The impact of students' generating and answering questions on their performance

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A B S T R A C T

The aim of the research is to measure the effect of students' use of the strategy of writing questions and answering them on their achievement performance. The researcher used the achievement test to measure the differences between variables, and checked the research tool from validity-consistency-experimental application. But for the implementation of the research experiment, the students were divided into three groups, namely: The experimental group 1 (generating questions and answering them by the learners in groups), the experimental group 2 (forming and answering the questions of the learners individually), and the control group (forming questions by the teacher). In addition, the researcher used the mean and standard deviation to answer the research question and compare student performance in all three research groups. The results showed that there were significant differences between the averages of the research groups, as the experimental group 2 achieved a higher average (26,474) than the experimental group 1 (24,333) and the control group (24,857).

1. Introduction

Teaching and learning environments contain a lot of strategies and activities that aim to improve the effectiveness and efficiency of the learning experience. Over the years, educational practitioners investigated many interventions that help students' experience effective learning. One of these interventions is active learning. It has been defined by many theorists such as Piaget (1936) and Vygotsky (1978). According to Piaget (1936), active learning is the construction of the knowledge and meaning by the learner via the interaction with the environment, whereas Vygotsky (1978) believed that active learning is the construction of the knowledge and meaning by the learner via social and collaborative interaction with peers.

Active learning has received substantial attention, and many studies had explored different strategies to actively engage students in small and large classes (Preszler et al., 2007; Hidayat et al., 2012). Active learning activities help students gain more knowledge and understanding of the course's

material (Braxton et al., 2000). According to Rowles and Russo (2009), active learning and critical thinking can be promoted using questioning strategies. However, the traditional way of using questioning strategies in our classrooms depends on passive learning since it focuses on asking the students different questions created by the instructors (Tofade et al., 2013). These questions could be different in types or styles, yet they are created by the instructors of the course or taken from the question's bank. Even though this process of questioning could test the remembering and understanding capabilities of the students and improve their comprehension and performance, the instructor-generated question has some limitations.

First, because students sometimes are not able to determine the important aspects of the material, they tend to ignore the questions provided by the instructor or answer them simply (Byun et al., 2014). Second, having prior knowledge is critical to answering the questions provided by the instructors, and if the students do not have this relevant knowledge, they may fail to promote their learning and comprehension and may be less likely to benefit from the questions (Byun et al., 2014). Third, instructor-generated question strategy could affect students' motivation and spontaneous dialogue negatively (Byun et al., 2014). Additionally, students in the process of instructor-generated questioning strategy are passive learners and do not have any active role in this process. For all these limitations of

the traditional questioning strategy, it was necessary to apply different interventions to increase the efficiency of the questioning strategy and apply active learning.

One of these interventions is the students questioning or self-generation. It means that instead of reading text and answering questions composed by the instructor, students are encouraged to generate their own questions and find answers to these questions. Also, Taboada and Guthrie (2006) defined students questioning as " self-generated requests for information within a topic or domain, relies on assessing what is known and what is unknown about a topic and attempting to expand existing knowledge of the topic". It provides the students with the opportunities to apply higher-order thinking skills such as analysis and synthesis. When learners read text, analyze it, determine important points, and synthesize questions, they improve their critical thinking and understanding of the material (King, 1991). Weinstein et al. (2010) mentioned that the self-questioning strategy enhances the memory of the students, especially in to-be-remembered information, and allows students to produce greater elaboration leading to more retention. In addition, question generation helps students make more attention to the content and combine information which leads to more comprehension (Rosenshine et al., 1996).

Question self-generation is also supported by the active learning theory. During the process of composing questions, students play an active role in the learning process since they inspect the content, determine the important information, and tie them together (Rosenshine et al., 1996). According to Braxton et al. (2000), these activities help students gain more knowledge and understanding of the course's material and enhance the recalling process. Based on Bloom's taxonomy, self-questioning encourages students to promote a higher form of thinking from knowledge to evaluation (Khaki, 2014). Many studies had explored the effects of self-questioning students' performance and comprehension. King (1992) conducted a study to investigate the effect of self-questioning compared to taking notes and summarizing the lecture. He found that in terms of long-term retention, students who generate self-question performed better than students who took notes or who summarized the lecture. Also, Khaki (2014) asserted that students who generated their own questions performed better than students who just answered the questions posed by the teacher. A meta-analysis conducted by Wong (1985) found that using a self-questioning strategy with students who studied at different educational levels promoted their reading comprehension compared to students who used different strategies. In a subsequent review, Joseph et al. (2016) examined 35 self-questioning studies conducted in K12 schools. They found sufficient evidence that self-questioning helps students at all levels to comprehend the content. They also indicated that self-questioning had a positive impact

on students' exams that contained short answers, recalling information, and retelling key thoughts.

