Students generating questions as a way of learning

Ester Aflalo

Ester Aflalo, Hemdat Hadarom College of Education, P.O.B. 412, Netivot 80200, Israel. Tel. 972-8-9937697. Fax. 972-8-9937688. Email: ester@hemdat.ac.il

Abstract

Student question generation is a constructive strategy that enriches learning, yet is hardly practiced in higher education. The study described here presents a potential model for integrating student question generation into an education setting.133 students generated questions in groups, answered and assessed the questions of their peers. Comparison of the exam grades before and after question generation found that, the activity did not result in a statistically significant improvement in achievements. However, a comparison of only the achievements in answering the higher-order thinking questions revealed an improvement in the students' ability to cope with these types of question. Moreover, the students reported advantages, such as reduction of test anxiety, productive group learning, and the creation of a question bank resulting from the activity, which helped the students study for the exam. The educational implications of the findings are discussed.

Keywords: student questions, question-generation, higher-order questions; active learning, higher education

Questioning in learning and teaching

Questioning lies at the foundation of learning and the students' questions play a crucial role in meaningful learning and learning motivation. In the study of science, questioning is a fundamental component of the research and problem solving process, and a basic skill students must develop (Chin and Osborne, 2008). In order to develop thinking, reasoning, and critical thinking, it is important to encourage questioning (Mason, 2007; Zoller et al., 1997). Students' questions, mainly in-depth questions, indicate that they are thinking about the topic, attempting to link new ideas to existing knowledge, and seeking comprehension (Watts and Alsop, 1995; Furtak and Ruiz-Primo, 2008). The questions help to enhance the student's knowledge; gradually the students clarify the information, discover and complete what is missing (Biddulph et al., 1986) and gain greater motivation for learning (Chin and Kayalvizhi, 2005). The students' questions also help teachers assess the quality of the students' knowledge, expose misconceptions, reveal what students wish to learn, and may also influence the lesson's sequence (Watts et al., 1997; Chin and Brown, 2002; Chin and Osborne, 2008).

The question types and levels can be classified according to the required order of thinking to answer the questions. One of the most commonly accepted classifications is Bloom's Taxonomy (Bloom et al., 1956), which offers a hierarchy of questions ranging from knowledge questions, expressing the lowest order of thinking, to comprehension questions, application, analysis, synthesis, and evaluation. Later, Anderson and Krathwohl (2001) changed the taxonomy by emphasizing the differences between the cognitive processes and classified the questions under the following categories: remember, understand, apply, analyze, evaluate, and create.

Another taxonomy classified questions into two groups: confirmation questions and transformation questions. Confirmation questions are meant to clarify information, define and explain concepts, while transformation questions involve a reconstruction and reorganization of the student's understanding (Pedrosa et al., 2003). Transformation questions are considered questions of higher-order questions. For example, they include Bloom and Anderson and Krathwohl's application, analysis, synthesis, and evaluation questions.

Students ask confirmation and basic knowledge questions on topics they are less familiar with, while they can ask transformation or higher-order questions, with higher potential educational contribution, on topics with which they are more familiar. Students will find it difficult to ask higher order questions when they have just begun to learn a topic. Therefore, in order to ask such questions, the student should have a satisfactory grasp of the subject (Scardamalia and Bereiter, 1992).

Student question-generation

The pedagogical value and importance of student question generation is empirically well founded. A comprehensive analysis of 109 empirical studies on student question generation that were conducted in numerous disciplines and across all ages (from elementary school to college), has led to widespread consensus on its positive effects on learning (Yu, 2012). For example, an extensive study that was conducted on science students from three different universities in Britain examined the effect of three student activities associated with multiple-choice questions: answering questions, generating questions, or checking and commenting on peers' questions. A significant positive correlation was found between these activities and test grades when all three activities were conducted (Hardy et al., 2014). Another comprehensive study which analyzed earlier studies related to teach effectiveness presented a correlation between a low ability to question and poor student achievements (Tisher, 1977).

