

Determination of learning styles and achievements of talented students in the fields of Science and Mathematics

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Abstract

The purpose of this study is to determine the distribution of talented students' course achievements in the fields of mathematics and science, according to the learning styles. General screening method was used in this research. The universe of the research consists of Ninth grade students (2016–2017) who study at Bornova Anatolian High School. The sample of the study was composed of 11 talented students. After determining learning styles, the distribution of the students according to the learning styles was determined. At the end of the study, it was detected that mathematics course achievements' average of the students who have assimilator learning style is higher than averages of the other students's who have other learning styles. It was determined that physics course achievements' average of the students who have assimilator learning style is higher than averages of the other students's who have other learning styles.

Keywords: Learning styles, talented students, science and mathematics.

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1. Introduction

In the globalising World, along with the national studies conducted in the field of education, studies in the international level show that, contemporary education system needs to raise individuals who are able to gain, use and construct the information efficiently. Individuals, who are a part of this education system, will contribute to develop the society in all areas.

One of the essential conditions for development of the countries economically, socially, culturally and technologically is qualified human source. Hence, this makes the education of the talented individuals more important so as to develop the society and country. Children or students, who exhibit higher performance in terms of intelligence, creativity, art, leadership capacity or special academic fields when compared to their peers, are described as talented (Bilsem Yonergesi, 2007).

Benefiting from personal interests and abilities of the talented students can be realised with the education by taking their personal differences into consideration. Talented students' education is multi-dimensional. A lot of factors such as education models, teaching strategies and resources selections should be determined and improved according to these kind of students' characteristics (Uzun, 2004).

When they are educated according to their abilities, interests and desires, abilities of these children can be used effectively. These children need comprehensive education opportunities that can not be provided with ordinary programmes (Renzulli & Reis, 1985).

In today's mathematics and science education, teachers' responsibility is to prepare the appropriate education and teaching atmosphere to the students in which the students access the information actively instead of presenting the information directly. Students' individual differences play a prominent role in gaining and structuring the information. While designing teaching and learning environment, taking individual differences into account is a necessity.

One of the individual's learning differences is learning style. Learning styles are described as a method that individuals prefer to receive and process the information personally (Kolb, 1984). Student can learn without paying attention to the learning styles. However, mathematics and science education are realised by considering the student's learning style, which makes learning the both more efficient and economical and also it provides with the opportunity to teach some concepts and abilities effectively that can be hardly taught and learnt by traditional teaching style.

The information gained by determining the students' learning styles can help educators how to develop methods in the learning-teaching environments held for adults (Akkoyunlu, 1995).

Students are expected to be more efficient in learning process in the education environments that educators create by considering students' learning styles. This duty belongs to the educators. One of the characteristics that talented students' educators must have is 'the ability to prepare learning models and activities for talented students' (Feldhusen, 1997). In the group of talented students who have different learning styles and necessities when compared to the normal learning level students, regulating learning activities with regard to learning style that they prefer will facilitate to disclose their potentials.

Learning styles include observable and idiocratical behaviours that give tips about every individuals. Learning styles come from birth and predisposition. However, these must be defined, disclosed, encouraged, explained, developed and disciplined (Kaplan & Kies, 1995). Every student has a unique learning style and this is like a fingerprint of this person. Educator can regulate both class environment and learning environment to meet student's individual needs by knowing the student's learning style. According to Babadogan (2000), if individual's learning styles are determined, how the individuals learn and what kind of teaching design must be regulated can be understood more easily.

Talented individuals are the most essential human source that any society can have. Determination of learning styles of these individuals who will have an important role in the process of development

and improvement and improving their achievements in the field of mathematics have an essential importance on the road to being prominent individuals who steer the science by disclosing their potentials. According to Moore (1992), talented individual must be passed through comprehensive diagnostic period to evaluate his existing potential in high level.

1.1. Theoretical background of the study

Evaluating a individual's learning style is essential to the learning and teaching process (Hein & Budny, 2000). The information gained by determining the students' learning styles can help educators how to develop methods in the learning and teaching environments designed for students (Akoyunlu, 1995). If individual's learning styles are determined, how the individuals learn and what kind of teaching design must be regulated can be understood more easily. Hence, educator can create teaching environments primarily for himself (Babadogan, 2000). When learning styles and teaching styles are matched, several studies showed its important influence on student's achievement (Scales, 2000). When students' learning styles are known, teaching can be designed according to students' interest by teaching strategies, teaching methods and techniques, and selecting and implementing necessary teaching equipments. Peker and Yalin (2002) stated that mathematics educators do not create teaching environment by considering the students' learning styles and they attract attention that educators must be aware of their students' learning styles and they must create a teaching environment by taking their students' learning styles into consideration. On the base of the studies related to the learning styles, the thought lies that personal differences are wealth in learning environment (Gencil, 2007, p. 121).

