Effective Strategies For Learning Basic Geometric Concepts and Factors

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Abstract

While in traditional mathematics teaching methods, it is possible to prove concepts while teaching geometry and to reach generalizations that require more complex definitions by using concept findings, while in today's geometry teaching, learning that activates the student's discovery process gains importance. In this context, the aim of this study is to examine ten different studies on the factors affecting students' learning of basic geometric concepts. In this study, document analysis method was used. The main purpose of document review is not to reach new information, but to reveal the current situation in light of different studies. During the data collection process of the research, ten different articles on the factors affecting learning basic geometric concepts in geometry teaching were examined by scanning Google Scholar. For the research, a keyword in the form of factors affecting geometry teaching was entered into the search engine at the scanning stage and ten different articles that were allowed to access full texts were examined. For the analysis of the data, 10 different studies made by the researchers were analyzed as a result of the document review. During the document analysis, descriptive analysis was carried out by looking at the sample, sample selection method, data analysis method, method and findings of the studies examined by the researcher, and the findings were presented in tables. As a result of the research, it was concluded that constructivist learning theories and methods are effective in teaching basic geometric concepts.

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Introductıon

Mathematics teaching helps students comprehend mathematical knowledge, construct procedural knowledge about this knowledge, and establish the links between this conceptual and procedural knowledge (Van de Wella, 1989, 6). In order for the mathematics teaching to

be carried out in a healthy way, the reasoning skills of the students should be developed, and they should be able to see the causal relationships between the events. Shoenfeld (1989) states that mathematics teaching consists of necessary factors for the student to understand mathematical concepts and principles, to be aware of mathematical relationships, and to reach logical results and solutions to unusual problems through these relationships.

It maintains its functionality with different sub-learning areas under the discipline of mathematics and carries out the work of educating students. One of these sub-learning areas is geometry. Formal or informal learning about geometric concepts and shapes in daily life is given to students in preschool and school period. Among the reasons why geometry is included in the curriculum are the need for geometric shapes and objects in daily life, the need for geometric knowledge and skills in most of the simple problems that need to be solved, and the need for geometric thinking for studies on recognizing space and developing skills related to space such as drawing and model making. counted (Akan and Altun, 1998). According to Türnüklü et al. (2005), it is important to start teaching geometry at an early age and to identify the concepts that geometric concepts express to students. According to Olkun and Toluk (2003), knowing how geometry is associated with different mathematical subjects and concepts and how geometric thinking develops in children is a building block for teaching geometry. According to Günçe (1973), educational environments should be structured appropriately in order for students to gain geometric thinking and spatial thinking competencies.

Again, according to Olkun and Altun (2003), it is necessary for students to create three-dimensional structures in their minds and to play with the images of objects in their minds in order to develop their spatial thinking abilities. While in traditional mathematics teaching methods, it is possible to prove concepts while teaching geometry and to reach generalizations that require more complex definitions by using concept findings, while in today's geometry teaching, learning that activates the student's discovery process gains importance.

A human’s curiosity about their environment emerges through geometry studies. In the early ages, geometry showed itself with the need of people to make the necessary calculations for construction. The Egyptian pyramids are one of the most important examples of this. This diversity forms the basis of the geometric objects taught today. Position calculations also laid the foundation for today's field of analytical geometry. Geometry has a great place in mathematics curricula; This is due to the fact that geometry serves as a bridge between the

events in daily life and mathematical concepts (Hızarcı et al., 2006, p. 1) Today, the aim of geometry teaching is to make sense of the universe in which students live; their ability to interpret for the order of the universe, planets, dimensions, objects and many shapes they encounter in daily life. In this respect, geometry is one of the most important fields of mathematics. The fact that Pythagoras wrote "Those who do not know geometry cannot enter" at the entrance of his school (Topdemir, 2000, p. 23) is an important indicator of this.