Similarly, a study of 10th grade science pupils found that students that practiced question-generation improved both their questioning ability and their academic achievements. But, the findings also demonstrated that question-generating skills can serve as an alternative assessment method, mainly to assess higher-order thinking (Dori and Herscovitz, 1999; Offerdahl and Montplaisir, 2014). In fact, student question generation can reinforce knowledge building and connect between learning and assessment (Gulikerset et al., 2004; Papinczak et al., 2012). Medical students that practiced question-generation in their last year of studies felt more confident and exhibited more positive perceptions of their assessment methods (Baerheim and Meland, 2003). Koch and Eckstine (1991) also found that physics students in college improved their reading comprehension when they were taught question-generation skills. This skill stimulated students' self-awareness of difficulties in reading comprehension and could serve as a self-regulated learning.

Studies have shown that students who have implemented self-regulated learning processes have refined their learning skills and developed critical thinking (Nguyen and Ikeda, 2015; Stefanou et al., 2013). Question-generation is an important metacognitive strategy that focuses the student's attention on the content and main ideas and helps develop critical thinking, self-criticism, and creativity (Chin and Brown, 2002; Rothstein and Santana, 2011; Cuccio-Schirripa and Steiner, 2000). An interesting comparison was made between the effect of the students' ability to answer questions and their ability to generate questions, when their academic achievements and cognitive and metacognitive strategies were examined. In contrast to the aforementioned studies, this study found no differences in the academic achievements among the students that were engaged in answering questions and those that generated questions—both activities were found to be equally effective. However, students that were engaged in generating questions displayed significantly higher cognitive strategies and metacognitive skills. These students were more aware of their learning process, were more self-critical and able to self-assess their progress, and more willing to change (Yu and Liu, 2008).

Numerous studies point to the dramatic effect that social factors have on the nature of learning and thinking (e.g., Howe, 1996; O'Loughlin, 1992; Hennessy, 1993). Therefore, question-generation in a group setting may be an even more meaningful cognitive activity than generating questions individually. Discussion among the pupils during the activity stimulates the discernment of various perspectives and possibilities, and develops the ability to reason and critical thinking (Chin and Osborne, 2008). Other findings, however, point to the complexity in benefiting from cooperative learning. For example, in a study conducted on medical students that worked in groups to generate questions for their tests, the researchers found that cooperative learning did not improve the ability to generate questions and did not influence their learning habits (Jobs et al., 2013).

Although most studies indicate that student question generation's value in promoting learning, this activity has barely been incorporated into a learning setting. Many lessons tend to be teacher-controlled monologues. The students in the class ask few questions (Nystrand et al., 2003), and when they do ask questions, the majority are confirmation basic knowledge questions requiring regurgitation of the information (Chin and Brown, 2002; Dillon, 1988; Middlecamp and Nickel, 2005). In higher education, particularly, the students' focus is on questions that the teachers ask or that are taken from textbooks. Formulating questions by oneself, mainly those involving higher order thinking, is a process that most students practice to a limited extent (Dori and Herscovitz, 1999; Yu and Chen, 2014).

Several reasons have been proposed for students' limited question-generation. Teachers that do not feel confident enough in their discipline will suppress questioning. Alternatively, teachers that studied the topics they teach via a didactic approach based on frontal teaching will teach this way themselves and not encourage pupils to ask questions (Woodward, 1992). When the teacher constantly controls questioning in a lesson it encourages the pupils to be passive (Good et al., 1987). Also, the atmosphere in the class, the pupils' fear of a negative response, and teacher-pupil relations will influence the pupils' questioning (Dillon, 1988). The number and type of questions the pupils ask depends on numerous additional factors, such as the pupils' age, their experience, skills, nature of the studied subject and interest in it and their proficiency in the subject (Shodell, 1995).