Overall, the self-questioning strategy has been proven an effective strategy to increase the comprehension and the active role of the students. Braxton et al. (2000) mentioned that the self-questioning strategy could be improved by increasing the active learning activities that required social interaction among the students. When students work in small groups and construct their own questions, they will have more opportunities to assist each other and increase their understating of the content. According to Vygotsky (1978), when peers work collaboratively and interact with each other, the expert students will have the opportunity to assist the less knowledgeable students to extend their development to a higher level. Doing so will increase the effectiveness of the self-questioning strategy and help students to cope with some of the limitations of this strategy (Khaki, 2014).

However, most of the studies implemented a self-questioning strategy using one method, which asked learners to generate their own questions and answer these questions. Even though this method seems to be effective as mentioned in the literature, the researcher believed that it is less challenging, and learners may generate questions on basic information or less complicated materials since they will answer these questions. To increase the effectiveness of the self-questioning strategy, the researcher proposed a new method that relies on asking learners to generate questions individually or in groups and passes them to their peers to answer each other's questions. This method will help learners read the material carefully and deeply to understand what they read for two purposes: 1) generating challenged and well questions from their peers will answer them and judge them based their question, 2) understanding the materials from their peers should ask them well and challenging questions.

To the best of the researcher's knowledge, no studies have been conducted to compare the effect of the new self-questioning strategy in the form of individual and collaborative with the traditional way of questioning strategy, and Joseph et al. (2016) asserted that no studies had compared the effect of self-questioning strategy between groups and individual learning. Therefore, this study aimed to explore the impact of the new self-questioning strategy on students' achievement. Based on this purpose, there was one research question:

Are students who complete the new self-questioning strategy are more likely to perform significantly better on a final exam than those who do not?

2. Methodology

2.1. Research design

The purpose of this study was to explore the impact of students' generating and answering

questions on students' performance. Since this study used existing groups (students in 242 Wasl course) randomization was not applicable, and quasi-experimental design, nonequivalent control group design, was applied. According to Cohen et al. (2000), when randomization is unachievable, the researcher uses a quasi-experimental design. The specific quasi-experimental design had been used in this study is "comparison groups posttest design". The reasons behind using only post-test instead of using pre and post-test design is for the following: 1) the course was an elective course, and no prerequisite course was required, 2) the knowledge of the course was new to all the students because it is out of their majors, 3) all students assured that they were taking the course for the first time. Due to all these reasons, the researchers believed that all students had the same knowledge baseline from the beginning of the course and there was no need to test that via a pre-test.

In this study, there were three groups: the experimental group 1 (generating and answering questions by the learners in groups), the experimental group 2 (generating and answering questions from the learners individually), and the control group (generating questions by the teacher) as shown in Table 1. This research design helped the researcher to compare the performance of the experimental groups 1 and 2 with the control group to determine the effect of the generating and answering questions strategy.

Table 1: Design of the study

The quasi-experimental study	
Experimental group (1)	Generating and answering questions by the learners in groups
Experimental group (2)	Generating and answering questions from the learners individually
Control group	Generating questions by the teacher