The fact that Atatürk wrote the work "Geometry" also shows how important this branch is. While it is so important for students to be competent in geometry, most students avoid geometry. When we look at the geometry averages of Turkey in the PISA (International Student Assessment Program) and TIMSS (International Science Tendency, Mathematics and Science Research) exams, which our country also participated in, it is seen that Turkey got 423 points. When the sub-areas of the PISA exams, in which Hong Kong-China is the first with an average of 550, are examined, it is seen that the lowest average after the numerical with 417 points is in space and shape. According to TIMSS 1999 results, Turkey ranked 31st out of 38 countries with an average of 429. Here too, geometry has the lowest average with 428 points (Fidan & Türnüklü, 2010, p. 187) As it can be understood from these data, the geometry success of the students is not at the desired level as in many other mathematics fields. In geometry teaching, concepts are arranged like the links of a chain. A disconnection in any of these rings makes it difficult to learn other concepts. For example, there will be difficulties in teaching the concept of area to a student who does not know units of measurement such as meter-centimeter. Therefore, in geometry teaching, no concept should be skipped and progress should be made. In particular, the transfer of concepts that can be considered as the basic building blocks is an important issue. In this context, the aim of this study is to examine ten different studies on the factors affecting students' learning of basic geometric concepts.

In this study, document analysis method was used. Document analysis is a qualitative research method used to systematically analyze the content of written documents (Wach, 2013). The main purpose of document review is not to reach new information, but to reveal the current situation in the light of different studies (Çepni, 2010).

Data Collection Tools

During the data collection process of the research, ten different articles on the factors affecting learning basic geometric concepts in geometry teaching were examined by scanning Google Scholar. For the research, a keyword in the form of factors affecting geometry teaching was entered into the search engine at the scanning stage and ten different articles that were allowed to access full texts were examined.

Altun and Kırcal (1998) examined the development of geometric thinking in children in an article that they researched on the development of geometric thinking on children. In line with this research, 7 different questions were asked to 105 children selected from different age groups. The sample of this study was selected from schools in Bursa. The research is a descriptive study and the findings were obtained from interviews with children. As a result of the study, it was determined that there were different levels and groups for learning each of the children's abilities in geometry. Considering these levels, it was emphasized that adjusting the training time would increase the efficiency. Within the scope of the results obtained, it was concluded that a scale related to the geometric thinking levels of children could be prepared.

Kılıç (2003) found that the effect of geometry teaching according to Van Hiele levels in the mathematics course on students' achievement, retention levels and attitudes, and that the teaching made according to the geometric learning levels developed by Hieleler in the mathematics course of the students, their attitudes towards the lesson and their retention. Research has been done on the effects on the level of In the research conducted with the pretest-posttest control group model, attitude scale, van Hiele geometry test and geometry achievement test prepared by the researcher were used. The research was carried out on two groups at the 5th grade level. An unbiased study was conducted with one of the groups as the control group and the other as the experimental group. As a result of the study, it was observed that there was a more positive difference in academic achievement and retention levels in the experimental group, in which the van Hiele model was applied, compared to the control group. It was observed that there was no difference between the attitude scores. If we make an inference here, it is concluded that when the results are progressed by considering the geometric thinking levels of the students, it has a positive effect on the academic success and retention levels of the students. Teaching the lesson according to the geometric thinking level of the student did not have an effect on the student's attitude towards the lesson.

In the study conducted by Hızarc et al. (2006) on the mistakes made in teaching basic geometric concepts, it was tried to find the mistakes made in the teaching and learning of basic geometric concepts. The study was conducted with pre-service mathematics teachers studying at Atatürk University Kazım Karabekir Education Faculty, Elementary Mathematics Teaching Department. Two activities were organized in the research, which was based on the course named Special Education Methods that teacher candidates took in the third grade. The data were obtained as a result of these two activities. In the study using the percentage frequency method, the data were loaded into the SPSS statistical program. It was determined that the mistakes of the students in the activities were caused by the physical thinking of the geometric concepts and the misconceptions in the basic concepts.