As stated, many studies have dealt with ways in which the teachers ask questions, the types of teacher's questions and their impact on student learning. However, there are far fewer systematic studies about student question generation. The importance of the current study lies in adding data and knowledge to the study of student question generation, as well as presenting a potential teaching model for teachers in higher education. The model combines three different activities: 1. Student question generation 2. Students answering questions generated by their peers 3. Peer-assessment of other students' questions. The study examines the effect of question-generation by students after they have studied topics and have attained a certain degree of proficiency with the material. There is a need to clarify whether the students would improve their achievements and their cognitive capabilities after participating in a group question-generating exercises, and after answering and assessing their peers' questions. Another is to examine whether the experience affects other factors such as cooperative learning, increasing self-confidence, reducing test anxiety, and so forth. This leads to the following research questions:
Does the practice of students generating, answering, and assessing questions improve final exam grades?
Does the practice of generating questions at higher order thinking and answering them improve students' ability to cope with such questions in an examination?
What are the students' opinions on generating, answering, and assessing questions? Do it contribute, in their opinion? If yes, in what way? If no, then why not?

Methodology

The research approach

The research is based on comparative pre / post-test intervention. The intervention refers to the students engaging in generating, answering, and peer assessment of questions in a cell biology course.

Participants

The research population included six classes of science education students taking a cell biology course, in two academic education colleges in Israel. The two colleges are located in the south of Israel, are attended mainly by females, and their science education curricula are very similar. A total of 133 students participated in the study (118 women and 15 men), with an average age of 22.3 years. The number of students in each class is detailed in Table 1. All the students studied the same course syllabus with the same lecturer, who had around 20 years of teaching experience.

The research process

The study was conducted over four academic years, between 2010 and 2014. The course was taught in each of the six classes for two semesters, one semester from October to January and the second semester from March to June. The lessons for each course were given once a week for two hours, for a total of 56 hours per course, 14 lessons per semester. In the first semester, the students did not engage in question-generation. In the last lesson of the first semester, time was set aside to study for the examination. Students were given examples of questions and given the opportunity to ask questions on each of the topics studied during the semester. In the second semester, the students engaged in question-generation and the activities were conducted according to the following breakdown:

In the fifth lesson of the second semester, the students were presented with examples of questions at various orders of thinking on a topic that had already been covered. The students were already familiar with the concepts pertaining to the types of questions and Bloom's taxonomy from their education courses. However, the students had little experience with classifying questions. To simplify matters, the classification of Pedrosa et al. (2003) into two groups of confirmation and transformation questions was demonstrated; the first were basic knowledge questions and memorization, and the second were higher orders thinking questions which included all other types of questions, such as comprehension, application, and synthesis questions. The activity lasted around 30 minutes and at the end, the students were given a homework assignment to be completed in pairs. The exercise, which was a course requirement, included generating three questions about transport through the cell membrane, at least two transformation questions. The students were required to upload the questions to the course website within a week and to answer and comment on another pair's questions.

In the seventh lesson, examples of student questions were presented in class and a discussion was conducted on the questions' level, clarity, and solutions. The class activity lasted around 40 minutes. Some of the students reported difficulty in generating questions, mainly transformation questions, and mentioned the long time they spent on the exercise.

The final lesson of the second semester was entirely devoted to generating and answering questions by the students. At the beginning of the lesson it was stressed to the students that the activities in the lesson would help them summarize and organize the material and result in building a question bank to help them review for the examination. Moreover, the sequence and nature of the activities, as they are detailed below, was briefly explained in advance:

- The teacher divided the class into 4–5 groups of 3–4 students, depending on the size of the class. Each group was heterogeneous with regards to their achievements in the first semester and included students that received a high grade in the first semester and students with mediocre or poor grades.

