American Journal of Mathematics and Statistics 2017, 7(1): 44-49
DOI: 10.5923/j.ajms.20170701.07

Effectiveness of the Method of Designing Classroom Oral Questioning on the Learning of Mathematics and Student's Interest in this Course

Razieh Heidari[1], Fahime Rajabi[2,*]

[1]Department of Mathematics, Payame Noor University, Tehran, Iran
[2]Department of Educational Sciences, Payame Noor University, Tehran, Iran

Abstract Classroom oral question is an inseparable part of the process of classroom education and in its proper form, it can have positive effects on the learning of the students. This study aims to review the effect of methods of designing classroom oral question on the learning of mathematics and students' interest in this course. 25 mathematic classes of freshmen boys in the high schools of Fars province administered by 5 teachers (each teacher had 5classes) were investigated. The teachers have been trained to use 4 different methods of classroom oral questions in four different classes and not to use classroom oral question in one of the classes in order for it to be the control group. The four methods used were: 1- designing questions with a cognitive level of higher than knowledge; 2- correcting the answers of the students and giving them feedback; 3- selecting a respondent after designing the questions and giving them time to think in order to respond and 4- classroom oral question without using the three aforementioned methods. After 10 sessions of using these educational methods, the students took a mathematic test and filled out a questionnaire that measured their interest in this course. Data was analyzed by using the analysis of variance method and post hoc test. The results showed that in cases when a question is asked and all of the students are given 5 seconds to think and then one of them is randomly selected to answer the question and 5 seconds is given to the selected student to respond, the rate of learning of the students is significantly more than that of the students who experience a different method in which the respondent is selected before the question is asked or when classroom oral questions are not used. The research results also showed that the mean of scores of students in the experimental groups in their mathematics test has been higher than that of those in the control group. A significant difference was seen in the groups regarding lack of usage of classroom questioning and the method selecting the respondent to the questions of the mathematic course. If the classroom oral question method is implemented accurately, it can have desirable effects on the learning of the students and their interest in the mathematic course.

Keywords Classroom questions, Oral questions, Learning math, Learning, Interest

1. Introduction

Using a classroom questioning method has been common for a long time as an evaluation method and as an educational method. As Camp (2002) believes, classroom questioning is a tool for assessing the improvement of the students and it is an important method for increasing the rate of their learning. Camp believes that classroom questioning makes students think and it can be used for attracting the attention of students, controlling classroom, repeating the issues and emphasizing the key points [1].

O'Donnell, et al. (2009) also believed that the purpose of classroom questioning is to attract the attention of students, to overview the studied information, to help the conceptual change and also to motivate students to seek more information about the subject matter of their courses. They also put emphasis on the fact that teachers must use questions with more complex cognitive levels by taking Bloom's classification into consideration; because the quality of reasoning of the students is associated with the type of question their teachers ask. Also, it seems that teachers are able to get the students excited for learning the subject matter by using classroom questioning [2].

According to the investigation of Appalachian Educational Laboratory, although 40% of the time of the classes is for the classroom oral questioning and averagely 40 to 50 questions are asked in a 50-minute class, these questions are often not asked properly and they do not make students think. In many cases designing classroom questions is the only tool that helps the students express verbally what they have been taught and they don't give the students the time and opportunity to contemplate and analyze those. Appropriate classroom oral questions have some features by

* Corresponding author:
teacheruni80@yahoo.com (Fahime Rajabi)
Published online at http://journal.sapub.org/ajms

knowing which the teachers can design effective questions [3]. Eggen and Kauchak (2010), have named some factors in expressing the basic skills needed by teachers in the classrooms and one of them is classroom questioning. They believe that one of the basic findings in the area of education is that the teacher must be able to involve the students in the process of learning in the classroom and classroom questioning is one of the most commonly used methods for increasing students' participation and increasing their interaction with the teacher. Of course classroom questioning shall be done skillfully, something that needs knowledge and experience and perhaps that is why efficient teachers use it more than inefficient teachers [4].

Math is one of the most important lessons that students need to know and understand it in all levels of education. Many students are faced with the fear and anxiety of this lesson for the following reasons: The teaching practices of teachers, the unsuccessful experience, parental pressure, low training and difficulty in learning mathematical concepts. So a student show strength in learning mathematics and sometimes cannot do the simplest mathematical tasks [5]. Today, learning math is very important, because Mathematics has great mastery on the new science and technologies. Therefore, teachers to teaching math need to the following: simplification of concepts, emphasis on the basic principles of mathematics, offering a variety of exercises and examples and motivate in students to learn math [6, 7].