In this study conducted by Kiriş (2008) on the misconceptions of primary school students about "Point, Line, Ray and Plane, Line Segment" and the determination of the reasons for these misconceptions, the misconceptions of elementary school students on "point, line, line segment, ray and plane". It is aimed to determine the causes of misconceptions and misconceptions. The results obtained with TIMSS 1999 and PISA 2003 data were compared. Diagnostic test was used in the research, explanations were added to the questions due to the problems that may occur in the test, and when the answers were insufficient, interviews were held with the students. The universe of the research was determined as the sixth grade students in Aydın. As a sample, 5 schools from central schools and 3 schools from İncirliova district were selected. As a result of the research, it was determined that the students had many misconceptions about the mentioned subjects, especially those related to associating them with daily life, misconceptions about using them in questions that required processing, and misconceptions about establishing a relationship between geometric concepts. It has been determined that students have difficulties in associating geometric models with daily life problems.

In the study conducted by Fidan and Türnüklü (2010) on the examination of students' geometric thinking levels in terms of some variables, it was aimed to investigate the geometric thinking levels of primary school students according to gender, computer use, pre-school education and education levels of their parents. Data were collected with the geometric thinking level determination test prepared by the researchers. Random stratified sampling was used as a method in the research conducted with 1644 students from 32 primary schools in the city of Izmir. As a result of the research, it was seen that almost half of the students were at level 0.

Differences were found in all of the investigated issues (gender, computer use, pre-school education, education level of parents).

In the study conducted by Önal and Gönoğlu Demir (2012) on the effect of computer aided geometry teaching on student success in secondary school, it was investigated to what extent computer aided geometry teaching affects the success of primary school seventh grade students. The research model with pretest-posttest control group was used in the study, which is in the experimental model. Seventh grade students in Karabük were chosen as the target. Two classes taking lessons from the same teacher selected from one of the public schools in this province formed the sample of this research. As a result of the research, it has been revealed that computer-assisted teaching is more efficient than traditional teaching in terms of reflection and rotation.

In the study conducted by Şahin (2013) on the effect of geometry teaching on the success of students in constructing geometric structures, he studies the effect of teaching concrete and virtual manipulative supported geometry to the target 5th grade students on their ability to construct and draw geometric structures. In the research, quasi-experimental research method with pretest-posttest control group was used. The population of the study consists of an elementary school in the Pendik district of Istanbul province, which is at the middle socio-economic level. A 21-question "Building and Drawing Geometric Structures" test developed by the researcher was applied to 56 students selected from this school. As a result of the research, differences were determined between the pre-test and post-tests applied to both the control group and the experimental group. It was observed that the difference between the results was higher in the classroom where concrete and virtual manipulative supported instruction was applied. As a result, it has been seen that concrete and virtual manipulative supported teaching has a positive effect on student success.

In the research conducted by Genç and Öksüz (2016) on the teaching of polygons and quadrilaterals with dynamic mathematics software, the effect of the success and permanence of the students' teaching of polygons and quadrilaterals with dynamic mathematics software was studied. The pretest-posttest control group quasi-experimental model was used as the research method. The normal program was applied to the control group for 5 weeks, and the dynamic mathematics software was applied to the experimental group. An achievement test of 26 questions prepared by the researcher was applied. The universe of the research consists of 5th

grade students in Aydın. The central district of Aydın province was chosen as the sample. As a result of the study, a significant difference was observed between the pre-test and post-test data of the experimental group. It was observed that there was a similar difference between the data in the control group, so that both programs had a positive effect on student learning. As a result of the comparison of the post-test data applied to both groups, a significant difference was observed in favor of the experimental group. It was observed that the experimental group was more successful in the permanence test performed 2 months after the study.

In the research conducted by Arslan (2016) on the effect of game-supported learning on the success of students in teaching the subject of basic geometric concepts, the effect of game-assisted teaching on basic geometric concepts and drawings in mathematics lesson was studied. In the research carried out in Mehmet Akif Ersoy Secondary School in Sinop between 2014-2015, at the secondary school level, two classes were divided into two classes, one control group and one experimental group, and groups of 30 students were handled. The normal curriculum was taught to the control group and the experimental group was taught with game-supported instruction. The geometry achievement test prepared by the researcher himself was used. This achievement test was applied to 3 different groups as pre-test, post-test and permanence test after 3 weeks. Standard deviation, single factor analysis of variance, independent group t-test, arithmetic mean, multiple comparison test and Shapiro-Wilk test were used as data collection tools. With this research, it was revealed that the success of the students increased in game-supported teaching and that it was effective on permanence.