The study applied a comparison group posttest design with 1) generating and answering questions by the learners in groups, 2) generating and answering questions from the learners individually, 3) and generating questions by the teacher, as the independent variables and students' performance as a dependent variable as shown in Fig. 1.
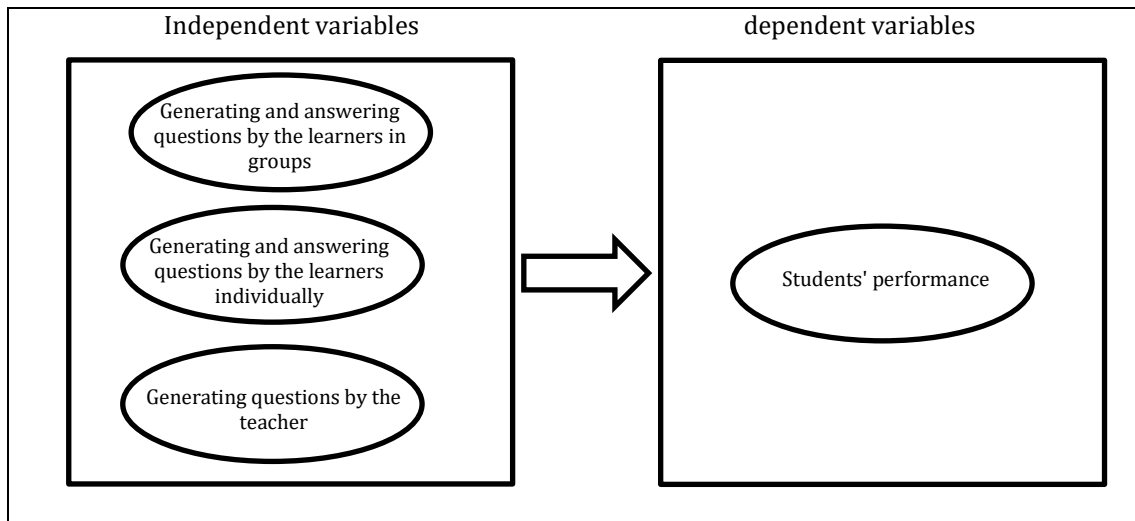
Fig. 1: Variables of the study

2.2. The setting and participant

The study was conducted at King Saud University in the College of Education. The population of this study was undergraduate students who studied in this college. The sampling strategy applied in this study was a naturally occurring group; therefore, students who enrolled in 242 Wasl courses were the sample of this study. This course is an elective course, and there is no prerequisite course for it. Also, it is a very basic course about the use of technology in the education setting. The course had been taught by the researcher during the entire semester through 12 weeks. All the sections of the course were taught at the same time but on different days.

There were 65 students registered in this course, and they were divided into three groups (sections) where a control group contained 28 students, experimental group 1 contained 18 students, and an experimental group 2 contained 19 students as shown in Table 2. The researcher described the study to the students, and how the data would be used. All students were agreed to participate in this study and completed a consent form.

Table 2: Groups of the study

Course	Group	Section	N
242 Wasl	Experimental group 1	1101	18
	Experimental group 2	1102	19
	Control group	1103	28
Total			65

2.3. The instrument

To determine the impact of students' generating and answering questions strategy on their performance, the study investigated the students' performance on their final exam (post-test). Therefore, the final exam was the only instrument used in this study. The researcher decided that the

final exam would include multiple-choice, true and false, and matching questions. These types of questions had been chosen to reduce the bias of the graders and increase the validity of the test. The exam included 14 true and false questions, 13 multiple-choice questions, and 13 matching questions. The total of the questions was 40 questions, and each question was worth one point.

As mentioned by Cohen et al. (2000), validity and reliability are important keys to effective quantitative research. To ensure the validity of the final exam, content validity had been conducted, and it means "how well the content material was sampled in the measure" (Rubio et al. 2003). Two faculty of the Instructional Technology Department judged the final exam, and the researcher modified the final exam based on their feedback.

To ensure reliability, the researcher applied the exam after it had been validated by the faculty on a sample (25 students) from the same population but out of the sample of the study. It had been counting one score for each right answer and zero for each wrong answer. The exam took two hours to be completed by the sample. To test the reliability of the exam, Kuder-Richardson 20 formula (K-R20) had been used. The result of K-R20 showed 0.78 and this result is considered great since it is above 0.70 (Fraenkel and Wallen, 2008).

2.4. Study procedure

At the beginning of the semester, the researcher divided the students who enrolled in the 242 WASL courses into three groups as shown in Table 1. Experimental group 1 was assigned for generating and answering questions by the learners in groups, whereas experimental group 2 was assigned for generating and answering questions from the learners individually. The control group was assigned for answering questions generated by the teacher. In the first class of the semester, the researcher described the self-questioning strategy to the experimental group 1 and 2 and clarified the

benefits of it and how would be applied all over the semester.

Briefly, students in experimental group 1 would be gathered in small groups which contained from three to four members. They would sit together after the end of the lecture and start to generate questions collaboratively using the provided by the researcher. After they wrote the questions, they passed them to another group and took the other group's questions, and started answering these questions. All small groups did this process fourth times during the semester. However, the researcher made the process difficult each time. At the first time, students generated the questions and answered their peer group questions using open books and notes. The second time, students used their book and notes only to generate questions and they could not use them to answer their peer group questions. The purpose of this modification was to help students review their material before coming to the class. In the third and fourth time, students generated the questions and answered their peer group questions without using their book and notes. Also, the purpose of this modification was to encourage students to study at home before coming to the class.

