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Questionbank: computer supported self-questioning

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QUESTIONBANK: COMPUTER SUPPORTED SELF-QUESTIONING

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Questionbank: Computer Supported Self-Questioning

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Abstract

Self-questioning is a learning strategy that focuses on knowledge acquisition and concept comprehension by the learner generating questions. This paper describes the development of an internet-based application that supports self-questioning, referred to as Questionbank, and presents a case study of its implementation, and an evaluation.

The findings in this paper suggest that Questionbank is a very useful tool to support self-questioning, but that the system in itself is not sufficient to improve the learning experience of students. Additional instructional measures for this are suggested.

Introduction

Self-questioning

Self-questioning is a learning strategy that focuses on knowledge acquisition and concept comprehension by the learner generating questions. An important theory in the discipline of cognitive psychology is that self-questioning helps learners to link new information to existing information and – in doing so – actively engages students in developing their own mental models.

According to Deshler and Schumacher (1988), the self-questioning technique is mostly applied to the learning of reading passages. However, in this paper we add that the technique should not necessarily be restricted to that kind of use.

The self-questioning strategy can help students to:

- improve their awareness and control their thinking, which in turn improves their performance;

- improve long-term retention of knowledge and skills;
- improve their ability to apply and transfer knowledge and skills;
- improve attitude and motivation.

To further enhance the self-questioning strategy, an internet-based application called Questionbank is being developed at the Digital University Consortium of the Netherlands. Questionbank allows instructors to set periodic assignments for students to submit multiple-choice questions in a database. When students have submitted a question, they can choose to answer questions that have been submitted by fellow students and comment on those questions; this results in a flexible formative assessment procedure. Instructors can also monitor all the questions in the database, modify questions, and comment on them.

Background

There is a large body of research on self-questioning and reading. A standard work in this field is the review on self-questioning in instructional research by Wong (1985). A more recent work was developed by Janssen (2002).

Frase and Schwartz (1975), Martin (1985), Denner and Rickards (1987) and Foos (1989) undertook empirical research into self-questioning and its effect on information retention and the effect on formal assessment results.

Frase and Schwartz (1975) compared high-school and college students who wrote questions while reading a text with students who did not do so. The students who wrote down questions performed better at a test that aimed at the recall of facts than those who did not do so. However, they also concluded that students only performed better on those questions about which they had actually formulated questions themselves. Other work by Frase and Schwartz (1975) and Martin (1985) reported that the majority of questions written by students focused mainly on questioning factual information, and not on more general concepts in a text, let alone the application of concepts.

For that reason, Denner and Rickards (1987) also found that students who wrote questions for themselves only performed better on test questions that aimed at the recall of facts. Foos (1989) had students write questions that aimed more at the questioning of concepts or the application of concepts. In order to do this, he investigated the effect of students writing essay type questions. In his experiment, he asked students to develop questions on that specific text two weeks prior to a final examination. Students could choose either to write essay type questions or multiple choice questions. In the test, no questions were asked that the students had developed themselves, but the questions did deal with the same subject. Foos reported no significant difference between the group of students who had worked with essay type questions with students who had worked with multiple choice questions. According to Foos, this lack of difference was caused by the fact that students who developed essay type questions also formulated questions that did not aim at questioning concepts, but also facts.

The implications and effects of self-questioning beyond the effect on retention of facts and application of concepts is situated in the idea that learners learn to make meaningful links between new information and existing information in general. Their ability to construct links is what makes it possible for students to perform better at final assessments in which it is easier for them to link new questions (new information) to existing information.

It can be concluded from these empirical studies that self-questioning is a good strategy for improving retention and reproducing knowledge, and dealing with new information. For that reason, it can be worthwhile to support this study skill with computer tools. This paper evaluates the Questionbank system in its ability to effectively support that study skill.

The system

The Questionbank system is designed to support self-questioning. It should motivate learners to apply the self-questioning technique, to distribute their time spent on this technique over a period of time, to gain as great an effect as possible from their effort in terms of a positive benefit for formal assessment. At the same time, the system should not ask for too much time from the instructors to monitor the application of the self-questioning technique by the learners and it should be easy to draw questions from it for other uses within the teaching and assessment process.

Questionbank is set up as a database application that can be accessed on the internet via a user friendly interface. The system distinguishes between the roles of:

- student
- instructor

A prototype of the system has been developed that incorporates the functions described below.

