Learning Environments Designed According to Learning Styles and Its Effects on Mathematics Achievement*

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Abstract

Problem Statement: While designing a learning environment it is vital to think about learner characteristics (learning styles, approaches, motivation, interests… etc.) in order to promote effective learning. The learning environment and learning process should be designed not to enable students to learn in the same manner and at the same level, but rather designed by giving thought to students' existing learning styles.

Purpose of the Study: The aim of this study is to examine primary students' and inspectors' opinions on different learning environments designed according to students' learning styles and its effects on students' achievement.

Method: Fifty-five seventh grade students and seven inspectors constituted the research sample. The data were collected through an open-ended questionnaire; a mathematics achievement test and the Pat Wyman Personal Learning Style Inventory were used as data collection tools in the research. Since the group consisted of less than 30 participants, the Wilcoxon Signed Rank Test for Paired Samples was used.

Findings and Results: The difference of pre-post test results of visual auditory learners, auditory-kinesthetic learners, and visual-auditory learners are statistically significant. When the ranked average of different grades and their sums are considered, the observed difference is in

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* This article has been produced from the doctorate thesis supervised by Prof. Dr. Buket Akkoyunlu at the Division of Educational Administration, Supervision, Planning and Economics, Graduate School of Educational Sciences, Near East University.
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positive ranking, meaning it is in favor of post-test results. According to these results, different learning environments designed for visual-auditory-kinesthetic learners have a positive effect on student grades. The majority of the students stated that the aforementioned activities used in the mathematics lesson could also be used in other school subjects.

Conclusions and Recommendations: Student responses emphasized that learning environments should be designed according to student learning styles. Inspectors underlined that learning styles designed according to students' individual learning styles may increase student success. In addition, inspectors thought that some of the advantages of designing learning environments according to students' learning styles included an opportunity to learn fairly, an increase in student motivation towards the lesson, and enabling students to learn at their own pace. In the upcoming studies, student behaviors and motivations towards environments designed according to students' learning styles will be analyzed.

Keywords: Learning styles, achievement, students' opinions

Introduction

Learning is a very complex process. One's general ability, cognitive process, emotions, motivation, developmental characteristics, readiness, previous experiences, social environment, and the culture of his/her community are variables that affect the process of learning. Affected by so many factors, individuals have different learning processes.

In a learning environment there are many stimuli created by the teacher. A student collects the information that s/he chooses from among these stimuli. Additionally, every student might have different senses s/he prefers to use. When one student tries to learn by listening to the teacher, another might be interested in the behaviors of the teacher or the script and pictures of the book open in front of him/her. Every student has a different strategy of coding information to their long-term memory. Some try to learn by giving meaning to them at once, whereas some try to learn by repeating. Some students can remember what they learned easily and quickly. Conversely, some have difficulty remembering and organizing what they know. Some students like learning in groups, and some might find it disturbing (Erden & Altun, 2006).

Researches on educational sciences have shown that there are learning differences among students and the only way for learning to take place in the proper sense is to find an individual's learning style and arrange the learning environment accordingly. Learning differences have affected learning and teaching processes, individualizing learning processes and taking these learning differences into the center of learning. Students have their own methods of obtaining information and processing it: while some focus on data and operations, others are better at theories and mathematical models. For some, written and verbal explanations are more

effective for others it can be visual elements like drawings, shapes, and graphics. Some learners prefer interactive environments, while others might prefer working individually. All of these differences in learning preferences are signs of their different learning styles (Felder, 1996).

The learning style of an individual not only shows how s/he learns but also gives information about how to design a learning environment. Although all the students in a class are at the same age, at the same developmental phase, and offered mutual chances by the teacher, different behaviors, learning styles, and achievements in a class can be observed. Dwyer (1996) emphasized that no matter the learning environment, students' learning styles should be taken into consideration while designing the learning process. Many of the researches underlined the importance of identifying students' learning styles and how helpful this can be in preparing the learning/teaching environment (Boydak, 2001; Claxton & Murell, 1987). In school learning, if the learning environment is designed according to student learning styles, their academic achievements increase (Erden & Altun, 2006).