In the light of this knowledge, by examining the distribution of achievements in mathematics and science of the talented students who compose the sample of the study, the results gathered as a result of the studies and this particular study are thought to be beneficial to organise learning and teaching environments for both educators and students. This situation is thought to contribute their academic achievements in the fields of mathematics and physics. Hence, we will seek an answer to the research questions below in order to determine distribution of the mathematics and physics course achievements of the talented students according to their learning styles.

1. What is the distribution of learning styles?
2. What is the distribution of learning styles according to gender?
3. What is the distribution of mathematics course achievements according to learning styles?
4. What is the distribution of physics course achievements according to learning styles?
5. What is the distribution of chemistry course achievements according to learning styles?
6. What is the distribution of biology course achievements according to learning styles?

2. Method

2.1. Research model

Correlational design was used in the study in which talented students' learning styles and course achievements were examined. This research, which aims to investigate students' learning styles and course achievements in the field of mathematics and physics, is a descriptive study. Survey models are research approaches that aim to describe a past situation or a still existing situation as it is (Karasar, 2005).

2.2. Universe and sample

The sample of the study consists of 11 ninth-grade talented students from Bornova Anatolian High School, which is a project school in Izmir in 2016–2017 academic year.

2.3. Data collection tools

In order to determine learning styles of students, learning style inventory, developed by Kolb (1985) and adapted into Turkish by Askar and Akkoyunlu (1993), was applied. In order to determine talented students' course achievements in the field of mathematics and science, their mathematics and physics grade point averages in the first and the second term of 2016–2017 academic year were used.

2.4. Learning style inventory

In order to specify students' learning styles, Learning Style Inventory developed by Kolb (1984) was used. Four learning styles were determined in this inventory, which was adapted into Turkish by conducting validity and reliability studies by Askar and Akkoyunlu (1993). Kolb's Experiential Learning Theory underlines Kolb's learning style. With regard to Kolb's learning style, learning is a cycle and one of these four learning styles is primary for an individual. Every individual's learning style is component of these four learning styles (Jonassen & Grabowski, 1999). Learning style inventory, which demands the individuals to collocate the four learning styles that describe their learning style best, consists of 12 items with four options. Each option represents a learning style. These are concrete experience, reflective observation, abstract conceptualisation and active experience. The point between 12 and 48 is gained according to the points that attendants give to each option. After that, combined points are gained. While the positive point obtained from abstract conceptualisation and concrete experience indicates that learning is abstract, the negative point refers that learning is concrete. In a similar way, the positive point gained from active experience and reflective observation shows that learning is active, the negative point implies that learning is reflective. According to the calculated values, each student's learning style is detected. The component of concrete experience (by feeling) and reflective observation (by watching) forms 'diverger' learning style. The individuals who have this kind of learning style are good at looking in different point of views to the concrete situations. The component of abstract conceptualisation (by thinking) and reflective observation (by watching) forms 'Assimilator' learning style. Among the most essential characteristics of the individuals who have this kind of learning style are the ability to think and being aware of the values and meanings. 'Converger' learning style is the component of abstract conceptualisation (by thinking) and active experience (by making). Solving the problems, making decisions planing ideas logically and systematically are major characteristics of the individuals with this learnig style. The component of concrete experience (by feeling) and active experience (by making) is 'Accomodator' learning style. Making plans, carrying out the decisions and having new experiences are major characteristics of the individuals with this learning style (Kolb, 1984).

2.5. Analysis

The data were obtained from talented students via Learning Style Inventory and Learning style inventory norms developed by Kolb (1985) were taken into consideration in determining students' learning styles. After that, the distribution of the students according to learning styles and genders was determined via frequency (*f*) and percentage (%) distributions. The findings were presented in Tables 1 and 2.

The distribution of talented students' course achievements in the field of mathematics and physics according to their learning styles was investigated by frequency (*f*) and percentage (%) distributions and the results were presented in Tables 3–6.

3. Findings

In this part, the findings of the study were represented via tables and the explanations related to them were presented in below the tables.

3.1. What is the distribution of learning styles?

To answer this research problem, four different learning styles obtained from Kolb's Learning Style Inventory were illustrated in Table 1.

Table 1. The distribution of learning styles

Learning styles	Converger	Accommodator	Assimilator	Diverger
N	6	2	3	-
%	54.5	18.2	27.3	-

When the data in Table 1 were taken into consideration, the most common learning style among the students was converger learning style. The distribution of learning styles was 54.5% converger learning style, 18.2% accomodator learning style and 27.3% assimilator learning style, on the other hand there was no student with diverger learning style.