An instructor runs a ‘course’. And the instructor can set assignments within that course. Every assignment will result in a database of questions. The instructor can set a number of variables within an assignment. A typical set of variable values is:

- the name of the assignment;
- the reading material that is to be used within the assignment;
- the period in which the assignment is accessible for the students;
- the period in which the students can submit questions to the specific assignment;
- the preconditions for students that need to be met in order to gain access to the questions of other students or to be able to remain a valid contributor of questions:
    - the number of questions students have to submit for that assignment;

    - the rating that students need to achieve for questions submitted.
- the period in which the question database is accessible for students to answer the available questions.

This results, for example, in an assignment as can be seen in Figure 1 below.

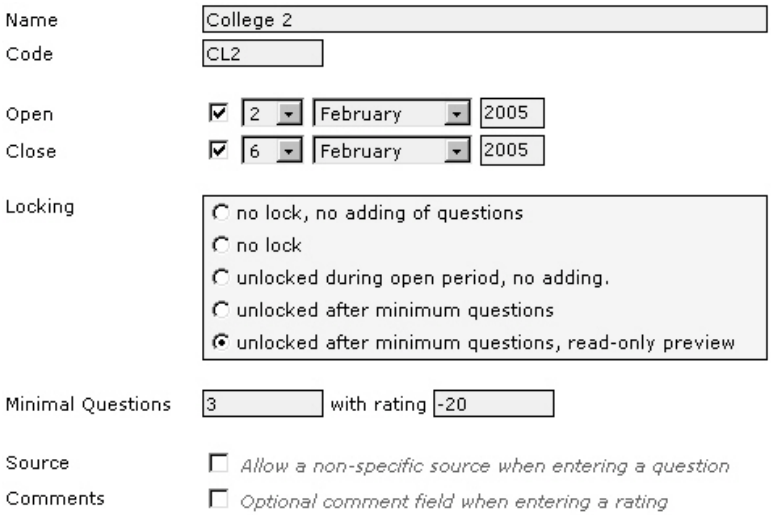


Figure 1. Assignment settings in Questionbank

The instructor can use the settings to influence the way in which the system will function within the practical educational setting.

The system is quite straightforward for the students. When students log in to the system they see the following screen as depicted in Figure 2.

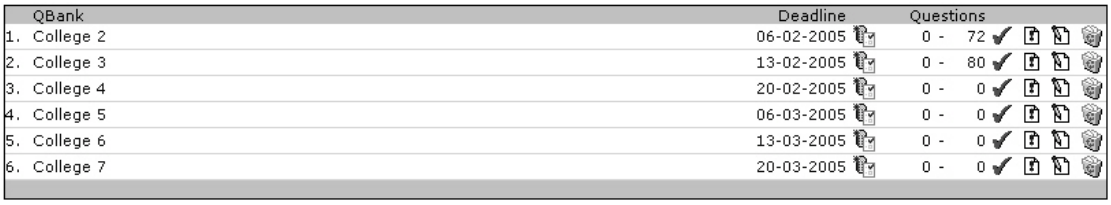
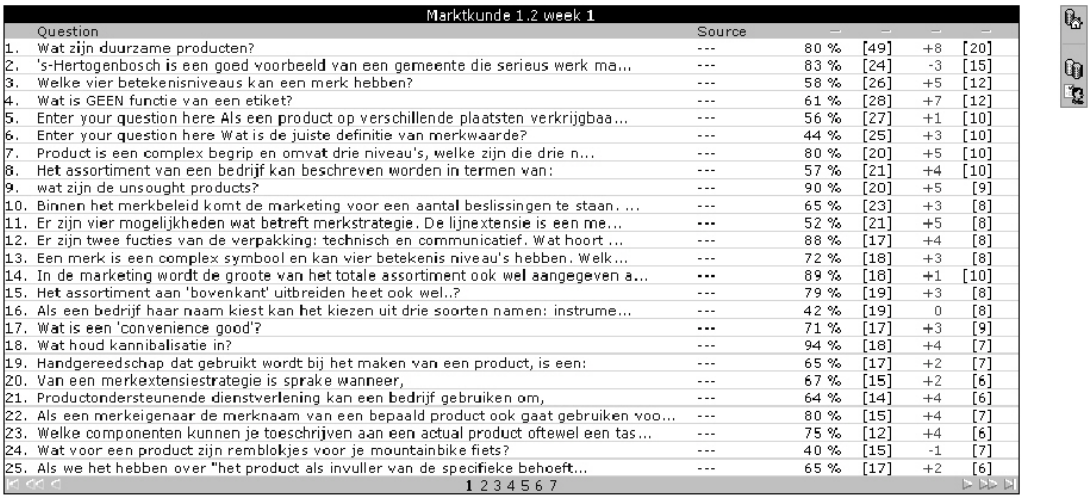