As it was mentioned, in the researchers done in Iran, the classroom oral questioning has not been focused much and that is why, given the available theoretical principles and research literature, this important question comes to mind: how different methods and strategies of classroom oral questioning affect the students' learning of mathematics and their interest in this course?

According to the study purpose, the following hypotheses raised and were examined in this study:

1- Learning mathematics by students increases with classroom oral questions.
2- Students' learning is greater when classroom oral questions put feedback to them.
3- Students' learning is greater when the use of higher cognitive level questions than questions of the level of students' knowledge.
4- Students' learning is greater when be given to them the opportunity to respond (waiting time 1 and 2).
5- Students' interest in math increases with classroom oral questions.

2. Methods

The multi-stage cluster sampling method was the sampling method used in this study; in such a way that at first 5 education districts were selected out of all of the education districts of Fars province and one all-boy high school was randomly selected out of all of the high schools in each district and 5 freshman math classes taught by one teacher were selected from each of these schools. Therefore, 5 education district and in each district, five mathematic classes of one school were selected.

In this study, a researcher-made questionnaire was used in order to investigate how much the students were interested in the mathematic course. Validity of the aforementioned questionnaire was confirmed by using the opinions of specialists (content validity). The purpose of this researcher-made questionnaire was to measure the interest of students and it was made based on the Inventory of School Motivation (ISM) and by changing and eliminating some parts of this inventory. The reliability of this questionnaire was calculated to be 0.82 by using retest.

In order to measure the academic performance of the students, the scores the students get in their math test at the end of the ten sessions of implementation of classroom questioning methods were used.

2.1. Method of Conduction of the Study

The present study is a semi-experimental research. In order to do such an investigation, after the research sample was selected, the selected teachers gone through some trainings regarding the implementation methods of each of the experimental variables – in order to design the classroom oral questions through the considered methods – (they were told to use only one of the methods in the ten sessions of their teaching). The methods were as follows: 1- not using oral questioning at all, 2- giving feedback to students after they answer the oral questions (feedback group), 3- designing oral questions with a cognitive level higher than knowledge (group of high cognitive level), 4- at first the question is asked and 5 seconds is given to the students to think and then respond and then one student is selected randomly to answer this question and five seconds is given to the selected student to respond (waiting time group), 5- designing an oral questioning in line with the level of knowledge, without feedback and selecting a respondent before asking the questions (mere classroom questioning group). After the teachers are trained and learn classroom oral questioning application methods, they use these methods in ten sessions and after that, all of the students take a mathematic test. It is necessary to note that the model of the present research is a single-factor analysis of variance model with five levels as follows:

Table 1. Model of the present research

A1	A2	A3	A4	A5
Without question (Control group)	Feedback (Experimental groups: 2)	Higher cognitive levels of knowledge (Experimental groups: 2)	Selection before asking questions (Experimental groups: 3)	Only classroom question (Experimental groups: 4)

3. Results

Data were analyzed and research hypotheses were tested with statistical software (SPSS), after data collection. One of the studied parameters in the students was academic performance (learning), which this data was collected after the math test. T-test were used to determine significant differences between the means, which the results are presented in Table 2.

Based on the data in Table 2, the ratio of calculated F was greater than the table F, therefore, the null hypothesis was rejected, and as a result, there was a significant difference between the compared means ($p<0.05$). Scheffe post hoc test was used to investigate the difference between mean scores of groups. The result is shown in Table 3.

According to the results presented in Table 3, there was significant difference between, without question and how to choose group ($p<0.05$). Also there was significant difference between, only classroom question and how to choose group ($p<0.05$). Thus it can be concluded that math score of how to choose groups was higher than the without classroom questions and only classroom question group significantly.

Based on the data in Table 4, the mean score of students' interest in mathematics was 75.85. The highest mean score of interest was dedicated to how to choose group with the score of 78.40, and the lowest mean score of interest was dedicated to without classroom question group with the score of 74.88. The results also showed that the mean score of students' interest in mathematics in all groups, were more than the control group.

Based on the data in Table 5, the ratio of calculated F was greater than the table F, therefore, the null hypothesis was rejected, and as a result, there was a significant difference between the compared means ($p<0.05$). Scheffe post hoc test was used to investigate the difference between mean scores of groups. The result is shown in Table 6.