Learning Styles

There are many definitions of learning styles in the literature. Shuell (1986) explained that learning styles are the different ways used by individuals to process and organize information or to respond to environmental stimuli. Jensen (1998) defined learning style as a way of thinking, comprehending, and processing information. Keefe and Ferrell (1990) underlined learning style as the pattern of cognitive, emotional, and physiological characteristics affected partially by individuals' way of perceiving, interacting with, and reacting to learning environments. According to Dunn and Dunn (1993, learning style is a path that may vary from one person to another, which starts with concentration and continues when information is received and located in the mind. Jensen (1998) defined learning style as a way of thinking, understanding, and processing data. Wyman (2006) defined learning styles as an individual's different way of receiving and processing information. If an individual knows his/her learning style, s/he can upgrade his/her learning level to the maximum, which can result in lifelong learning success. Wyman (2006) divided learning styles into three categories: audio, visual, and kinesthetic. According to Wyman, if a student's learning is identified and arrangements are made, the student's success can be enhanced. The most important thing while making necessary adjustments is preparing the learning environment to be suitable for each learning style.

Analysis of the various definitions concludes that every individual has a unique learning style. Even though they are learning in the same environment, for the same duration, and they are internalizing the same facts and events, their approaches can be different. Although learning styles are not permanent or fixed components, it takes time. Because of this, it is easier and more effective to arrange the classroom environment, learning materials, and learning styles related to the learning styles, rather than expecting students to adapt to the existing system. Learning styles play a vital role in an individual having an effective learning life. As a result, it is a

necessity to design learning environments suitable for the individuals (Hood, 1995). As Cela, Sicilia, and Sánchez-Alonso (2015) underlined, learning styles influence different learning environments, such as social networks in an e-learning class.

Learning Environment

A learning environment has many meanings according to the way it is used. Besides its definition as an indicator of learning task (Tynjala, 1999), psychosocial environments in class (Henderson, Fisher, & Fraser, 2000), and virtual environments formed with computer and internet technologies (Fulkerth, 2002), it is also used in a very wide range of ways. Studies on learning environments focus on behavior management, classroom rules and discipline, motivation of students, teaching methods, the set-up of classroom tools (tables, desks, etc.), and even the color of the classroom (Chesebro & McCroskey, 2002; Slavin, 2000; Snowman & Biehler, 2003). Learning environment the surroundings that make it possible for the learner to find solutions to their problems and to have access to the materials to help them achieve their goals. To make lifelong learning possible, the experiences in the learning environment are crucial. These experiences are formed of the interaction between the learner and the learning environment. The role of the interaction with sensory stimulants (tools and materials) is very important in a learning environment designed for learners. In today's educational concept, the insight of learner-centered education not only enables materials to be designed according to students' different learning characteristics, but also enhances the efficient learning environments with the help of the developed technology. Learning environments designed according to students' needs improve student motivation and success by using a variety of materials. In this context, when instructional technologies are analyzed, they can be classified as visual environments, auditory environments, or both. As Vinales (2015) mentioned in her study, the learning environment is a key factor for student learning. It provides crucial exposure for the students and helps students develop their repertoire of skills, knowledge, attitudes, and behaviors in order to meet 21st century competencies.

Designing the learning environment is a complicated process including many different variables. Unless a learning environment is constructed in advance, it is not only inadequate in learning goals but also an environment without control. In order to avoid chaos in the learning environment, either the teachers or the instructional designers should prepare and check it in advance (Wilson, 1995). Instructional designers cannot design a learning environment that can be applied to every kind of learning. This is not possible even though the characteristics of learning and the learner are taken into consideration. During the learning process, learners use more than one sense: they use visual and auditory information, perceive data from the outside, choose the meaningful data, and combine new data with existing data. Besides, learners with different learning styles activate the aforementioned mind processes. These experiences can be acquired by interacting with the learning environment (Bolliger, 2004). Studies have shown that learning environments that consider learner characteristics affect academic success in a positive way (Chen &

Duh, 2008; Dascalu, Bodea, Moldoveanu, Mohora, Lytras, & de Pablos, 2015; Millwood, Powell, & Tindal, 2008).