Figure 2. An overview of available assignments (question banks) in Questionbank

The banks are grouped according to the assignment schedules. Students have access to all the question banks of a course and to their own questions, providing they have met the preconditions for participation. When they access Questionbank, they see a screen as depicted in Figure 3:



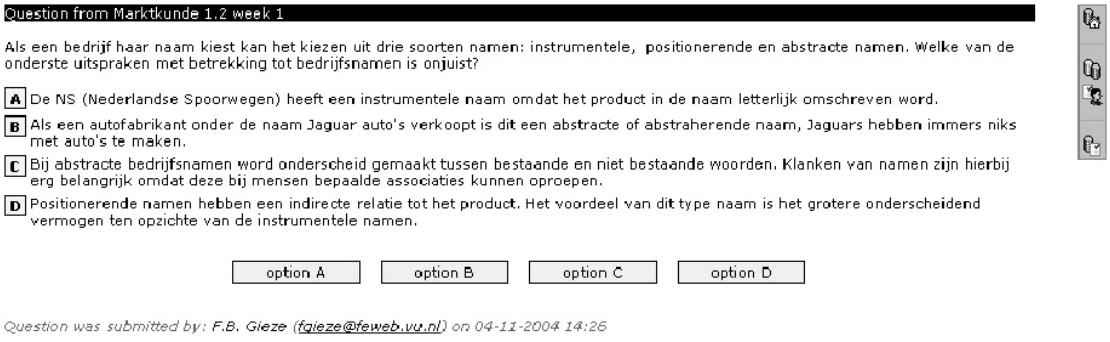
Marktkunde 1.2 week **1**

	Question	Source				
1.	Wat zijn duurzame producten?	---	80 %	[49]	+8	[20]
2.	's-Hertogenbosch is een goed voorbeeld van een gemeente die serieus werk ma...	---	83 %	[24]	-3	[15]
3.	Welke vier betekenisniveaus kan een merk hebben?	---	58 %	[26]	+5	[12]
4.	Wat is GEEN functie van een etiket?	---	61 %	[28]	+7	[12]
5.	Enter your question here Als een product op verschillende plaatsten verkrijgbaa...	---	56 %	[27]	+1	[10]
6.	Enter your question here Wat is de juiste definitie van merkwaarde?	---	44 %	[25]	+3	[10]
7.	Product is een complex begrip en omvat drie niveau's, welke zijn die drie n...	---	80 %	[20]	+5	[10]
8.	Het assortiment van een bedrijf kan beschreven worden in termen van:	---	57 %	[21]	+4	[10]
9.	wat zijn de unsought products?	---	90 %	[20]	+5	[9]
10.	Binnen het merkbeleid komt de marketing voor een aantal beslissingen te staan. ...	---	65 %	[23]	+3	[8]
11.	Er zijn vier mogelijkheden wat betreft merkstrategie. De lijnextensie is een me...	---	52 %	[21]	+5	[8]
12.	Er zijn twee fucties van de verpakking: technisch en communicatief. Wat hoort ...	---	88 %	[17]	+4	[8]
13.	Een merk is een complex symbool en kan vier betekenis niveau's hebben. Welk...	---	72 %	[18]	+3	[8]
14.	In de marketing wordt de groote van het totale assortiment ook wel aangegeven a...	---	89 %	[18]	+1	[10]
15.	Het assortiment aan 'bovenkant' uitbreiden heet ook wel..?	---	79 %	[19]	+3	[8]
16.	Als een bedrijf haar naam kiest kan het kiezen uit drie soorten namen: instrume...	---	42 %	[19]	0	[8]
17.	Wat is een 'convenience good'?	---	71 %	[17]	+3	[9]
18.	Wat houd kannibalisatie in?	---	94 %	[18]	+4	[7]
19.	Handgereedschap dat gebruikt wordt bij het maken van een product, is een:	---	65 %	[17]	+2	[7]
20.	Van een merkextensiestrategie is sprake wanneer,	---	67 %	[15]	+2	[6]
21.	Productondersteunende dienstverlening kan een bedrijf gebruiken om,	---	64 %	[14]	+4	[6]
22.	Als een merkeigenaar de merknaam van een bepaald product ook gaat gebruiken voo...	---	80 %	[15]	+4	[7]
23.	Welke componenten kunnen je toeschrijven aan een actual product oftewel een tas...	---	75 %	[12]	+4	[6]
24.	Wat voor een product zijn remblokjes voor je mountainbike fiets?	---	40 %	[15]	-1	[7]
25.	Als we het hebben over "het product als invuller van de specifieke behoeft...	---	65 %	[17]	+2	[6]

