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SECONDARY EDUCATION GEOMETRY PROGRAM FROM STUDENTS' PERSPECTIVE

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ABSTRACT

The geometry program which was developed by the Board of Education and began to be used in 2009 brought innovations in the geometry course. Its major innovations is the addition of vectors, transformation geometry, rotation in space and drawings of perspectives. In addition, the order of subjects was modified. The goal of the course is to improve the students' ability to prove. It is recommended that teachers should employ the synthetic, vectoral and analytical approaches in geometrical proofs. However, new design of the course has led to many problems. The aim of the study is to reveal the reasons for such problems based on the views of the students. To this end, semi-structured interviews were conducted with twenty senior high school students. The findings indicate that the participants refer to the inconsistency between the current examination system and the geometry program in regard to the problems experienced in the course.

Key Words: Geometry program, educational change, examination system.

INTRODUCTION

As a result of globalisation numerous changes have occurred in several domains and instutions, and these changes have also affected educational institutions (Sahlberg, 2006; Doğan, 2012; Köstereliođlu ve Özen,2014). The latter effects are of great importance since educational institutions should produce individuals who know how to update their knowledge base and how to use their knowledge in future working roles. Therefore, it is very significant for educational institutions to keep up with the changes occurred (Şaşan, 2002; Wedell, 2009). As it is known the major portions of the government budget are allocated for educational expenses (Kennedy, 1996).

Educational institutions can transfer these changes to individuals through educational programs. Given that educational programs are structured based on new educational philosophies they have not a static but a dynmaic pattern. Educational programs should be developed in a way that they allow to transform the students' knowledge and skills into behaviour. Therefore, the development of educational programs is of great importance (Demirel, 2004; Yapıcı ve Demirdelen, 2007). In Turkey studies to revise educational programs has been continuing at both basic education and secondary education levels (Kurt and Yıldırım, 2010). One of the revised educational programs is that of the geometry course. In terms of education geometry is a domain of mathematics of which basis should be established during the period of basic education. The inefficient teaching of geometry during the basic education period leads to serious problems in teaching geometry at the secondary education level and also, at the following levels. Given that the scope of geometry is very large and comprehensive it has developed more than it was expected. For instance, the Euclidean geometry was the mere type of it and it was taught. However, now it is a sub-field of the space-based comprehensive mathematical theories. There are currently more than fifty types of geometry (MEB,2011).

History of educational programs used in geometry course

Since the school year of 1976–1977 modern mathematics programs have been used in Turkey. These programs have included both geometry and analytical geometry.

The mathematics program for high schools used between 1987 and 1991 in Turkey was the same as that used between 1976 and 1977.

Beginning by the school year of 1991-1992 the credit system and passing class system began to be used. However, both were cancelled at the end of the school year of 1993-1994. During this period the most striking characteristic of the educational programs used was that the topics of geometry and analytical geometry were excluded from the math program and they became independent courses.

The educational programs for geometry and analytical geometry in 1998 were developed in parallel to those used in 1992 and these programs were in use until the school year of 2005–2006.

In the school year of 2005–2006 high school duration became four years. With this change the course of geometry 1 began to be delivered in the tenth grade, the course of geometry 2 began to be delivered in the eleventh grade and the course of geometry and the course of analytical geometry began to be delivered in the twelfth grade.

During the school year of 2009- 2010 the educational program for geometry was again significantly modified.

This new program significantly altered the teaching process of the geometry course. the significant differences occurred include the enrichment of the content, the changes in the order of the topics and in the coverage of various geometrical approaches. The new topics added are transformational geometry, decorations in space, drawings of rotation and perspectives. In regard to the order of topics the topic of circles is delivered before the topic of triangle. In relation to the process of teaching the new program covers the approaches towards the geometrical proofs. The program requires teachers to employ the analytical, vectoral, synthetic approaches in lecturing about the proofs in geometrical topics. It also encourages them to commonly use analytical and vectoral approaches rather than conventional synthetic approach.

The efficiency and validity of an educational program can be established based on the findings of an evaluation about its implementation. Therefore, the educational programs should be continously and systematically evaluated (Ertürk,1972; Saylan, 2001). In such evaluations the views of the students should be identified. It is certain that the findings are very significant in determining the weaker points to be improved for the future educational program development work.