The Aim of the Study

While designing the learning environment, it is vital to think about learner characteristics (learning styles, approaches, motivation, interests, etc.) in order to promote permanent and effective learning. Multimedia environments address more than one sense and teach by giving importance to individual differences, which increase success and make permanent learning possible. Dwyer (1996) mentioned that learning environment and learning process should be designed not to enable students to learn in the same manner and at the same level, but rather should be designed by giving thought to students' existing learning styles. The aim of the study is to examine primary school students' and inspectors' opinions on different learning environments designed according to students' learning styles and its effects on students' mathematics achievement. Therefore, this study seeks the answers to the following questions:

a. What are the learning styles of the students?

b. Is there a difference between mathematics pre- and post-test results of students who have different learning styles (visual-auditory, auditory-kinesthetic, and visual-auditory–kinesthetic)?

c. What are the students' opinions about learning environments designed according to students' learning styles?

d. What are the inspectors' opinions about learning environments designed according to students' learning styles?

Method

Research Design

The study is a one-group pre-test – post-test design. There is a single selected group under observation, with careful measurement done before applying the experimental treatment and then measuring after (Gay, 1987). In the one-group pre-test – post-test design, a single group is measured or observed not only after being exposed to a treatment of some sort, but also before (Fraenkel, Wallen, & Hyun, 2012). In this design, the effect is taken to be the difference between the pre-test and post-test scores.

Research Sample

The convenience sampling method was chosen for this study. Convenience sampling is a statistical method of drawing representative data by selecting people because of the ease of their volunteering or selecting units because of their availability or easy access (Lavrakas, 2008). For this study, the convenience sampling method was chosen because the subjects were readily available for the researcher, as well as other research advantages. The researcher was a mathematics teacher of the study group, and she designed the learning environment in their mathematics

lessons. This sampling method was also useful in documenting that quality of the designed learning environment for the research (Lavrakas, 2008). However, convenience sampling has limitations. The most obvious criticism about convenience sampling is that it is not representative of the entire population. It has limitations in generalization and inference making about the entire population. Since the sample is not representative of the population, the results of the study cannot speak for the entire population.

Fifty-five seventh grade students and seven inspectors constituted the research sample. 56.5% of the students were girls and 43.6% were boys. 47.3% of the students had a visual auditory learning style, 23% had auditory kinesthetic, and 29.1% had visual auditory kinesthetic. Four of the inspectors were male and three were female, with seven years of work experience in the field.

Research Instrument and Procedure

The data for the study were collected through open-ended questionnaires, the Mathematics Achievement Essay Test, and the Pat Wyman Personal Learning Style Inventory.

Open-ended questionnaires: The researchers developed open-ended questionnaires for students and inspectors in order to examine their opinions on learning environment. The student questionnaire had four questions: "What do you think about the Transformation subject?", "Did you have any trouble during the course?", "If so, what was it?", and "Would you like to be taught the same way in other courses? Why?". The inspector questionnaire had three questions: "Do you think students' achievements would increase if learning environments were designed according to student learning styles?", "Why?", and "What are the advantages of learning environments designed according to student learning styles?". Questions were prepared and sent to subject specialists, then were redesigned according to their suggestions.

Mathematics Achievement Essay: A Mathematics Achievement Essay on the Transformation unit was prepared to define students' mathematics achievement; these were used as pre- and post-test. The achievement test aimed to ask questions that triggered students' interpretation, analysis, arguments, and evaluation skills. The exam consisted of 10 questions of increasing difficulty (knowledge, interpretation, application, and analysis). The questions were designed according to their difficulties; in other words, the difficult questions were graded with a higher score. The test was conducted on fifty-two 8th grade students who had already been taught the unit for testing the reliability and validity of the essay. The test - retest method and inter rater reliability were used for reliability. The essay was given to the group as pre- and post-test in four weeks. The correlation coefficient was found to be $\alpha=.79$. For inter rater reliability, three different examiners graded the ten questions independently and the correlation coefficient changed between 0.89 and 0.94, which was quite high. Kendall's coefficient of concordance was used to test inter-rater reliability, which was found as .52 ($\chi^2= 315.16$, sd=3, p<.05). Criteria validity was

used to test the validity, and 8th grade students' essay scores were compared to their mathematics report marks and the correlation between them was found to be .61.