In the study named "Geometry Education with Augmented Reality Activities Using Three-Dimensional Modeling" conducted by Topraklıkoğlu (2018), it was aimed to investigate the effect of augmented reality applications on the view of objects from different sides on the development of spatial abilities of seventh grade students, their attitudes towards geometry and augmented reality applications. The research proceeded with a mixed research design in which both qualitative and quantitative research methods were used. A single group pretest-posttest and case study were used. The research was carried out on a class of 53 students selected from the seventh grade of a school in a district of Balıkesir during the 2016-2017 education period. Geometry attitude scale, augmented reality attitude scale and spatial ability test were applied to collect data. In addition, semi-structured interviews were conducted with the students for qualitative data. As a result of the research, it was seen that augmented reality applications

contributed to the development of students' spatial abilities. It has been understood that the students have a positive attitude towards the use of mobile devices in the lesson. There was no significant difference in geometry attitudes.

Analysis of Data

For the analysis of the data, 10 different studies made by the researchers were analyzed as a result of the document review. During the document analysis, descriptive analysis was carried out by looking at the sample, sample selection method, data analysis method, method and findings of the studies examined by the researcher, and the findings were presented in tables.

Results

In this part of the research, the findings related to the characteristics of the articles examined are included. The distribution of articles by years is shown below.

Distribution of Articles by Publication Types by Years

Table 1- Distribution of Articles by Years

Yıl	**Makale**
1998	1
2003	1
2006	1
2008	1
2010	1
2012	1
2013	1
2016	2
2018	1
Toplam	**10**

When Table 1 is examined, it is seen that the most studies were conducted in 2016 and 2 studies were conducted in this year.

Distribution of Articles by Data Collection Tools

The findings regarding the distribution of the articles examined in the study according to the data collection tools are given in Table 2.

Table 2. Distribution of Articles by Data Collection Tools

Data Collection Tools	Article
Achievement test	3
Diagnostic Test	1
Leveling Test	1
Persistence Test	2
Aptitude test	1
Attitude Scale	1
Reality Attitude Scale	1
Spatial Ability Test	1
Test of Building and drawing Geometric Structures	1
Unspecified	3
Total	**15**

When Table 2 is examined, it is seen that more than one data collection tool was used in some studies, so the total number was 15. In the studies, it is seen that the most used test is the achievement test and this test is generally used to evaluate the success of students on basic geometric concepts.

Distribution of Articles by Research Design

The findings regarding the distribution of the articles examined in the study according to the research design are given in Table 3. The pattern of the articles was determined by taking into account the explanations made for the research patterns of the articles examined.

Table 3. Distribution of Articles by Research Design

Research pattern	Article
Pretest-Posttest	6
Unspecified	4
Total	**10**

When the research findings are examined, it is seen that the experimental design is generally used in the research.

Distribution of Articles by Data Analysis Method

The findings regarding the distribution of the articles examined in the study according to the data analysis method are given in Table 4.

Table 4. Distribution of Articles by Data Analysis

Data analysis	Article
Descriptive Analysis	2
Unspecified	7
Variance Analysis	1
T test	1
Multiple Comparison Test	1
Shapira Wilk Test	1
Total	**13**

When Table 4 is examined, it is seen that descriptive analysis is mostly used in these studies.

Discussion And Conclusion

When the results of the research are examined, it is seen that the achievement test is generally used in the studies and the pretest, posttest, experimental and control group model is used. In the studies, tests such as geometry attitude scale, spatial ability test and augmented reality test, which are generally used to determine students' attitudes towards geometry, were used. When the studies are examined, in most of the studies, academic success is related to class, gender, etc. It is seen that there has not been a study on whether it differs according to sub-components such as

In this context, it is recommended to increase the number of studies aiming to investigate the components of the factors affecting student achievement in research and to carry out studies to determine the source of significant differences.

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