On the other hand, experimental group 2 would follow the same procedure as the experimental group 1 however, they did all the procedures individually instead of small groups. Lastly, students in the control group received the questions written by their teacher and they answered them individually. They did that fourth time during the semester.

At the end of the semester, the researcher conducted a post-test (final exam) for all students in all groups. The exam included multiple-choice, true and false, and matching, and students answered them individually in two hours. This exam was used to compare the performance of the students between the research groups. The procedures are summarized in Table 3.

Table 3: Performance of the groups

Group	First class	First time	Second time	Third time	Fourth time	last class
Experimental group 1	1. descried the self-questioning strategy 2. sit the small groups	After the lecture, they wrote questions in group and answer their peer group questions in group using book and notes	After the lecture, they wrote questions in group using book and notes, but they answer their peer group questions in group without using book and notes	After the lecture, they wrote questions in group, and they answer their peer group questions in group without using book and notes		Post-test (final exam)
Experimental group 2	descried the self-questioning strategy	After the lecture, they wrote questions individually and answer their peer questions individually using book and notes	After the lecture, they wrote questions individually using book and notes, but they answer their peer questions individually without using book and notes	After the lecture, they wrote questions individually and they answer their peer questions individually without using book and notes		Post-test (final exam)
Control group	Regular class	After lecture, they answered questions written by their teacher without using book and notes				Post-test (final exam)

2.5. Data analysis methods

The study has one question: 1) Is there any significant difference between the experimental groups and the control on students' performance? The data analysis used to answer the research question was One Way ANOVA. After the students

completed the post-test (final exam), the researcher graded the exam. Since the exam is an objective-based test and there is only one correct answer, there was no need for two graders. Once the researcher completed the grading, One Way ANOVA had been conducted on the data.

However, one of the main assumptions of One Way ANOVA is normality. To ensure the normality of the data, Shapiro-Wilk and Kolmogorov-Smirnova were used. As shown in Table 4, the result assured that the data followed the normal distribution for P-Value was greater than 0.05.

Table 4: Tests of normality

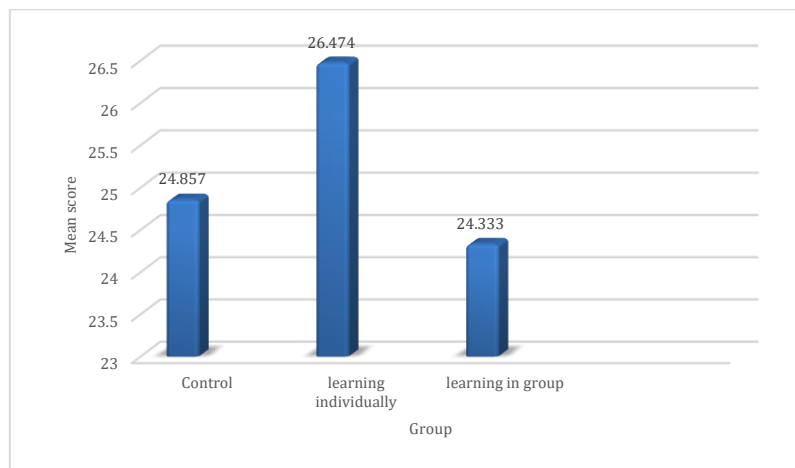| Group		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	P-Value	Statistic	df	P-Value
score	Control	.096	28	.200*	.977	28	.784
	learning individually	.088	19	.200*	.983	19	.972
	learning in a group	.171	18	.175	.920	18	.127

*: This is a lower bound of the true significance; a. Lilliefors Significance Correction

3. Result and discussion

The aim of this study was to determine the effect of students' generating and answering questions on their performance. To do so, the study had to answer one question. The question was "Is there any significant difference between the experimental groups and the control on students' performance?" Mean and standard deviation was used to answer the research question and compare the performance of the students in all three research groups. As shown in Table 5 and Fig. 2, there were differences between the means of the research groups where the experimental group 2 achieved a higher mean (26.474) than the experimental group 1 (24.333) and the control group (24.857). Fig. 2 shows the mean and standard deviation.