Pat Wyman Personal Learning Style Inventory: The Pat Wyman Personal Learning Style Inventory was used to identify students' learning styles and was developed by Pat Wyman (1998). The Learning Style Inventory consists of 36 questions. Students check the statements he/she agree with. The Pat Wyman Personal Learning Style Inventory was adapted into Turkish by Erdem & Akkoyunlu (2006) and its validation and the alpha reliability coefficient were calculated. The reliability of the scale was .73.

Data Analysis

The data was analyzed using SPSS (The Statistical Package for the Social Sciences). Since the group consists of less than 30 participants, the Wilcoxon Signed Rank Test for Paired Samples was used.

Implementation of the Process

First, daily lesson plans were prepared according achievements in the Transformation unit. The learning styles of students were defined and learning environments were designed considering their learning styles. Transformation Geometry was chosen because it is taught in schools only by using written documents and tracing paper; in addition to this, it was important to thoroughly investigate how auditory, kinesthetic, and visual learners learn. Moreover, Transformation Geometry can develop students' geometry experiences, imaginations, thinking abilities, and spatial skills. With the help of Transformation Geometry, students not only associate mathematics and art, but also understand the importance of mathematics and its application to our daily lives. For instance, when students look at a rug and its repeated and rotated patterns, they can look at their environment from another perspective. Because of this, Transformation should be taught to students at very early ages; the fact that reflection and rotation can be observed in many natural constructions and natural appearances should be emphasized.

Studies show that Transformation geometry can develop students' abstract concepts such as consistency, symmetry, analogy, and parallelism and can help to improve their three-dimensional thinking abilities (Flanagan 2001; Hannafin, Truxaw, Vermillion, & Liu, 2008). The objects used in the activities were chosen as suitable for the subject matter and the age group. Students were given the opportunity to actively innovate in the given activities and there was an attempt to widen their previously acquired knowledge. Instead of giving students ready shapes, they were encouraged to design their own shapes, analyze them, and make comments about the activity. Both individual and group activities were used. Most of the prepared activities were presented in PowerPoint, supported with colorful pictures, animations, and voice effects.

Findings

What Are Student Learning Styles?

The students' learning styles were identified by the Pat Wyman Personal Learning Style Inventory. According to Table 1, most of the students have visual-auditory learning styles. 47.3% of the students have visual-auditory, 23.6% have auditory-kinesthetic, and 29.1% have visual-auditory-kinesthetic. When distributions of learning styles are analyzed, the majority of students are found to be visual-auditory learners and the proportions between auditory-kinesthetic and visual-auditory-kinesthetic are very close.

Table 1.

Distribution of Students' Learning Styles

Learning Styles	N	%
Visual-Auditory	28	47,3
Auditory-Kinesthetic	13	23,6
Visual-Auditory-Kinesthetic	14	29,1
Total	55	100

Is There a Difference Between Mathematics Pre- And Post-test Results of Students Who Have Different Learning Styles (Visual-Auditory, Auditory-Kinesthetic, and Visual-Auditory-Kinesthetic)?

The pre- and post-tests scores of students' who had different learning styles (Visual-Auditory, Auditory-Kinesthetic, and Visual-Auditory-Kinesthetic) were calculated separately (Table 2). As seen in Table 2, there is a difference between students' pre- and post-test results. The mean score of students who have visual auditory learning styles in pre-test is 9.72 and 27.30 in the post-test. The mean score of students with auditory kinesthetic learning styles in pre-test is 9.09 and 28.23 in the post-test. The mean score of kinesthetic learners is 9.53 in pre-test and 27.03 in post-test.

Table 2.

The Pre- and Post-Tests Scores of Students According to Their Learning Styles

Learning styles	N	Pre-test Mean	Std deviation	Post-test Mean	Std deviation
Visual-Auditory	28	9,72	7,01	27,30	6,18
Auditory-Kinesthetic	13	9,09	8,50	28,23	7,04
Visual-Auditory-Kinesthetic	14	9,53	8,25	27,03	5,15
Total	55	9,52	7,55	27,46	6,06

The difference between the pre-post test results of students who have different learning styles are statistically tested and presented in Table 3. Since the group consists of less than 30 participants, the Wilcoxon Signed Rank Test for Paired Samples was used.

Table 3.