1 2 3 4 5 6 7

Figure 3. A list of questions in Questionbank

The screen displays the truncated stem of each question, the percentage of correct answers other students have given and the rating given to that question by the other students. When they click on a question, the entire question is displayed as in Figure 4.



Question from Marktkunde 1.2 week 1

Als een bedrijf haar naam kiest kan het kiezen uit drie soorten namen: instrumentele, positionerende en abstracte namen. Welke van de onderste uitspraken met betrekking tot bedrijfsnamen is onjuist?

A De NS (Nederlandse Spoorwegen) heeft een instrumentele naam omdat het product in de naam letterlijk omschreven word.

B Als een autofabrikant onder de naam Jaguar auto's verkoopt is dit een abstracte of abstraherende naam, Jaguars hebben immers niks met auto's te maken.

C Bij abstracte bedrijfsnamen word onderscheid gemaakt tussen bestaande en niet bestaande woorden. Klanken van namen zijn hierbij erg belangrijk omdat deze bij mensen bepaalde associaties kunnen oproepen.

D Positionerende namen hebben een indirecte relatie tot het product. Het voordeel van dit type naam is het grotere onderscheidend vermogen ten opzichte van de instrumentele namen.

option A | option B | option C | option D

Question was submitted by: F.B. Gieze (fgieze@feweb.vu.nl) on 04-11-2004 14:26

Figure 4. A question in Questionbank

By clicking on one of the four buttons below, the student can indicate which alternative he thinks is the correct one. After submitting, the student can see on the screen (Figure 5) whether the right answer was selected, and if not, what the right answer was.