According to the results presented in Table 6, there was significant difference between, without classroom question and how to choose group ($p<0.05$). Thus it can be concluded that mean score of students' interest in mathematics of how to choose group was higher than the only classroom question group.

In this research the correlation between learning math and students' interest in mathematics was calculated that the results are shown in Table 7.

Table 2. One-way analysis of variance of mathematical scores in the groups

Sources of variation	SS	df	MS	F	sig
Between group	300.172	4	75.068	2.457	0.05
Intergroup	25002.090	785	31.850		
Total	25302.364	789			

Table 3. Results of Scheffe post hoc for pairwise comparison of mathematical mean score

Statistical indexes of compared groups	Mean difference	SE	Significance level
Without question and feedback	-0.84	0.62	-
Without question and question type	-0.849	0.62	-
Without question and how to choose *	-1.756	0.60	0.05
Without questions and only classroom question	-0.387	0.65	-
Feedback and without question	0.84	0.62	-
Feedback and questions type	-0.01	0.63	-
Feedback and how to choose	-0.916	0.62	-
Feedback and only classroom question	0.46	0.66	-
Question type and without question	0.849	0.62	-
Question type and feedback	0.01	0.63	-
Question type and how to choose	-0.906	0.62	-
Questions type and only classroom question*	0.47	0.66	-
How to choose without question	1.756	0.60	0.05
How to choose and feedback	0.916	0.62	-
How to choose and question type	0.906	0.62	-
How to choose and only classroom question*	1.37	0.65	0.05
Only classroom question and without question	0.387	0.65	-
Only classroom question and feedback	-0.46	0.66	-
Only classroom question and question type	-0.47	0.66	-
Only classroom question and how to choose*	-1.37	0.65	0.05

Table 4. Descriptive data of students' interest in mathematics

Statistical indexes / Groups	Frequency	Mean	SD	SE	Lowest score	Highest score
Without classroom question	137	74.88	14.39	1.23	29	104
Feedback group	125	75.64	13.11	1.17	29	101
Cognitive levels of knowledge	140	74.92	12.81	1.08	37	97
How to choose group	143	78.40	13.06	1.09	31	132
Total	666	75.85	12.98	0.50	-	-

Table 5. Analysis of variance of students' interest in mathematics

Sources of variation	SS	df	MS	F	sig
Between group	1592.877	4	398.219	3.049	0.017
Intergroup	86318.247	661	130.587		
Total	87911.125	665			

Table 6. Results of Scheffe post hoc for pairwise comparison of mean score of students' interest in mathematics

Statistical indexes of compared groups	Mean difference	SE	Significance level
Without question and feedback	-0.76	1.413	-
Without question and question type	-0.04	1.373	-
Without question and how to choose *	-3.52	1.366	0.05
Without questions and only classroom question	-0.35	1.425	-
Feedback and without question	0.76	1.413	-
Feedback and questions type	0.72	1.406	-
Feedback and how to choose	-2.76	1.399	-
Feedback and only classroom question	0.41	1.457	-
Question type and without question	0.04	1.37	-
Question type and feedback	-0.72	1.406	-
Question type and how to choose	-3.48	1.358	-
Questions type and only classroom question	-0.31	1.418	-
How to choose without question*	3.52	1.366	0.05
How to choose and feedback	2.76	1.399	-
How to choose and question type	3.48	1.358	-
How to choose and only classroom question	3.17	1.411	-
Only classroom question and without question	0.35	1.425	-
Only classroom question and feedback	-0.41	1.457	-
Only classroom question and question type	0.31	1.418	-
Only classroom question and how to choose	-3.17	1.411	-

Table 7. Pearson correlation coefficient between the variables of interest and math score

Variables	The interest in math
Math score	0.403**

**: Correlation is significant at the 0.001 level

According to the data in Table 7, there was a significant relationship between the study variables (math score and students' interest in mathematics) ($p<0.01$).