Wilcoxon Signed Rank Test for Paired Samples for the Significance of Pre-Post Test Result Differences of Visual - Auditory Learners

Visual-Auditory					
		Post-test – Pre-test	n	Mean Rank	Sum of Ranks
Negative Ranks	1	1	1	-4,600*	.000
Positive Ranks	27	15	405		
Tries	0	-	-		
Total	28				
Auditory-Kinesthetic					
Negative Ranks	1	1	1	-3,110*	.002
Positive Ranks	12	7,5	90		
Tries	0	-	-		
Total	13				
Visual-Auditory-Kinesthetic					
Negative Ranks	0	0	0	-3,297*	.001
Positive Ranks	14	7,5	105		
Tries	0	-	-		
Total	14				

*Related to Negative Ranking Base.

The difference of pre-post test results of visual auditory learners are statistically significant (z=-4.600; p<.05). When the ranked average of different grades and their sums are considered, the observed difference is positive, meaning it is in favor of post-test results. According to these results, different learning environments designed for visual-auditory learners have a positive effect on student grades.

The difference of pre-post test results of auditory-kinesthetic learners are statistically significant (z=-3.110; p<.05). When the ranked average of different grades and their sums are considered, the observed difference is positive, meaning that it is in favor of post-test results. According to these results, different learning environments designed for auditory-kinesthetic learners have a positive effect on student grades.

The difference of pre-post test results of visual auditory kinesthetic learners are statistically significant (z=-3.197; p<.05). When the ranked average of different grades and their sums are considered, the observed difference is positive, meaning that it is in favor of post-test results. According to these results, different learning environments designed for visual-auditory-kinesthetic learners have a positive effect on student grades.

What Are the Students' Opinions About the Learning Environments Designed According to Students' Learning Styles?

A questionnaire including three open-ended questions was prepared to determine student opinions on learning environments designed for their different learning styles. Students' responses are presented in Table 4 about the designed learning environments for different learning styles.

Table 4.

Students' Responses about the Designed Learning Environments for Different Learning Styles

Q1: What do you think about the way the Transformation subject is taught?
It was very good and educational. (E.T)
We did good instructional activities. (S.K)
I think it contributed to our learning (D.B)
The way the teacher taught was very good. (N.O)
It was very good. I had so much fun. (I.O)
The time flew, it was very clear. I learned a lot (O.Y)
It was a good lesson. The way the lesson was taught was fun. (S.S)
It was good. You baffled us. (S.B.O)
It was fun, we learned better by drawing, writing, and then doing activities. (O.M.A)
Because Transformation is more of a visual subject and our learning styles were taken into consideration the lesson was taught better. (E.G.S)

Q2: Did you have any difficulties during the lesson? If so, what were they?
I did not face any difficulties; I had so much fun. (D.B)
I did. I could not do some of the shapes or I did them incorrectly and our teacher could not help me because of the intensity of the lesson. (İ.E.S)
The time was limited; I think the time was not enough for all the activities. (E.G.S)
It is a very good and entertaining subject; with the way our teacher taught and the activities, I understood it very well. (A.A)

Q3: Would you like these activities to be used in other lessons? Why?
Yes, it would be fun. (E.T)
Yes, definitely, I can learn in an easier way. (S.K)
Yes, I can still remember it. (B.A)
Yes, the subjects can be learned better. (I.O)
Yes, because these activities helped me to learn the subject better. (O.Y)
No, because I think these activities are not suitable for all lessons. (A.A)
Yes, because we can revise more. (I.O)
Yes, because the lessons would be more fun and it can increase our love of school. (E.R)
Yes, because the lessons are more entertaining. (D.K)
Yes, because the activities are more memorable; since we have fun while learning the motivation is higher. (E.G.S)
Yes, it can help us remember, keep us motivated, have fun, and to look forward to the lesson. (A.A)

Analysis of responses for question 1 show the students they are generally appreciative of the presentation of the lesson. According to student feedback, it is understood that Transformation was taught in an entertaining way, including many different kinds of activities. The students expressed that teaching the lesson by considering student learning styles contributed to a better learning and comprehension of the subject (Table 3).

Analysis of responses to question 2 show some of the students thought that the time was not enough; some said that because of the classroom intensity they could not get enough attention from the teacher. In addition, other students said that the teaching style and supporting the lesson with different activities helped the lesson to be understood (Table 3).