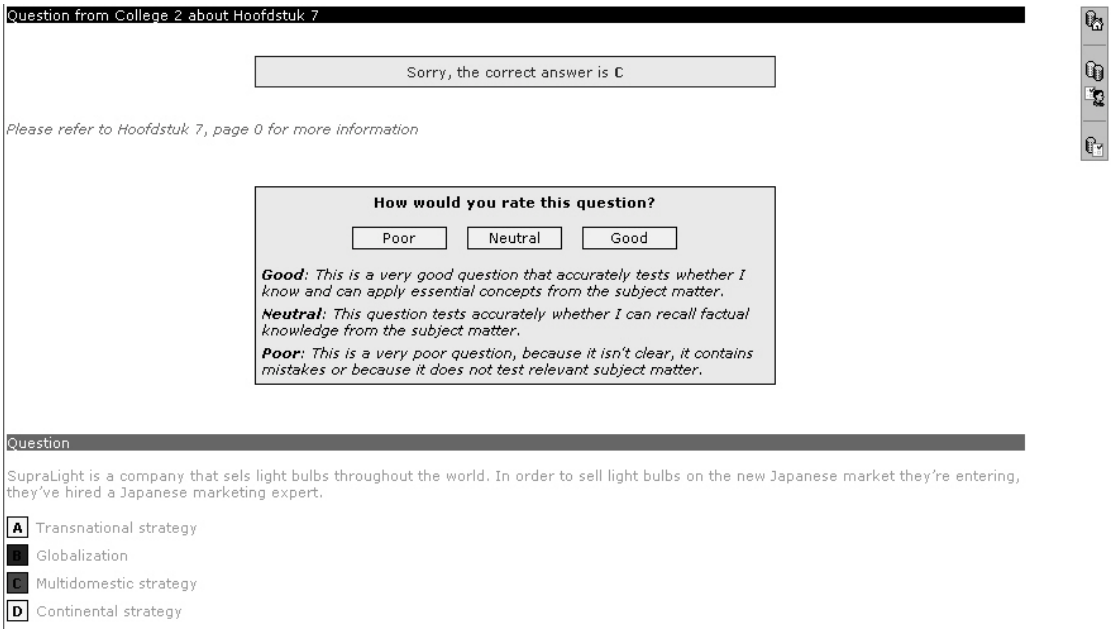
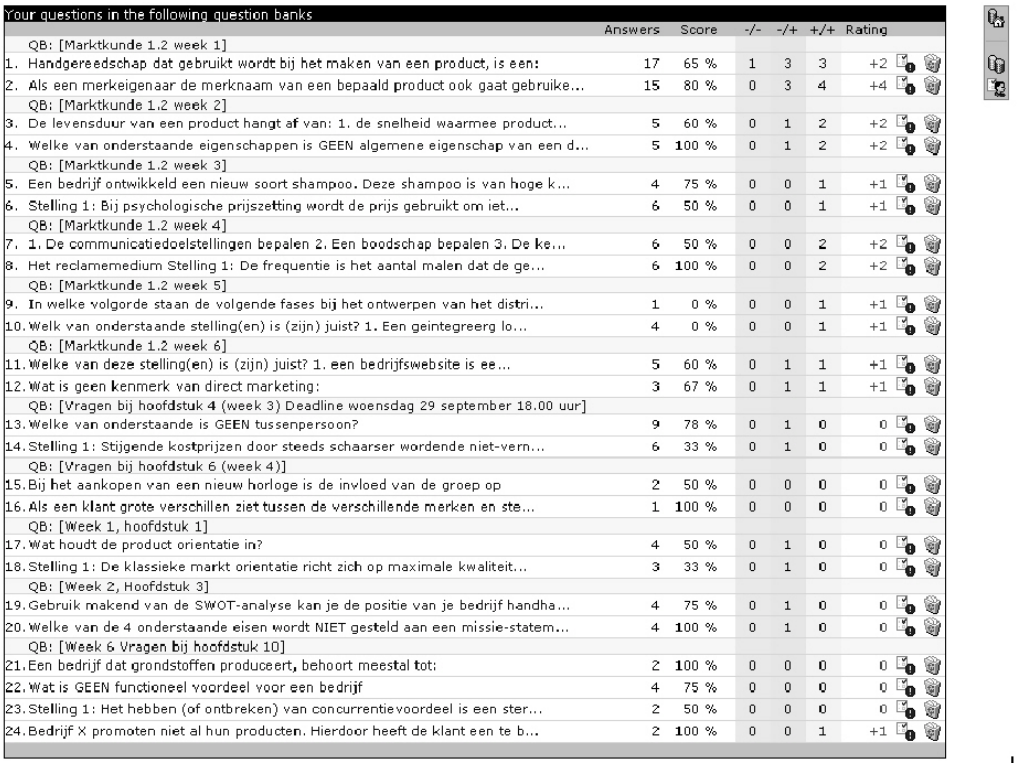


Figure 5. Feedback and rating option for a Question in Questionbank

The students are also asked to rate the quality of the question by selecting one of the following options:

- **Good**: this is a very good question that accurately tests whether I know and can apply essential concepts from the subject matter (results in a +1 rating score).
- **Neutral**: this question accurately tests whether I can recall factual knowledge about the subject matter (results in a 0 rating score).
- **Poor**: this is a very poor question because it is not clear, it contains mistakes or because it does not test relevant subject matter (results in a -1 rating score).

When students view their own question bank as can be seen in Figure 6 and Figure 7, they get a detailed overview of the questions they have submitted, with, for example, the total number of times the question has been answered by other students, how often these students gave the right answer, and how the other students rated the quality of these questions.