The first graduates of the high schools who were educated through the geometry program developed and first used in the school year of 2009- 2010. This study aims at revealing the views of the twelfth grade students who were educated through the geometry program developed and first used in the school year of 2009- 2010. In parallel to this aim the study attempts to answer the following research questions:

- What the views of the twelfth grade students about the content of the geometry program?
- What the views of the twelfth grade students about the applicability of the geometry program?
- What the suggestions of the twelfth grade students to improve the efficiency and applicability of the geometry program?

METHOD

The study was designed as a case study which is part of the qaulitative research methods. Case study is a research method that deals with a current fact within its real situation and analyses the fact concerned in a multidimensional, systematical and detailed manner (Yıldırım and Şimşek, 2005). Cases studies are particiularly proper for individual studies. Because these studies provide the researcher with the opportunity to analyse all

aspects of the problem in depth and in a short period of time. The most significant advantage of this method is that it provides the researcher with the opportunity to focus on the problem or case (Çepni, 2007).
Information about participants, data collection tools, data collection process and data analyze is given as follows.

Participants

The participants of the study were twenty students attending at the twelfth grade in an Anatolian High School in Trabzon province during the school year of 2012-2013.

Data Collection Tools and Procedure

The data of the study were collected through semi-structured interviews with the participants. The items asked during the interviews were prepared based on the views of the field specialists who had experience in the study subject. The interviews with the students lasted nearly for twenty minutes and were recorded after getting permission of them.

Data Analysis

The data obtained during the interviews were transcribed. Then these transcribed data were reviewed and coded by the authors. Related notes were added to the codes regarding why these codes would be used. These codes then were categorized under the themes. The themes were developed based on the consistency among the codes covered. The draft forms of the themes and codes included were discussed by the authors. Then, these codes and themes were finalized.

FINDINGS

The positive and negative views of the students about the content of the geometry program are given in the following Table.

Table 1: Student views about the content of the geometry program

Positive views	f
Topics in the ninth grade are very understandable	10
The order of the topics in the tenth grade is very effective	3
Both the content and order of the topics in the eleventh grade are the most reasonable	15
Negative views	
Topics in the ninth grade are exclusively based on formulas	8
The number of the topics in the ninth grade are very many	12
Topics in the twelfth grade are very abstract	18
Topics are so much repeated	5
Vectors are so much covered in the course	15
Space geometry is so much covered in the course	11
Transformation geometry is so much covered in the course	7
Proofs are so much covered in the course	9

As can be seen in Table 1 the students reported both positive and negative views about the content of the geometry program. More specifically, fifteen students out of twenty participants indicated a positive aspect of the program stating that the order and content of the eleventh grade topics were the most reasonable ones in contrast to others at different grade levels. ten students reported that the topics in the ninth grade are very understandable. Three students stated that the order of the topics in the tenth grade is very effective. Exemplary reports by the students are given as follows:
''The most reasonable geometry course in high school level is that of eleventh grade. Its content and the order of the topics are both fun and informative …''

"*The topics in the ninth grade are much clearer and understanable since we studied these topics before. We were alsready familiar with these topics since we were taught them in secondary school…''*

'' The order of the topics in the tenth grade is very effective and topics include vectors and triangles. Following the ninth grade the order of the topics in the tenth grade was very good.…''

As can be seen in Table 1 the students also reported negative views about the content of the geometry program. Eighteen students out of twenty participants remarked a negative point about the program stating that the topics in twelfth grade were very abstract. Fifteen students argued that the program mostly covers the topic of vectors. Twelf students stated that the number of topics covered in the ninth grade is very much. Eleven students reported that space geometry is very much studied in the geometry program. Nine students remarked the similar point for the proofs and seven students for transformational geometry. Eight students stated that geometry topics in the ninth grade are exclusively focused on formulas. Five students stated that the topics are frequently and unnecessarily repeated. The examples for these views of the participants are given below:

''…There is a topic of space in the twelfth grade. We have problems in understanding the plane. It becomes more difficult when the topic of space is covered since it is an abstract subject. We cannot easily imagine these topics in our mind. Learning occurs very difficult. …''

''… In the geometry program the topic of vectors is very much emphasized. Is it necessary? For me the answer is "no". This is an extra concept for the geometry course and it is not needed …''

''…In the ninth grade we got confused since there are many topics covered in the geometry course. For in instance, angles, rectangulars, prism among the others. These are very detailed but are given at a surface level. When there is no detail about them we could not learn them at all. Without comprehending a topic we begin to deal with a new one…''

''We need to know vectors in plane before vectors in space. Space geometry is given in a detailed manner. But we have difficulty in understanding the plane geometry. So when we are introduced space geometry it becomes much harder to undertsand.… In addition space geometry is not frequent part of the examination…''

''…We are asked to provide proofs for everything. I do not think so much proofs are necessary. In addition these proofs are not those that we are familiar with. We are asked to make proofs using vectors and coordinate system. It makes things much harder. We could not do and understand proofs making it much more difficult. It also diminish the understandability of geometry …''

''… In the ninth grade there are many formulas to be memorized. I got bored due to the higher number of formulas. These were heavy for me. …''

''In the program the concepts of shift, reflection and symmetry are frequently repeated. For me covering so much the transformational geometry is not good for other topics in the course …''

'' … In the ninth grade we studied rectangulars and we again studied them in the eleventh grade. For me topics should be completed in a single grade. In the ninth grade it was at the surface level, so it was unnecessary, but in the eleventh grade it was given in detail. So we should study rectangulars only at the eleventh grade. …''

The positive and negative views about the applicability of the geometry program repoted by the students are given in Table 2:

Table 2: Student views about the applicability of the program

Positive views	**f**
Proofs make it easy to understand the topics	7
Transformational geometry improve our ability to geometrically think	5
Vectors make it easy to understand the topics	3
Perspective drawings and isometric drawings improve our ability to think in three dimensional way	4
Vectors improve our interest towards geometry	2

Transformational geometry is closely related to daily life.	2
Negative views	
The program is not closely parallel to the examination system	18
Vectors direct us to memorize the topics	15
Vectors diminish our interest towards geometry	10
Vectors make the topics more abstract	11
Proofs are not used in daily life	5
Drawings of perspectives and izometric drawings do not have any significant effect on our achievement	5
Time allocated for the topics is not sufficient	17
The topic of coni not is not used in daily life	2

Table 2 shows that students reported both positive and negative views about the applicability of the geometry program. Seven out of twenty students stated positive views about the applicability of the program in terms of the proofs stating that proofs make it easier to understand the subject. Five students stated that transformational geometry improve their ability to geometrically think. Four students argued that perspective drawings and isometric drawings improve their ability to think in three dimensional way. Three students reported that vectors faciliate understanding of the topics and two that vectors improves their interest in geometry. Another two students stated that transformational geometry is closely related to daily life. The examples for these views of the participants are given below:

'' …In fact, proofs make it easier for us to understand the topics. Instead of solving ten problems about a topic dealing with its proof is enough for me. Although making proofs is time-consuming it makes it for us to have in-depth understanding of the topic …''

''… For instance, in transformational geometry we are asked about a new shape of an object that is rotated at 90-degree angle. We should think and reason about it. So it improves my ability to think in geometric terms …''
''… For me drawings are very enjoyable. They help us in imaging things in our mind and abstractly think about them. Such topics should be studied since nearly all of us have problems in thinking about an object in a three-dimensional way…''

''… For me the inclusion of vectors in the course of geometry is very useful. It helps me in helping some topics fast and I could understand these topics better. Through vectors we can do many things in a short time.... Through vectors we can directly reach the conclusions…''

''…Since vectors are new for us they are interesting. It makes some topics more intersting and extraordinary. It has made geometry diversified. So it should certainly be part of geometry. When we study familiar topics using vectors we can much more easily understand them and these topics become more interesting…''

''…Transformational geometry is an useful topic since we come across those situations in daily life which are closely related to tranformational geometry… It has many domains in daily life where transformational geometry can be….''