- Each group was given one main topic from among the topics studied during the second semester and was asked to generate five questions about their topic, at least three transformation or higher order thinking questions. Forty minutes were allocated for the question generation and the students used the materials from the lectures, the course website, digital books, and various websites to help them with the assignment.
- During the question generation, the groups were guided by the teacher, who mostly helped with transformation question generation, and encouraged the less active students to participate. The group uploaded the questions to the course website only after teacher approval.
- When the 40 minutes of question generation were up, each group received another group's questions, answered them for around 30 minutes, and also commented on their level and clarity. The answers and the comments were given to the group that generated the questions and the group checked the answers and read the comments on their questions.
- When the activity was over, a bank of around 25 questions on all the course topics in the second semester was created and uploaded to the course website. 60% of the questions were higher order thinking questions.

To summarize, the sequence of the question-generation, answering and peer-assessment activities was as follows:

A class discussion on the types of questions and their classification. 2. A homework assignment to generate, answer and assess questions. 3. A class discussion on the homework assignment. 4. A group activity in class to generate, answer and peer-assessment questions. 5. Creating a question bank.

Data sources

In order to examine the effect of student question generation, the following sources were used:

1. Examinations — At the end of each semester, the students were tested on the topics covered during the semester. Each examination included around 15 questions, the majority of which (around 11) were closed confirmation questions involving knowledge and memory, and four questions (around 25% of the examination) were open transformation questions that tested comprehension, application or synthesis. The examinations were very similar for all six groups, with minor variations.

2. Questionnaire — The students from classes 4, 5, and 6, a total of 57 students, were asked to answer the following question in writing: "Did you benefit from engaging in question generation coupled with solving and assessing questions? If yes, in what way? If no, then why not? Explain and elaborate as much as possible." The students answered the question in the last lesson of the second semester, at the end of the activity, for around 15 minutes.

Data analysis

The student exams in the first and second semesters were graded and the averages and standard deviations of each group's grades and of all the groups' grades were calculated. The four higher order thinking questions were graded using a uniform gauge: points were given for the accuracy of the answers, a description of the explanation, and the reasoning. The average grade and standard deviations for the thinking questions of each student, each group, and all the groups overall were calculated. 30 out of 133 examinations (5 examinations from each group) were graded by an additional lecturer with extensive experience in cell biology. The correlation between the grades was high, at 89%. For a comparison between first semester and second semester grades for each student, paired t-tests between the overall grades of the examinations in each semester and between the grades for only the thinking questions were conducted. In addition, an ANOVA test was conducted to examine the differences between the groups' grades. No significant differences were found between the groups with regards to the overall examination grades in each semester and also with regards to the grades for the thinking questions, and therefore all the students can be treated as one group.

The answers of the 57 students to the question pertaining to the benefit of engaging in question-generation generally included more than one statement. A total of 110 statements were obtained. The responses underwent content analysis (Marshall and Rossman, 2011) and were divided into categories that were constructed according to the content of the statements. The categories were determined separately by two researchers to check for consistency. Several differences were found between the two analyses and after a joint discussion a consensus was reached to divide the students' statements into six categories. The categories detailed in Table 3 include, for example, reference to the question bank, to the skill of question-generation, or to cooperative learning. The percentage of students that stated the category and percentages of each category of all the statements were calculated.

Findings

The examination grades before and after question generation

Table 1 presents the comparison between each class's exam grades in the first semester- before student question generation and the second semester grades- after student question generation. It can be seen that there was no statistically significant increase in examination grades in most classes after engaging in question-generation. A statistically significant rise in grades after engaging in question-generation was only evident in two of six classes. A review of all the students also found that question-generation did not affect the overall examination grade.

