

Opinions of the pre-service mathematics teachers' about a teaching experiment designed using a dynamic geometry software *

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Acceptation : 12/03/2022

Publication : 31/12/2022

Keywords: Cabri Geometry;
Dynamic Geometry Software;
Euclidian Geometry.

Abstract:

This research is a qualitative study aimed to determine opinions, difficulties and needs of the pre-service mathematics teachers' about a teaching experiment designed using a dynamic geometry software and its effectiveness. Considering the pre-service teachers as teachers of the future it is necessary to recognize the difficulties they experience during a geometry class enriched with dynamic tools. The participants of this study involved 68 pre-service teachers who took Geometry-1 class and enrolled at a university located at Bursa- in a western city province in Turkey in the spring semester of 2016-2017. The teaching experiment lasted for 12 weeks covering the Geometry-1 course curriculum involving foundations of Euclidean geometry as an axiomatic system, constructing proves for the basic geometrical theorems, constructing geometric structures with a constructivist approach by using Cabri Geometry Dynamic Geometry Software. Semi-structured written open-ended questionnaire and verbal interview techniques were used in order to examine the students' views on the geometry teaching experiment. The findings were analyzed by content analysis approach. The data obtained from the written interviews were coded by the researcher and an academician. Descriptive statistics involving frequency and percentage

* This paper presented in the 2nd International Colloquium on Didactic of Mathematics, 12th March 2022 (2nd-DiMa) organized by the National Commission for Education, science and Culture of UNESCO Algeria, National Institute for research in education (INRE) and the University of Tiaret (LIM laboratory), the Center for Education in Mathematics and informatics of Al Awael School (CEMI).

tables were also utilized. As a result of the study, it was concluded that the students found the lessons created using dynamic geometry instructive, entertaining, interesting, exciting, motivational, time-saving and productive. They stated that visuality reinforces their understanding of the lesson, concretizes the abstract concepts, and increases retention and memorability. Used methods takes the learning away from a rote approach, teaches questioning and change their perspectives positively to the geometry lesson. Some of the difficulties students experienced are carrying computers to the class everytime and the large class sizes. Overall they think that lessons helped them to learn geometry concepts better and Cabri Geometry is a useful software for a geometry teacher and a learner. The findings of this study will contribute to the instruction methods of undergraduate mathematics courses and give insights to the future researches.

Introduction

Geometry, which is an active tool in expressing the environment in which we exist, also undertakes important tasks in terms of achieving the general goals of mathematics. It is one of the main goals of mathematics for the student to learn to care about mathematics (Baki, 2006; Baki and Bell, 1996). When mathematics is linked to the environment in lessons, students can be made to care about mathematics, realize that mathematics has an important task while perceiving the world because all the shapes surrounding them are geometric, and thus they can value mathematics and adopt it (Güven, 2006). Geometry and geometric thinking style, which is the study of forms and spaces, is of great importance in many stages of our lives and is a valid skill in many fields.(Baki, 2002)

The emergence of the use of technical and technological tools has been realized with the accumulation of new knowledge and skills in every unit of life. All these advances and changes in the field of technology also necessitate change in the field of education. Since the understanding of education whose structure is not revised cannot be accepted, education should also act in parallel with these technological advances. The rapid progress in technology, which has influenced many fields, has also affected mathematics classes. Especially in recent years, the role of technology has been seen to a great extent in many fields under the title of mathematics (Laborde, 2001). The rapid progress in technology has created new opportunities for mathematics

1. Aim

2. Research Questions

ISSN : 2800-1303 Journal of Didactic / Vol 01 – N 02 - December 2022 64

3. Methodology

This research is a qualitative study which is a teaching experiment lasted for 12 weeks covering the Geometry-1 course curriculum involving foundations of Euclidean geometry as an axiomatic system, constructing proves for the basic geometrical theorems, constructing geometric structures with a constructivist approach by using Cabri Geometry Software. Lesson plans containing activities for learning basic geometric concepts and proofs using Cabri Geometry were developed for Geometry-1 course curriculum. Lesson plans and activities were demonstrated to four mathematics teachers. In line with the feedback of the teachers, the activities were reviewed and made ready for the pilot application. The pilot teaching experiment lasted for 12 weeks of 2015-2016 academic year. During the pilot teaching experiment preservice teachers could structure their own learning with classroom discussions and active participation in a dynamic geometry learning environment. The studies were carried out by the academician and the researcher. After the pilot application lesson plans, tests and written and verbal questionnaires were revised and made ready for the actual application which took part on 2016-2017 for 12 weeks 3 hours a week.

4. Participants

The participants of this study involved 68 pre-service teachers who took Geometry-1 class and enrolled at a university located at Bursa - in a western city province in Turkey in the spring semester of 2016-2017. All students who participated in the teaching process attended the written interviews where only 15 of them were selected for the verbal interview by criterion sampling method. Three basic criteria were taken into account in the selection of students They were chosen from three different success levels from the students who were also open to self-expression and would like to volunteer. All the participants who were determined not to have received a geometry education using dynamic geometry software before the teaching process, were secondary school graduates and were introduced to geometry at various levels.

5. Data Collection Tools

Semi-structured written open-ended questionnaire and verbal interview techniques were used in order to examine the students' views on the geometry teaching experiment enriched with dynamic geometry applications. The written questionnaire consisted of 17 questions and verbal interview questionnaire consisted of 16 questions. The questions were presented to four academics for the expert opinion. During the written interviews held after the pilot and the actual implementation students were not given a time limit, they were asked to express their ideas as clearly and freely as possible, to explain the reasons for their answers if any.

