described, and suggests that small steps in the change of the assessment system can result in relatively big changes in students’ learning and results.

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