Your questions in the following question banks

		Answers	Score	-/-	-/+	+/+	Rating
	QB: [Marktkunde 1.2 week 1]						
1.	Handgereedschap dat gebruikt wordt bij het maken van een product, is een:	17	65 %	1	3	3	+2
2.	Als een merkeigenaar de merknaam van een bepaald product ook gaat gebruike...	15	80 %	0	3	4	+4
	QB: [Marktkunde 1.2 week 2]						
3.	De levensduur van een product hangt af van: 1. de snelheid waarmee product...	5	60 %	0	1	2	+2
4.	Welke van onderstaande eigenschappen is GEEN algemene eigenschap van een d...	5	100 %	0	1	2	+2
	QB: [Marktkunde 1.2 week 3]						
5.	Een bedrijf ontwikkeld een nieuw soort shampoo. Deze shampoo is van hoge k...	4	75 %	0	0	1	+1
6.	Stelling 1: Bij psychologische prijszetting wordt de prijs gebruikt om iet...	6	50 %	0	0	1	+1
	QB: [Marktkunde 1.2 week 4]						
7.	1. De communicatiedoelstellingen bepalen 2. Een boodschap bepalen 3. De ke...	6	50 %	0	0	2	+2
8.	Het reclamemedium Stelling 1: De frequentie is het aantal malen dat de ge...	6	100 %	0	0	2	+2
	QB: [Marktkunde 1.2 week 5]						
9.	In welke volgorde staan de volgende fases bij het ontwerpen van het distri...	1	0 %	0	0	1	+1
10.	Welk van onderstaande stelling(en) is (zijn) juist? 1. Een geintegreerg lo...	4	0 %	0	0	1	+1
	QB: [Marktkunde 1.2 week 6]						
11.	Welke van deze stelling(en) is (zijn) juist? 1. een bedrijfswebsite is ee...	5	60 %	0	1	1	+1
12.	Wat is geen kenmerk van direct marketing:	3	67 %	0	1	1	+1
	QB: [Vragen bij hoofdstuk 4 (week 3) Deadline woensdag 29 september 18.00 uur]						
13.	Welke van onderstaande is GEEN tussenpersoon?	9	78 %	0	1	0	0
14.	Stelling 1: Stijgende kostprijzen door steeds schaarser wordende niet-vern...	6	33 %	0	1	0	0
	QB: [Vragen bij hoofdstuk 6 (week 4)]						
15.	Bij het aankopen van een nieuw horloge is de invloed van de groep op	2	50 %	0	0	0	0
16.	Als een klant grote verschillen ziet tussen de verschillende merken en ste...	1	100 %	0	0	0	0
	QB: [Week 1, hoofdstuk 1]						
17.	Wat houdt de product orientatie in?	4	50 %	0	1	0	0
18.	Stelling 1: De klassieke markt orientatie richt zich op maximale kwaliteit...	3	33 %	0	1	0	0
	QB: [Week 2, Hoofdstuk 3]						
19.	Gebruik makend van de SWOT-analyse kan je de positie van je bedrijf handha...	4	75 %	0	1	0	0
20.	Welke van de 4 onderstaande eisen wordt NIET gesteld aan een missie-statem...	4	100 %	0	1	0	0
	QB: [Week 6 Vragen bij hoofdstuk 10]						
21.	Een bedrijf dat grondstoffen produceert, behoort meestal tot:	2	100 %	0	0	0	0
22.	Wat is GEEN functioneel voordeel voor een bedrijf	4	75 %	0	0	0	0
23.	Stelling 1: Het hebben (of ontbreken) van concurrentievoordeel is een ster...	2	50 %	0	0	0	0
24.	Bedrijf X promoten niet al hun producten. Hierdoor heeft de klant een te b...	2	100 %	0	0	1	+1

Figure 6. Overview of the personal questions of a student in Questionbank



Question from Marktkunde 1.2 week 1

Als een merkeigenaar de merknaam van een bepaald product ook gaat gebruiken voor een product uit een andere productgroep, is er sprake van:

A lijnextensie
B merkextensie
C individuele merken
D nieuwe merken

Question was submitted by: Heleen Bonhof (wbonhof@feweb.vu.nl) on 04-11-2004 20:54

Comments by author

Please refer to , page 503 for more information

Question stats

15 answers of which **12** correct answers resulting in a score of **80 %**
7 ratings resulting in a 4 = (**0** x-1) + (3 x0) + (4 x1)

Additional comments

Figure 7. Details on feedback, ratings and comments on a question in Questionbank

The instructor has access to all the question banks and to all the detailed information that is stored for each question. The instructor can also make changes or improvements to any question.

To make the system easy to use, it is possible to sort by a number of variables, such as: student name, question, rating, bank, percentage of correct answers etc.

Case study

The system was implemented in the second half of 2004, and the implementation was designed to generate descriptive data about the use of the system, and the ideas students and instructors had about the system.

These descriptive data could then be used as pointers for improving the design and the features of the system and its implementation.