6. Data Analysis

Content analysis technique was used in the analysis of the qualitative data obtained from the interviews with the students. The data analysis process took place in four stages consisting of coding the data, finding the themes, organizing the codes and themes, defining and interpreting the findings. The verbal interview recordings were listened repeatedly by two experts, analysed and transcribed. Multiple readings were made on the written texts. The data obtained from the interviews were coded by the researcher and an academician. The codes that the researcher and the academician defined personally were compared within the framework of the evaluations and the similarities-differences on the basis of different codes were revealed. The determined codes were gathered under certain themes. After the categories were utilized, they were enriched with example sentences reflecting the categories, and detailed explanations were made about the tables.

7. Findings

There were totally 33 questions in the written and verbal interviews. Frequency distribution of the category, sub-category and coding of one question from the written questionnaire is presented in **Table 01**.

Table 01: Frequency distribution of the category, sub-category and coding of the 7th question of the written questionnaire.

Categories	Sub Categories	Example sentence	Codes	Frequency Percentage	
				f	%
Positive	Time saving	"Learning took less time as we did our drawings ourselves."	Time, time saving, less time, in a short time	4	8
	Visual	"Errors caused by drawing were eliminated with the computer."	drawing, see, concrete, clear, three dimensions	13	25
	Motivation	"The teaching of geometry lesson becomes more fun."	interested, yes, there is, fun, positive	15	29
	Learning	"We learned better by practising on the computer..."	progress, knowledge, learning, memorable	4	8
Negative	Class size	"Computer would be good if class size was smaller"	Class size, crowded	1	2
	Interest	"I don't like using computers."	Dislike, don't love	2	4
	Time wasting	"It wastes our time since it takes longer time practicing on computer"	waste of time, take time	3	6
Neutral and partly positive	Partly disadvantageous	"Yes, but looking at the computer for a long time tires me out very quickly." "Yes, but I have a hard time carrying the computer to school."	There is but.	5	10
	Indecisive	"I don't think there is a difference, sometimes there is"	not think there is a difference, not known, sometimes	3	6
	Topic	"It has a positive contribution to some geometry topics."	For some topics	1	2

7th question in the written questionnaire was “Do you think the use of computers within the scope of Geometry-1 course has a

positive effect on learning geometry and teaching the course?" The opinions were analyzed in three categories, as seen in Table 1, based on the answers received. When the students' views on whether computer use contributes positively to geometry learning and teaching of the course within the scope of Geometry-1 course analyzed in the "positive" category, 70% of the students stated that computer use contributed positively, and that computer use made concretization, generalization, visualization, geometry and computer use. It is seen that it makes it easier to learn how to use it, to draw, to see the shape, to understand theorems and proofs. Students who express their opinions this way state that computer use reduces the margin of error, eliminates misconceptions, and ensures the permanence of their knowledge. It is observed that these students stated that computer use reduces boredom, is fun, increases their interest and accelerates learning by saving time. When answers were analyzed in the "negative" category, it is observed that 12% of students see computer use as a waste of time, they are not interested in using computers, and they say that learning geometry using computers is difficult to understand and takes more time. When their opinions are analyzed in the "neutral and partly positive" category, 18% of the students stated that computer use does not contribute positively or negatively, or that it has disadvantages even if it contributes, that it is difficult to carry a computer, that looking at the computer is tiring because the lessons are long, that computer use takes a lot of time. It is observed that they stated that the process can contribute to the use of computers, not geometry. It was determined that the students said the following sentences:

“Yes, it makes a positive contribution, so we can see concretely that the theorems we have proved are valid in an infinite state or only in one case.”

“..of course there is. It helps us a lot, especially in drawing issues. It helps save time. Definitely useful for proof”

“It serves to embody. We can see the feature very easily by creating the shape on the computer, which we cannot play on as we want, even if it is drawn on the board, and playing as we want. Drawings are very easy”

“The teaching of the lesson is more fun because I am usually a person who gets bored in geometry lessons.”

"Yes there is. It makes the lesson more interesting and provides the realization and convenience of the operations we do. Very memorable.”

“Maybe it has a positive effect on my friends, but not on me. This is because I don't like using computers and I can't fully follow the lesson.”

Conclusion

As a result of the study, it was concluded that the students found the lessons created using dynamic geometry instructive, entertaining, interesting, exciting, motivational, time-saving and productive. They stated that visuality reinforces their understanding of the lesson, concretizes the abstract concepts, and increases retention and memorability. Used methods takes the learning away from a rote approach, teaches questioning and change their perspectives positively to the geometry lesson. Overall, they think that lessons helped them to learn geometry concepts better and Cabri Geometry is a useful software for a geometry teacher and a learner. They stated that they will teach their own geometry lessons with the same approach in the future. The students' opinions coincide with the results that the use of dynamic software changes the students' views on mathematics in general, and geometry in particular, and that dynamic environments affect success and attitude positively (Trust and Karatas, 2003; Bedir, 2005). In another study participant opinions were obtained that the application saves time and visuality, makes the subject easy to understand, and makes the lesson fun by taking it away from monotony (Bagcivan, 2005). Özen (2013) also mentioned in his study that it is useful, practical, measured and provides the opportunity to obtain a smooth shape, as well as its visuality and concretization features are remarkable. Some of the difficulties students experienced were carrying computers to the class and they stated a computer lab as a mandatory need since the the class size negatively affects the lessons. They also found the pace of the course to be fast, the number and duration of the lesson hours to be less. Bağcivan (2005) and Vatansever (2007) also found negative opinions such as students not

being very active, passing the topics quickly. Student opinions about course speed are in parallel with the results of their study. Reaching similar results in these studies has led to the conclusion that the course times arranged according to the traditional method are not suitable for teaching by structuring learning on the computer, and the course pace negatively affects the process.

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