Table 2 shows that the participants also reported some negative views about the applicability of the geometry program. Eighteen students out of twenty participants stated that the program is not consistent with the current examination system. Seventeen of them reported that time is not enough to cover all topics in the program. Fifteen students argued that vectors direct them to memorize the topics. Another negative view about the vectors was stated by eleven students who claimed that vectors make the topics more abstract. Ten students also stated that vectors decrease their interest in geometry. Five students reported that proofs are not related to daily life. Another five students argued that prespective drawing and isometric drawing do not have positive contributions to their achievement in the geometry course. Two students reported that conis are not related to daily life. The examples for these views of the participants are given below:

''…Everbody knows how the current examination system is. So while developing the program it should also be taken into consideration. Examinations are very important for us. The content of the geometry course was

enriched but these new topics are not part of the examination. So why do we try to learn these new stuff?…. In addition, we need more practical knowledge since we try to do our best in a limited time in examinations. For me new topics are very time sonsuming and have no place in the current system…''

''…For me the most significant problem in regard to this educational program has to do with time. Time is not enough to cover all topics and topics are not completely studied. When our learning was not complete next year would be much more difficult for us. Time should be balanced and topics should be divided based on each grade level. It should be taken into consideration that there is a possibility not to cover the last topics in the course…''

''…. When vectors are covered there should be formulas and in turn, formulas require the memorization. Therefore, vectors means memorization….''

''… Vector itself is an abstract concept. So when the topics are given through vectors the topics become difficult to learn. Geometry is already a difficult course. It becomes more abstract and hard to understand when an abstract concept is used to teach the course …''

***''**…I think vectors should be omitted from the geometry course. Because they are both useless and boring and make students indifferent towards the course of geometry …''*

''… I think geometry is related to daily life. So why we are learning about proofs and how I can relate proofs with daily life. So that we do not need to learn about them ….''

''… There is no place for perspective drawing and isometric drawing in the geometry course. they do not have any positive effect for our achievement in the course. If I attend any architecture department future I learn them at that time. Now I could not figure out why we need them at this level …''

***''**…The topic of conis is not related to daily life. Studying them makes no sense for me. I do not know why we study them …''*

The suggestions reported by the participants to make the current geometry program more effective and applicable are given in Table 3:

Table 3: Suggestions by students about the program

The topic of conis should not be covered only in the eleventh grade	5
Analytical geometry should be covered more than the current situation	3
All analytical topics should be given in the same course.	2
A single topic should be delivered only at a single grade and should not be studied at other grades	7
Vectors should be covered in the course of physics.	9
Instead of larger proofs only shorter ones should be offered	4
Decorations should be omitted from the geometry course	6
Textbooks should be more carefully written.	8

Table 3 indicates that the students provided certain suggestions to improve the current geometry program. Nine students out of twenty participants reported that vectors should be covered in the physics course. Eight students stated that textbooks should be developed in a more detailed manner. Seven students suggested that any single topic should be covered at a single grade and it should be separated into subcategories to be studied at different grades. Six students remarked that the topic of decorations should be excleded from the geometry courses. Five students argued that the topic of conis should be covered only at the eleventh grade. Four students suggested that shorter proofs but not longer ones should be given to them. Three students stated that the topics in regard to the analytical geometry should be more included in the course. Two students suggested that all analytical topics should be covered in a single grade level. The example statements of the students in regard to the suggestions to improve the current geometry program are as follows:

''…For me the topic of vectors belongs to the physics course and it is much more related to physics. So we must study vectors in the physics course. It distracts out attention to the geometry course. …''

''… Why do we have textbooks? Because we could not use them. Because its content is totally different from what teachers deliver and it contains less exercises. I think that textbooks should provide us with everything what we need and so we do not need any other sources …''
''…For me each topic should be studied at a single grade level. We should not study it again in other grades. Because in this case topics are given without any detail. After studying the topic it should be completed. For instance if triangles are covered in the ninth grade we would not be again given this topic at the following grades …''

''…Decorations are simpler for the geometry course and I think it is unnecessary. However, the program has more references to it. I think high school program should not include this topic. If it is so necessary we must study it in basic education school, but not in high school. In high school we need to study more basic topics …''