4. Discussion and Conclusions

The findings of this research showed that giving feedback to the answers of the students and asking questions with a cognitive level higher than knowledge significantly affect the rise of the students' score in their mathematic test, in

comparison with when these methods are not used. This means that using these methods, at least apparently, causes an increase in the scores. In fact, the results of the present research show that not asking any questions in the class (control group), giving feedback after asking the questions (experimental group 1), asking questions with a cognitive level which is higher than the students' knowledge (experimental group 2) and designing classroom questionings without any feedbacks and using questions at the same level as the level of knowledge and selecting the respondent before asking the question (experimental group 4) have no significant impact on the rise of the students' score in the mathematic test. The only result of this research which complies with the results of other researches is the impact selecting the respondent after asking the question and giving them 5 seconds to respond (experimental group 3) has. In this study, it has been shown that the mean of the mathematic scores of the students in the group where no questions are asked and in the group where no feedback is given, the level of the questions is the same as the level of knowledge, and the respondent is selected before asking the question (the mere classroom questioning group), have been significantly lower than that of the group where the respondent is selected a few seconds after asking the question in the classroom (experimental group 3).

In the field of the role of various methods of designing classroom oral questioning and its impact on how interested the students are in mathematics show that the level of interest of the students of the group where the respondents are selected through various methods is significantly higher than that of the group without any classroom questioning. In order to justify such a result, it can be assumed that using the respondent selection method a few seconds after asking the question in the classroom leads to the improvement of the students' learning and the students who are after a better learning, become more interested in mathematics as well. This analysis complies with the analysis of Asobelle regarding the connection between learning and interest. In his opinion, if the students learn something in a course, they will become interested in it.

According to the obtained results, it can be concluded that using proper strategies such as selecting the respondent a few seconds after asking the question in the classroom, using questions at a cognitive level higher than the knowledge of the classroom and giving feedback to students in the classroom can be impactful on the improvement of their learning (although the only factor that significantly affected their improvement here was method of selection). In other words, a classroom oral questioning without proper questioning methods will not have a significant positive effect on the students' learning and it is not just the classroom questioning that increases students' learning and it would make no difference from when these questions are not asked in the classroom. Selecting the respondent after asking the question makes all of the students mentally involved in the question and makes them try to prepare an answer for it. During this mental activity, they think about various aspects of this question and analyze it. In addition, they become more curious about hearing and understanding the answer to the question and a sum of these mental efforts improves their learning.

The research findings also show that using proper methods of classroom questioning can increase the students' interest in the subject matter. Accordingly, selecting the respondent after asking the question makes them more interested in the subject matter. It seems that in this case, the mental involvement of the students with the question asked in the classroom and their mental efforts to answer them can create a kind of cognitive incoordination in students. This incoordination can be due to the conflict between the mental effort of the student for preparing an answer for the question and a probable lack of interest in mathematics. In this case, the student must make efforts to eliminate this incoordination. Given the necessity of the mental involvement caused, which is due to the method of the classroom questioning, and that it is impossible to change this condition, the students try to change their negative view of mathematics to be able to have a reason and to justify their mental effort and to eliminate the created cognitive incoordination or at least to reduce it. Therefore, the rate of student's negative view of the course will also be decreased. In other words, the students will have a more positive approach to the course and they will become more interested in it.

In addition to what was said about the effect of using various strategies of classroom questioning on the students' learning and their interest in mathematics, the obtained information is an indication of a significant correlation between learning mathematics and the rate of interest in it. No matter what reason we have for justifying this relationship, what is important here is the relationship between the students' interest in mathematics and their score in the test. By considering this relationship, we must try to make the students interested in mathematics more than before by creating self-belief and increasing the feeling of self-sufficiency and by creating a positive approach to the students' abilities. The most important and efficient tool to do this is how the teacher treats the students. It is by transferring their positive approaches to the subject of education and by making students more capable in this course that the teachers can increase the level of their interest in mathematics. They can become a strong role model favored by the students by creating appropriate emotional relationships. In this case, the student becomes interested in what the teacher is teaching through the expansion process and the process of the development of the effect and this leads the student to making more efforts and this cycle goes on and on. Despite the importance of this issue, unfortunately many teachers create some difficulties in the educational environment through indulgence or moderation in the subject-oriented or student-oriented processes. Indulgence in being subject-oriented and not paying attention to the bilateral human and emotional relationships with the students will reduce the student's interest in the

course and their lack of interest in the environmental environment. On the other hand, if the teacher puts too much emphasis on their own relationship with the student and doesn't pay enough attention to the course and the education, some problems would be created for the students and for the society. A knowledgeable teacher tries to make a suitable balance through meeting the educational purposes as well as establishing and maintain a good teacher-student relationship.

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