Table 1. The students' overall test grades before and after student question generation (SGQ)

Class	No. of students	Overall grade before SQG (SD)	Overall grade after SQG (SD)	*t*	*df*	*p*
1	25	73.36 (17.52)	74.44 (14.05)	.65	24	.52
2	25	71.28 (16.84)	74.72 (17.99)	2.50	24	.02*
3	26	68.04 (18.72)	72.12 (16.98)	2.22	25	.04*
4	27	74.26 (14.58)	71.93 (14.57)	1.07	26	.29
5	15	70.93 (16.04)	72.93 (12.71)	.76	14	.46
6	15	74.13 (18.16)	73.93 (15.42)	.09	14	.93
Total	133	71.92 (16.82)	73.30 (15.32)	1.71	132	.09

Higher order thinking question grades before and after question generation

A comparison between only the higher order thinking question grades on the examination before and after student question generation presents a different picture than a comparison of the overall examination grade. As Table 2 shows, an examination of all the students shows that there is a statistically significant rise in the higher order thinking question grades after the students engaged in question-generation. However, this rise was not exhibited in all the classes. In fact, a statistically significant rise in grades after questions generation was only evident in three of the six classes.

Table 2. Higher order-thinking question grades before and after student question generation (SGQ)

Class	No. of students	Grade before SQG (SD)	Grade after SQG (SD)	*t*	*df*	*p*
1	25	57.80 (30.75)	62.60 (28.87)	1.08	24	.52
2	25	39.00 (28.02)	62.40 (30.62)	5.39	24	.00**
3	26	52.88 (29.43)	64.42 (26.62)	2.48	25	.02*
4	27	58.15 (25.84)	61.85 (24.30)	.85	26	.40
5	15	43.33 (19.97)	65.33 (29.43)	3.71	14	.00**
6	15	51.67 (29.07)	60.00 (22.76)	1.09	14	.29
Total	133	51.05 (28.23)	62.78 (26.86)	5.56	132	.00**

The benefit of question generation - students' responses

The students' responses regarding the benefit of engaging in question-generation, divided into six categories, is summarized in Table 3. The statements on the benefit of the question bank generated by the activities were the most prominent, over 70% of the students wrote about the importance of the question bank in reviewing for the examination. 20% of the students also stated that generating the questions reduced their test anxiety. Around one third of the students addressed the skills they acquired, such as formulating questions and checking and assessing the answers, skills that were important to them as future teachers. 28% of the students wrote statements about being better equipped to cope with thinking questions and around a quarter of the students stated the benefit of the group work and the enjoyment from cooperative learning. In contrast, around 16% of the students wrote that they did not benefit from the exercise, which they claimed was too short or too difficult.

Table 3. The students' opinions on question-generation activities

Category	% of Students n= 57	% of Statements n= 110	Selected student statements
Preparing for the exam – question bank	73.68	38.18	'The question bank made it easier for me to prepare for the exam'; 'I was mostly happy with the question bank because I could review them before the exam'; 'The question bank was the most beneficial. I wish it was possible to build a bank like this in other courses'
Question generating and assessment skills	31.58	13.64	'This experience is really important for me as a future teacher who will be compiling tests. This is the first time I did this'; 'When we tried to generate higher order thinking questions, it was hard. At first we generated a lot of closed and relatively simple questions... but this is how we acquired tools to generate all sorts of questions'
Coping with higher order thinking questions	28.07	14.54	'I hope that writing and solving complex questions will help me cope with these types of questions in the exam'; 'The

			exercise helped me better understand open questions’
Cooperative learning	24.56	15.45	‘I enjoyed the group work in class, mainly in the last lesson, there was a great atmosphere’; ‘My group was strong and we managed to generate nice questions’
Test anxiety	21.05	10.90	‘I hope that I will be less anxious of the 2nd semester exam because of the exercise and the question bank’; ‘The question writing exercise was important for me because I really suffer from test anxiety...’
Did not contribute much	15.78	2.80	‘I prefer answering questions to generating questions... It’s what I’ve been accustomed to’; ‘Engaging in question writing was good but too brief and I don’t feel that it helped me much’; ‘I had a hard time generating higher order thinking questions. Even generating closed questions was complex...’