Table 5: Mean and standard deviation

Group	N	Mean	Std. Deviation
Control	28	24.857	3.5352
learning individually	19	26.474	5.2743
learning in group	18	24.333	7.1948
Total	65	25.185	5.2527

To know if these differences between the means of the research groups are significant, One Way ANOVA was conducted. As shown in Table 6 the result assured that there were no significant differences between the research groups in terms of students' performance as the p-Value indicted (.428) which is greater than (α0.05) and the effect size was very low (.027) as indicted by Cohen et al. (2000). Also, the Scheffe test was used in the analysis of the variance of the data, and the result showed that there were no statistically significant differences between any research groups (Table 6).

Whereas, Table 7 below shows multiple comparisons between groups.

The results of this study were agreed with other studies (Daniel and Williams, 2019; Al-Dahdouh, 2015) which did not find direct effects of such strategy on the performance of the students. The results of non-significance could be attributed to many reasons. First, the size of the groups was very small and that could affect the effectiveness of the new strategy.

Fig. 2: Mean and standard deviation

Table 6: ANOVA test results

	Sum of Squares	df	Mean Square	F	P-Value	η^2
Between Groups	47.619	2	23.810	.859	.428	.027
Within Groups	1718.165	62	27.712			
Total	1765.785	64				

Table 7: Multiple comparisons

(I) group	(J) group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Control	learning individually	-1.6165	1.5647	.589	-5.541	2.308
	learning in group	.5238	1.5904	.947	-3.465	4.513
learning individually	Control	1.6165	1.5647	.589	-2.308	5.541
	learning in group	2.1404	1.7315	.470	-2.202	6.483
learning in group	Control	-.5238	1.5904	.947	-4.513	3.465
	learning individually	-2.1404	1.7315	.470	-6.483	2.202

According to Cohen et al. (2000), the ideal sample size to reach a high level of accuracy is thirty. So, the number of each group should be 30 students to increase the accuracy of the results. Unfortunately, the sample size of both experimental groups did not exceed 20 students, and that could explain the failure to find statistically significant differences between groups.

The second reason for the absence of statistically significant results could be attributed to the repetition of the intervention. The semester contained fourteen weeks, and the strategy of students' generating and answering questions had been applied only four times during the entire semester. This definitely affected the impact of the intervention on the students' performance, and Wong (1985) mentioned that insufficient training of the students in the new strategy could negatively affect the results of the studies.

Third, the course when the study had been applied as an elective course, and students did not put a lot of effort to pass it with high grades, and therefore, they did not strive to perfectly complete their homework and exam.

Fourth, almost all the types of questions generated by the students were low-level (multiple choice, true and false, matching) since the answer to these questions was explicit in the content. According to Watts and Anderson (1971), "questions that demand more than verbatim recall will promote deeper processing of the instructional materials". Low-level questions require low cognitive skills which affect the comprehension process (Miciano, 2002).

Lastly, time restrictions could affect the results of the study since the process of generating and answering questions requires sufficient time to be useful for the students in terms of comprehension (Miciano, 2002), and in this study, the time to generate and answer the question was half-hour which defiantly was considered short time. For that reason, the result of this study did not show significant differences between groups.

Although there were no statistically significant differences between groups, their result was found to improve the mean scores of the experimental group 2 compared with the other groups. These findings agreed with other studies (Asfour, 2016) which found differences between the mean scores of the study groups in favor of the group who used the self-questioning strategy. These results which showed positive effects of students' generating and answering questions strategy on students' performance were supported by many theories.

Miciano (2002) indicted that self-questioning effectiveness is based on metacognitive theory, active process theory, and schema theory. First, when students spend time interacting with the text deeply in order to generate and answer questions about it, they increase their understanding and retention of the content (Singer, 1978). Second, as a metacognitive strategy, when students use the

questing method, they have to stop to evaluate the information's significance and assess their own reading comprehension (Wong, 1985). Third, when students generate their questions from the text, they activate their own schema, thereby strengthening the connection between the new information and old information that had been saved in the long memory (Miciano, 2002).

4. Conclusion

Based on the results, generating and answering questions as a strategy in higher education may not significantly affect the performance of the students. Some factors, if not carefully controlled, may affect the efficacy of the strategy. One such factor is the type of questions. If students generate and answer questions classified as low-level questions, their comprehension of the content will be low because only high-level questions will increase the cognitive skills which lead to comprehensive processing of the content. Other factors are the repetition of the intervention, time, and sample size.

Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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