''Time allocated for the topics in the eleventh grade is not enough. The last topic is about conis and time to study is very very short. In the ninth grade we studied similar topics that we studied in the eleventh grade. Then we study the topic of conis in the ninth grade. Maybe we can understand it better like this. Or the topic of conis can be covered in the twelfth grade …''

''…Yes, proof is useful for me. It is also necessary in geometry course. But we should not study longer proofs. For instance, there is proof for the carnot theorem in the textbook. This theorem is easy to memorize and its proof is longer. For me it is not needed to cover this proof. Shorter proofs should be given. Longer ones make us indifferent towards geometry …''

'' …Sometimes it is very useful to study at the level of coordinates. However, I think that the place of analytical geometry in the program is less and that it should be covered more than now. Analytical geometry makes things much easier…''

''…Topics of the analytical geometry are distributed at different grade levels. at each grade we studied them. For me there should be a separate course called analytical geometry like that was in the old system. Because topics of the analytical geometry are difficult to recognize among other topics. For instance, there should be only analytical geometry and it should contain only topics of analytical geometry…''

DISCUSSION AND CONCLUSION

As can be seen in Table 1 students frequently reported as a positive point about the content of the geometry program that the program for the eleventh grade is the most reasonable one in terms of both the order of the topics and the content. Moreover, they also stated that the program for the ninth grade is very understandable. In terms of negative points about the geometry program they mostly indicated that the program for the twelfth grade covers very abstract topics. In addition, they reported that the program covers much of the topics such as vectors, space geometry, proofs, and transformational geometry and that the program for the ninth grade includes too many topics which are mostly depended on formulas and which are frequently repeated. As indicated by Cansız Aktaş and Aktaş (2011), Cansız Aktaş (2013) and Öztürk (2013) teachers also have similar negative views about the geometry program arguing that the program is very intensive and that the topics covered are unnnecessarily divided into subtopics. In addition, Dağdeviren Çay (2012) also found that teachers regarded the geometry program for the ninth grade as very intensive.

Table 2 shows that concerning the positive characteristics of the geometry program in terms of the applicability the students interviewed mostly reported that the proofs involved in the program faciliate their understanding of the topics studied. They also stated that transformational geometry improves their ability to think in geometrical terms and that perspective drawings and isometrical drawings improves their ability to 3D think.

The other positive remarks of the participants included the vectors' positive contribution in understanding of the topics and in improving the interest in geometry and daily life reflections of the transformational geometry. Regarding the negative characteristics of the geometry program in terms of the applicability the students interviewed mostly reported that the geometry program is not consistent with the examination system. They also stated that time allocated is not enough and that vectors require the memorization of the topics and make the topics more abstract, leading to decrease in interest in geometry. The other negative reports included the following: proofs are not used in daily life; perspective drawings and isometrical drawings do not have positive effects on their achievement and conics are not used in daily life. Similarly, Cansız Aktaş and Aktaş (2011) and Cansız Aktaş (2013) found that teachers regard time allocated to topics as insufficient which is one of the negative dimensions of the geometry program. In a similar vein Dağdeviren Çay (2012) concluded that for teachers time allocated to the ninth grade topics is not sufficient. Dağdeviren Çay (2012), Cansız Aktaş (2013) and Öztürk (2013) found that according to teachers the program can be more applicable only if it is made consistent with the current examination system. On the other hand, Öztürk (2013) concluded that teachers argue that lack of full correspondence between the geometry program and the examination system seriously affects the applicability of it.

Table 3 indicates that the most frequently reported suggestion of the students interviewed about the content and applicability of the geometry program is to study vectors in the physics course. The other major suggestions of the students in this regard are as follows: textbooks should be carefully written; each topic should be studied in a single grade; the topic of conics should be delivered only in the eleventh grade and small-size proofs instead of larger ones should be covered in the program. They also argued that analytical geometry should be covered more than its current state and that all topics related to analytical geometry should be delivered in the same grade. Cansız Aktaş and Aktaş (2011) and Cansız Aktaş (2013) also found that for teachers the textbook used is a significant barrier in the implementation of the geometry program.

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