Discussion

An analysis of the findings shows that the students’ engagement in question-generation did not significantly improve most students’ examination grades. Two of the six classes did, in fact, exhibit an improvement in the examination grades. However, the fact that there was no statistically significant rise in grades in four of the classes after the question-generation activity reinforces the hypothesis that the improvement in the two classes was not necessarily related to question-generation. These findings seem to contradict other empirical studies that have shown student question generation’s contribution to academic achievements (Yu, 2012). However, a more in-depth analysis referring to student achievements in only the higher order thinking questions (comprising only 25% of the overall examination grade), presents a different picture.

An analysis of all the students indicates that the achievements in solving higher order thinking problems after engaging in question-generation resulted in a statistically significant increase. It seems that after a relatively brief exercise in question-generation, the students’ cognitive abilities improved. Similarly, Yu and Liu’s study (2008) found that students that engaged in question-generation exhibited significantly higher cognitive strategies. It is interesting to note that when the students in the current study were asked about how the question-generation activities helped them, some hoped that formulating higher order thinking questions would improve their ability to cope with such questions. The students wrote their opinions down before they took the second semester examination, and indeed the thinking question grades improved. It is important to emphasize that the students composed questions only after they were familiar with the topics. The degree of proficiency with the material had a direct effect on the type and level of the questions (Scodell, 1995) and the students in the study described here were given the required knowledge foundation to formulate higher order thinking questions.

The student question generation activity in this study was conducted in pairs (the homework exercise) or in groups (class exercise). The beneficial effect of cooperative learning on thinking, reasoning, and the nature of learning has been known for some time (O’Loughlin, 1992; Hennessy, 1993; Chin and Osborne, 2008; Hsiung, 2012). It can be presumed that the discussion between the students during the question-generating activity, the sharing of knowledge and the need to hone and clarify matters contributed to more in-depth thinking about the topics, which led to an improved coping with the higher order thinking questions. Some of the students also wrote explicitly about the contribution of group learning to the question generation and the peer assessment and to their enjoyment from the cooperative learning.

Despite these encouraging findings, they must be treated with caution. An analysis of each class's achievements in the higher order thinking questions found that there was not a statistically significant improvement in grades after the question-generation exercise for all the classes. Although statistically no differences were found between the groups and all six classes can be addressed as one group, it is important not to overlook the fact that for three classes there was no improvement in the higher order thinking question grades. Also, the relatively high value of the standard deviations of the average grades highlights the significant differences between students.

Undoubtedly, a different social environment and dynamic develops in the different classes, which influences the individual's learning. Furthermore, it can be presumed that the group activity is not effective for students that have difficulty cooperating or those that prefer to study alone. Students are differentiated by their learning approaches, interest and ability to take risks or cope with uncertainty (Pedrosa et al., 2003). All these may affect their flexibility to change learning strategy and to engage in tasks that they were not accustomed to, such as question-generation. Another explanation is that the duration of the activities (less than three hours in class and one homework assignment) were too short. As stated, generating questions, unlike answering questions, is a new and difficult exercise for most students and some require more time, encouragement, and structured support (Chin and Brown, 2002).

From an analysis of the students' opinions regarding the entire set of activities of generation, answering, and peer assessment of questions, the practical aspect of the question bank's advantage for reviewing for the examination was the most prominent. It is clear, knowing that the activity would lead to building a shared review question bank was the students' main motivation. It was expected that the students, who aspired to succeed on the examination and were very focused on this goal, would readily engage in an activity that could potentially lead them to their goal directly. A similar study was conducted on medical students who worked in small groups to build a question bank while also checking and assessing their peers' questions. The study showed that 91% of the students believed that the bank had significant value in reviewing for the examination and they expressed a desire to build such banks in the future as well (Gooi and Sommerfeld, 2015).

However, in another study on medical students that engaged in a group activity of question-generation, Papinczak et al. (2012) showed that the question bank the students built did not contribute to in-depth learning. The students were promised that 25% of the examination questions would be composed of the questions they would formulate and they chose mainly to memorize the questions and answers. In contrast, in the study described here, the students were not promised that their examination would contain questions from the bank they built, although it was stressed that some of the examination questions may be similar. Perhaps this adversely affected some of the students' motivation to generate questions, but it may have also prevented them from adopting superficial learning tactics.