Questionbank was used on a first-year Marketing 1.1 course at the Faculty of Economics and Business Administration at the Vrije Universiteit Amsterdam The course was taken by 135 first-year students.

The course structure was as follows:

- Course duration: 6 weeks;
- A weekly 2 hour lecture;
- Every week the lectures covered two or three chapters from the textbook (a total of some 40 to 80 pages of text);
- Students could attend tutorial groups;
- The course ended with a summative assessment;
- The summative assessment comprised both multiple choice and open-ended questions. Some of the multiple choice questions were to be taken from the Questionbank database.

The students could acquire an additional credit of 0.5 points for the final grade (on a scale of 1 to 10) if they met the conditions that were set in the assignment. The conditions were:

- 2 questions had to be submitted every week;
- every question should be given a minimum –2 rating.

During the first lecture, 10 minutes were spent on introducing students to the purpose and use of the Questionbank system. In lectures 2 to 6, the lecturer covered two questions taken from Questionbank in his lecture.

Results of the case study

Of the 135 first-year students, 88 students submitted questions (65%). Of these 88 students, about 70% of them submitted more than 8 questions (2 every week). There was only one student who submitted more than two questions a week. For this course, this group of students submitted a total of 867 questions. 56 students actually answered questions set in the system by their fellow students. These students answered an average of 45 questions each. However, the majority of questions were only answered shortly before the final exam was due to take place.

The instructor reported that it was easy each week to find two interesting questions in the database and to discuss them during his lectures. Though this instructor had very low student attendance at his lectures, he reported that the discussions enhanced his lectures and made them more interactive. The instructor also reported that he found a sufficient number of questions in the database which he could include unmodified in the final examination. The final assessment included 8 multiple-choice questions from Questionbank out of a total of 25 multiple-choice questions. The instructor

reported that the identification, selection and copy-and-pasting process took about one hour. He was very pleased with the features which facilitated sorting by subject-content, rating, percentage of correct answers etc. which enabled him to identify useful questions quickly. He also added that a good export function for re-using questions in other applications, such as MS-Word or Respondus, would be useful.

Immediately after the summative assessments, the students were asked to fill in an online questionnaire. The results of the questionnaire, which looked at their opinions about the system, are summarized in Table 1.

	Strongly disagree	Disagree	Neutral	Agree	Strongly Disagree	Total
'Questionbank is a good addition to a course to improve my learning'	20.5%	25.0%	29.5%	11.4%	13.6%	100%
'I think that Questionbank is fun'	31.0%	28.6%	19.0%	11.9%	9.5%	100%
'I think that formulating multiple-choice questions about a text is useful for my learning'	20.0%	26.0%	22.0%	22.0%	10.0%	100%

Table 1. Frequency table of responses to questions relating to the opinion of students about self-questioning and Questionbank

It can be concluded from the results shown in the table that students do not, in general, have a very positive opinion about the system.

The relationship between the results of the multiple-choice part of the final assessment and student participation in Questionbank was also examined. See Figure 8 below.

