

## Students Generating Questions as a Way of Learning

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### 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. In all, 133 students generated questions in groups, answered and assessed the questions of their peers. Comparison of the examination 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 examination. The educational implications of the findings are discussed.*

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

### Introduction

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). 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, extensive research presented a correlation between a low ability to question and poor student achievements (Tisher, 1977). 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).

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 and when they do ask questions, the majority are confirmation basic knowledge questions requiring regurgitation of the information (Chin and Brown, 2002; Middlecamp and Nickel, 2005).

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 study described here 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 research questions:

Does the practice of students generating, answering, and assessing questions improve final examination 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? Does it contribute, in their opinion? If yes, in what way? If no, then why not?

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## Methodology

### Participants

The research population included six classes of science education students taking a cell biology course, in two academic education colleges in Israel. A total of 133 students participated in the study (118 women and 15 men), with an average age of 22.3 years.

### 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 and the lessons for each course were given once a week 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 second semester, the students engaged in question generation and the activities were conducted according to the following:

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 activity lasted around 30 minutes and at the end, the students were given a homework assignment to be completed in pairs. The exercise 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 final lesson of the second semester was entirely devoted to generating and answering questions by the students. The sequence and nature of the activities:

- The teacher divided the class into 4–5 groups of 3–4 students, depending on the size of the class.
- 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 questions.
- The group uploaded the questions to the course website only after teacher approval.
- Each group received another group's questions, answered them and commented on their level and clarity.
- 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.

### 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 and four questions (around 25% of the examination) were open transformation questions that tested comprehension, application or synthesis.
2. Questionnaire — The 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."

## 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 (SQG)

Class	No. of students	Overall grade before SQG (SD)	Overall grade after SQG (SD)	<i>t</i>	<i>df</i>	<i>p</i>
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.

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

Class	No. of students	Grade before SQG (SD)	Grade after SQG (SD)	<i>t</i>	<i>df</i>	<i>p</i>
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. 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
Preparing for the exam – question bank	73.68	38.18
Question generating and assessment skills	31.58	13.64
Coping with higher order thinking questions	28.07	14.54
Cooperative learning	24.56	15.45
Test anxiety	21.05	10.90
Did not contribute much	15.78	2.80

### 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 findings is that student question generation should be adopted as a built-in and more prominent activity in the curriculum. Student question generation is a constructive strategy of active learning with valuable potential. This study offers teachers a potential model to incorporate student question generation in their teaching.

### References

- [1] Chin C and Brown DE (2002) Student-generated questions: A meaningful aspect of learning in science. *International Journal of Science Education* 24(5): 521–549.
- [2] Chin C and Osborne J (2008) Students' questions: a potential resource for teaching and learning science. *Studies in Science Education* 44(1): 1–39.
- [3] Dori YJ and Herscovitz O (1999) Question-posing capability as an alternative evaluation method: analysis of an environmental case study. *Journal of Research in Science Teaching* 36(4): 411–430.
- [4] Gulikers J, Bastiaens T and Kirschner P (2004) A five-dimensional framework for authentic assessment. *Educational Technology Research and Development* 52(3): 67–76.
- [5] Middlecamp CH and Nickel AL (2005) Doing science and asking questions II: An exercise that generates questions. *Journal of Chemical Education* 82(8): 1181–1186.
- [6] Offerdahl EG and Montplaisir L (2014) Student generated reading questions: Diagnosing student thinking with diverse formative assessments. *Biochemistry and Molecular Biology Education* 42(1): 29–38.
- [7] Papinczak TR, Peterson AS, Babri K, et al. (2012) Using student-generated questions for student-centred assessment. *Assessment & Evaluation in Higher Education* 37(4): 439–52.
- [8] Tisher RP (1977) Practical insights gained from Australian research on teaching. *Australian Science Teachers Journal* 23(2): 99–104.
- [9] Yu FY (2012) Learner-centered pedagogy + adaptable and scaffolded learning space design-online student question-generation. In *International Conference on Computers in Education* (pp. 26-30). Singapore.