The majority of students in the study described here, who had not previously engaged in systematic question-generation, were surprised to discover how difficult the assignment was. Some of the students wrote that the activities helped to improve their question-generating and assessment skills, but as preservice teachers they asked to continue to strengthen these skills. The students also had virtually no experience in peer assessment and giving feedback. The empirical evidence on the contribution of peer assessment is sizeable and indicates that it promotes critical thinking, cognitive development, and performance (Nelson and Schunn, 2009; Topping, 2010; van Gennip et al., 2010; Mulder et al., 2015). Yu and Wu (2016) recently showed that students that give quality feedback to their peers' questions tend to generate higher quality questions. In addition to promoting cognitive abilities, the question generation in this study, coupled with the peer assessment, encouraged the students to reflect on the questions they composed and on their learning in general.

One of the limitations of the study is that the comparison between each student's first semester grade (the control – prior to question generation) and the second semester grade (the experiment – after question generation) was conducted on different topics that were studied during each semester. Diverse topics, even in the same discipline, may affect the degree of comprehension and the ability to cope with the examination questions.

Additional limitations were the relatively brief time of engaging in question-generation and the relatively small number of students that answered the open question (only 57). It can be presumed that a more prolonged and thorough engagement would have led to a more inclusive improvement in the students' grades. In addition, all of the participants in the study were undergraduates, all were studying the same discipline, and were from only two colleges in the same country.

A more general limitation relates to the research tool: examinations, and the basic question of their effectiveness as a measure of students' learning. Examinations are still a very common assessment method, and it is important to be aware of their limitations. When using a summative evaluation, rather than a formative evaluation, we should address the question of how well we can assess a student's learning using grades. Further research on different forms of evaluation is needed, also for other disciplines and other types of universities or cultures. For other years,- levels, disciplines, universities, cultures, or evaluation methods the results might have been different.

In conclusions, the study described here demonstrates that even a relatively brief engagement in generating comprehension and application questions by the students improved their ability to cope with these types of questions in the same discipline. Furthermore, student question generation presents additional advantages, such as reducing test anxiety, acquiring skills in formulating questions or productive group learning. The main conclusion from these encouraging findings and also from other researchers' findings is that student question generation should be adopted as a built-in and more prominent activity in the curriculum.

In order to encourage students to generate questions, teachers, the majority of whom were accustomed to teaching as they were taught, need to be trained accordingly. Teachers must challenge the students to question and can stimulate their motivation in setting goals such as building a review question bank for an examination. It is also important that the students become familiar with the taxonomy of questions. Different types of questions on various topics must be demonstrated, class time must be allocated to formulate questions and give homework that include question-generation.

It is recommended that the students' engagement in formulating questions at higher thinking orders after a basic competence in the material is achieved. Some of the students in the study had difficulty formulating even simple knowledge questions, all the more so higher order thinking questions, due to inadequate mastery of the subjects.

It is highly recommended that students be allowed to generate questions in groups and solve and assess their peers' questions. The interaction and the cooperative learning impart significantly valuable cognitive and metacognitive advantages. Generating questions forces the students to master the material and the peer assessment stimulates reflection on the individual learning.

Students' ability to generate questions may serve as a means to assess higher-order thinking, as shown by Dori and Herscovitz (1999) for example, and therefore question-generation has the potential to serve as an alternative assessment tool to conventional assessment methods.

In summary, student question generation is a constructive strategy of active learning with valuable potential. The study described here offers teachers a potential model to incorporate student question generation in their teaching. The more teachers incorporate student self-generation and peer assessment of questions into their lessons, instead of sufficing with answering questions, the more they will promote learning where the students are more active and involved in their learning.

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