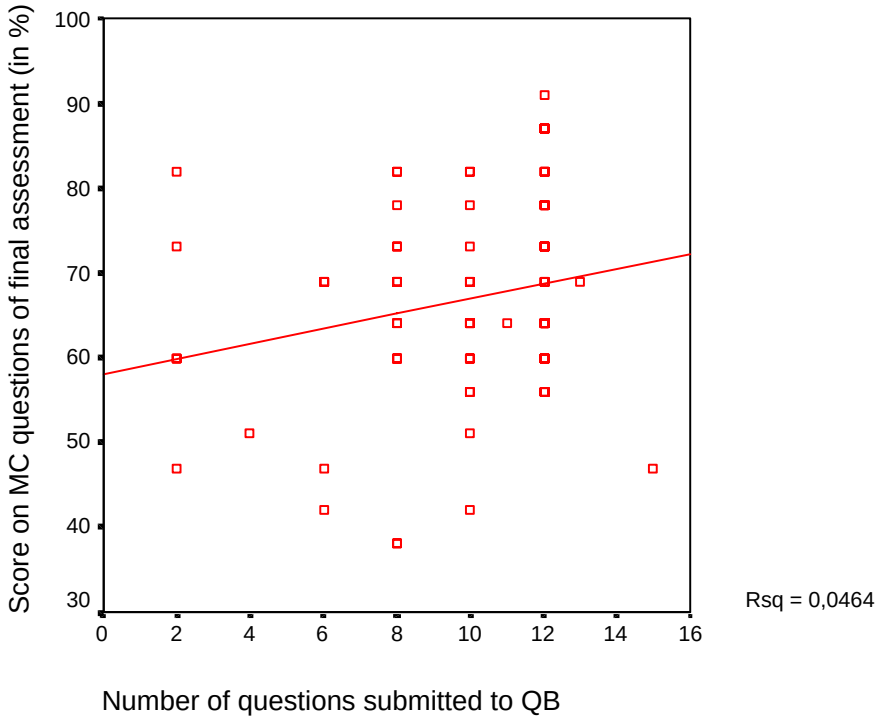


Figure 8. Scatterplot of the score for the multiple-choice part of the final assessment (vertical axis on a scale of 0 to 100) and total number of questions submitted in Questionbank (horizontal axis)

No significant differences between students who had participated in the system and their grade results could be identified.

Conclusion

The first point of interest for Questionbank is whether students think that Questionbank has a positive effect on their learning experience. It can be concluded from Table 1 that, given the conditions of the case, Questionbank does not directly have a positive effect on the learning experience of students.

The second question of interest for Questionbank is whether Questionbank has a positive effect on the input for instructors to design formative and summative assessments more effectively and efficiently. It can be concluded from the instructor's experiences, and given the conditions of the course and Questionbank set-up, that this question can be answered positively.

The final point of interest is whether students achieve a higher score on a formal assessment on the subject matter. Given the conditions of the case, this question must be answered negatively.

Discussion

The case study has shown that Questionbank can function in educational practice. Both the intrinsic motivation (designing questions) and extrinsic

motivation (acquiring a limited number of credits, and knowing in advance that a number of questions will be present in the final assessment) are sufficient for more than 65% of the student population to submit questions into the system. The system is easy to use and a large number of questions are designed and submitted by students.

However, there are a number of matters that need attention for further development and research. We will mention three two of them here.

Firstly, it seems evident that it takes more than one simple and short introduction to students to convince them of the fact that self-questioning is a very worthwhile study technique, let alone to let them acquire sufficient skills to perform the technique in meaningful way. The designers of Questionbank should start to look for ways to support instructors and students to help to resolve these two problems. Though the enthusiasm and persuasiveness of the instructor are of major importance, any help in the form of, for example, a tutorial, a website or Questionbank itself could help. The designers could consider to build ‘wizards’, ‘examples’, ‘hints,’ etc. The designer probably also can draw from various procedures that have, in fact, already been developed (Davey and McBride 1986; King 1989; Rosenshine, Meister et al. 1996; Wright 2001).

Secondly, though the self-questioning technique in itself helps students develop bridges between information in general, it is only when a significant number of questions is developed per unit of information (text, concepts) that a significant gain in the performance on the summative assessment is likely to occur. Questionbank has the features to support this type of question generation: it can create the conditions that can be set for the assignments, such as the minimum number of questions per assignment and the minimum rating per question. It only needs bold instructors to set assignments in this way.

Questionbank can also be regarded as a specific form of working with a Discussion Board. The use of an internet-based discussion board that allows students and instructors to exchange information in a threaded discussion list is similar in many ways to information exchange between students in the form of questions, answers and comments. The use of computer-mediated communication (CMC) in education has grown over the past two decades and has already been researched quite extensively. A review by Tolmie and Boyle (2000), for example, showed that, despite the potential benefits, the effectiveness of CMC when used to support learning in higher education is very variable, which means it is important to identify those factors that best predict successful implementation. We can argue that the same applies to the use of Questionbank in education.

It may prove very effective to have students work in groups with the tool. For example, if students design questions in small groups before submitting the questions to Questionbank, a preliminary discussion of the questions takes place before they are submitted to the system. This will enhance progress in learning. Another way to improve effectiveness could be to have students

compete in designing questions and determine which groups attain the highest score on a specific subject.

All in all, self-questioning is a worthwhile technique in education, and Questionbank can promote the use of this study skill in students' daily practice. Instructors can generate a large number of questions with little effort. However, Questionbank in itself will not resolve the more fundamental instructional problems relating to self-questioning. This requires the commitment of a devoted instructor, and a broader, well-developed methodology.

At the CAA conference on the 5th and 6th of July 2005, we will be reporting on the results of at least two other experiments involving Questionbank in university courses.

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