3.2. What is the distrubition of learning styles according to gender?

To answer this research problem, the distribution of four different learning styles obtained from Kolb's Learning Style Inventory according to gender was illustrated in Table 2.

Table 2. The distribution of learning styles according to gender

Learning styles	Converger	Accommodator	Assimilator	Diverger
Female (n)	2	1	1	-
%	50	25	25	-
Male (n)	4	1	2	-
%	57.1	14.3	28.6	-

With regard to Table 2, the most common learning style among was converger learning style. While 50% of the female students had converger learning style, 25% of them had accomodator learning style and 25% of them had assimilator learning style; the most common learning style among male students was converger learning style. The distribution of learning styles among male students was 57.1% converger learning style, 14.3% accommodator learning style and 28.6% assimilator learning style.

3.3. What is the distribution of mathematics course achievements according to learning styles?

In order to answer this research problem, end-of-the term mathematics grades of the ninth grade students were taken into consideration and shown in Table 3.

Table 3. The distribution of mathematics course achievements according to learning styles

Learning styles	Converger	Accommodator	Assimilator	Diverger
n	6	2	3	-
Math achievements average	78.2	73.3	83.3	-

As illustrated in Table 3, the mathematics course achievements' average of the students with converger learning style was 78.2, of the students with accommodator learning style was 73.3 and of the students with assmilator learning style was 83.3. In this case, mathematics course achievements' average of the students with assimilator learning style was higher than the students with other learning styles.

3.4. What is the distribution of physics course achievements according to learning styles?

In order to answer this research problem, end-of-the term physics grades of the ninth grade students and their learning styles were taken into account and shown in Table 4.

Table 4. The distributions of physics course achievements according to learning styles

Learning styles	Converger	Accommodator	Assimilator	Diverger
<i>n</i>	6	2	3	-
Physics achievements average	84.9	82.5	91.7	-

With regard to the data in Table 4, the physics course achievements' average of the students with converger learning style was 84.9, of the students with accommodator learning style was 82.5 and of the students with assimilator learning style was 91.7. In that case, physics course achievements' average of the students with assimilator learning style was higher than the students with other learning styles.

3.5. What is the distribution of chemistry course achievements according to learning styles?

In order to answer this research problem, end-of-the term chemistry grades of the ninth grade students and their learning styles were taken into consideration and illustrated in Table 5.

Table 5. The distribution of chemistry course achievements according to learning styles

Learning styles	Converger	Accommodator	Assimilator	Diverger
<i>n</i>	6	2	3	-
Chemistry achievements average	79	73.1	77	-

As presented in Table 5, chemistry course achievements' average of the students with converger learning style was 79, of the students with accommodator learning style was 73.1 and of the students with assimilator learning style was 77. So, chemistry course achievements' average of the students with converger learning style was higher than the students with other learning styles.

3.6. What is the distribution of biology course achievements according to learning styles?

In order to answer this research problem, end-of-the term biology grades of the ninth grade students and their learning styles were taken into account and presented in the Table 6.

Table 6. The distribution of biology course achievements according to learning styles

Learning styles	Converger	Accommodator	Assimilator	Diverger
<i>n</i>	6	2	3	-
Biology achievements average	81.1	80.9	83.2	-

As demonstrated in Table 6, biology course achievements' average of the students with converger learning style was 81.1%, of the students with accommodator learning style was 80.9 and of the students with assimilator learning style was 83.2. At that point, biology course achievements' average of the students with assimilator learning style was higher than the students with other learning styles.

4. Results, suggestions and discussion

4.1. Results

The reasons such as using prototype curriculum in the education of talented children who are way above the average, crowded classes, no timing for personal teaching, limited equipment and diversified teaching opportunity make harder for them to have efficient education-teaching (Akarsu, 2001). Determination of the learning styles of talented students is pretty essential for both students and educators.

In the present study that has been prepared with the conscious of the importance of their education in an environment designed appropriately for talented students, it was emphasised that as

long as individuals do not get training in an appropriate environment for their personal differences, they may not improve their existing potentials, in fact their potentials may disappear.

It is thought that, for the countries, the importance of regulating education environments by considering the results of the present study and the future studies conducted with talented students is pretty vital.

4.2. Discussion

The study shows that most of the students adopt converger learning style. The characteristics of the individuals with this learning style are the ability of solving problems, giving decisions and planning the ideas logically and systematically. These characteristics coincide with the characteristics of talented students. It can be thought the fact that there is no student with diverger learning style that includes the characteristics of being successful at looking in different point of views to concrete situations' results from the ability of the abstract thinking of talented students. In the study conducted with the students from Anatolian and Science high school, Peker and Aydin (2003) pointed out that 54.5% of the students were assimilators, 29.4% of the students were convergers, 10.9% of the students were divergers and 5.2% of the students were accomodators. In another study conducted with the secondary education students, Guven (2004) determined that almost half of the students (46.6%) were assimilators, 27.1% of the students were convergers, 16.8% of the students were divergers and 9.5% of the students were accomodators. In the present study, it was seen that there were differences among students' learning styles. According to Kolb, the reason of the differences among students' learning styles results from their families, schools and offices in addition to their past experiences (Ulgen, 1995).

In his study, Kaya (2007) indicated that the most common learning styles were diverger and assimilator learning styles and the least common ones were converger and accomodator learning styles among female and male students. In a similar way, Koc (2007) ascertained that female and male students adopted assimilator learning style the most. The studies showed that students' learning styles differ with regard to their developmental period.

The results of several studies (Arslan and Babadogan, 2005; Bilgin & Durmus, 2003; Kocak, 2007; Peker, 2005; Yenilmez & Cakir, 2005) supported that there is a significant relationship between learning styles and achievement. Peker (2005) examined the relationship between learning styles of the students at the department of Mathematics Teaching and their mathematics achievements. He found that students' mathematics achievements showed significant differences with regard to their learning styles and these differences were related to accomodator and converger learning styles.

In the present study, mathematics course achievements differ with regard to students' different learning styles. The studies suggested that this difference should be realised through taking students' learning styles into consideration. Along with the general needs of the talented students, mathematics education programme that will be prepared by taking learning styles into account can be beneficial for the students. It is barely seen that secondary education and high school courses overreach the national standarts. This situation is not appropriate for the talented ones who have the ability and desire to do more (Johnson, 1994). In this level, one of the most essential points in mathematics education is to acknowledge the different aspects of talented students, understand them and prepare convenient education teaching environment for them.

Students with the high mathematics, phsics and biology average points have assimilator learning style. One of the most essential characteristics of the individuals with this learning style is the ability of thinking and being aware of the values and meanings. Students with high chemistry average points have converger-learning style. The main features of convergers are the ability of solving problems, giving decisions and planning ideas logically and systematically.

In Koc (2007)'s study called Primary school students' Learning styles: the relationship between Science achievement and attitudes towards Science, a significant difference was found out among primary school students' attitudes towards science with regard to their learning styles. Biology Teaching based on learning style is a concept that refers student-centred biology teaching and emphasises that biology teaching should be made appropriately according to choices of the students on learning process and learning conditions (Ekici, 2001). Ekici (2001) analysed biology teaching based on teaching style and stated 70% of the educators in the study did not carry out biology teaching based on learning style. In Arslan and Babadogan (2005)'s study, the relationships between primary school students' learning styles and their academic achievement levels, gender and age, high relationships between science course achievement and concrete experience, and abstract conceptualisation and active experience learning styles were found.

4.3. Suggestions

With regard to the findings of the study, it will be beneficial to give suggestions related to the educations and studies that will be conducted with talented students.

4.3.1. Suggestions for researcher

As the sample of the study composed of talented students, it is a specific group. It is suggested that experimental and longitudinal studies should be carried out with different groups of talented students.

It is suggested that experimental and longitudinal studies should be conducted with educators who take charge in science art centres.

Similar studies should be carried out with the talented students from science high school, project school and Anatolian high school or college.

4.3.2. Suggestions for practitioners

Educators should tell the students the fact that students who aware of their learning styles will contribute disclosing their potentials and improving their abilities.

In order to use learning styles effectively in their learning, students should be informed about which learning styles they have, what the characteristics of learning styles are, how to use them, in which situations and why they need to use them.

To determinine the learning styles of talented students, educators should know which learning strategies students use and what kind of learning styles they prefer to use in learning.

The thoughts of all educators who give lectures to talented students in Science and Art centres should be revealed. This is necessary for specifying activities used in mathematics and science course materials. Educators who will be in charge in education programmes of talented students are expected to be positively different from the other educators in terms of knowledge, ability and sufficiency (Chan, 2001; Feldhusen, 1997; Renzulli, 1985).

Battal-Karaduman (2009) states that high flyer students might be regarded as unsuccessful by their educators since they are uninterested in homeworks given in school and they do their works perfunctorily. Hence, determination of homeworks given in school due to students' learning styles is vital.

In order to improve their abilities and interests, talented students need to be presented opportunities via appropriate and compelling education programes that pay attention to their personal differences. Instead of rote learning, standarts should be improved to pay attention to communication, interdisciplinary relationship and personal abilities.

It is thought that investigating the relationship between talented students' learning styles and course achievements in the field of mathematics and science, by the light of that, improving and editing the education programmes will contribute the education of talented students who will make contributions to developments of their countries.

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