The majority of the students said that the aforementioned activities used in the Mathematics lesson could also be used in other lessons. Other findings from this study include that these activities revised the lesson, enabled students to better understand the subject, and increased their motivation. Since the lesson was enjoyable, it made the students like Mathematics and made the lesson entertaining. The student responses emphasize the importance of creating entertaining learning environments.

What Are the Inspectors' Opinions About the Learning Environments Designed According to Students' Learning Styles?

A questionnaire of three open-ended questions was also prepared to learn inspectors' opinions on learning environments designed for different learning styles.

The inspector responses to questions on learning environments designed for different learning styles are presented in Table 5.

Table 5.

Inspectors' Responses about the Designed Learning Environments for Different Learning Styles

Q1: Do you think learning environments designed for different learning styles can improve students' achievement?
I1: Yes, every student has a different way of learning. It has to be designed.
I2: Yes, because every student is different and every student has different verbal and mathematical intelligence.
I3: Yes, if multiple intelligence theory is taken into consideration, it proves it. Individual learning methods vary.
I4: Yes, since multiple intelligence theory is individual differences, when a learning environment is designed accordingly to learning styles success will be improved.
I5: For learning styles, what students learn is less important than how they learn. For permanent learning, how students learn is an important factor to increase student success.
I6: Yes, because every student has a different learning style and pace. If learning environments are designed according to students' individual needs, both perception and success will increase.
I7: Learning environments designed according to learning styles increases student

success. Every human being has different perception characteristics. Environments designed suitable for individual differences will increase student success.

Q2: In your opinion, what are the advantages of designing learning environments according to student learning styles?

I1: There will be a fair learning environment in class. But these styles are not applicable to crowded classes. It might cause lesson loss. Daily lesson plans and preparations should be done.

I2: When individual differences are taken into consideration, it is an advantage. It increases success.

I3: It increases success; it helps the students and the teacher to teach and learn in a happy way. It increases student motivation towards the lesson. It forms a fair learning environment.

I4: It helps to increase success. Learning can take place sooner. It increases student motivation to the lesson. It causes a fair learning environment.

I5: When learning environments are designed according to learning styles, each student can learn according to their needs and pace. It is also advantageous for the teacher to learn about his/her students when teaching tools, methods, and techniques are designed according to students' learning styles.

I6: It might help the students to have a positive attitude about the topic and learn significantly. They will not suffer the difficulties of being a stranger in class since his/her needs and expectations are fulfilled and their significant learning and success will increase related to all of the reasons above.

I7: Since the classroom environment is designed according to their individual characteristics, it will ease their perception. This will increase student success.

Q3: What are possible challenges when learning environments are designed according to students' learning styles?

I1: Lack of knowledge, physical environment, inexperience, crowded classrooms, curriculum.

I2: The time can be inadequate. Because the education is part time. Classes that are crowded might cause problems.

I3: Crowded classes, curriculum, time, equipment, the time teacher needs to prepare the lesson and materials.

I4: Physical environment, crowded classes, the education is not full time, the adaptation of the curriculum, time deficiency, needed equipment, and inadequate number of teachers.

I5: Financial problems, missing knowledge, the school, teachers, and the authorities lack of knowledge towards student care and needs to design a suitable environment for their learning styles.

I6: Financial issues, the teachers and school authorities not in the level of understanding learning styles of students, the crowded classes, more preparation, it needs sacrifice and more work, in a real sense it is not applicable 100% to all classes.

I7: Firstly, it brings financial problems to the surface. It not only causes time loss to design the environments according to each of the individual's needs but also it requires more preparation.

The inspectors' opinions on designed environments according to students' learning styles show that this application can increase student success. All of the interviewed inspectors emphasized the importance of individual differences and

multiple intelligence as a basis for different types of learning. The importance was emphasized on students learning in the most suitable environments according to their learning styles; one of the inspector's emphasis on retention of the learning also captured attention. This inspector emphasized that learning styles focus on how students learn in this context, and that success and retention in learning can increase related to this.

Analysis of the inspectors' opinions on the second question shows that some of the advantages of designing a learning environment by giving thought to students' learning styles include the interest and motivation towards the lesson will increase and it gives students the chance to learn at their own pace. In addition, it was also stated that when classrooms are designed according to students' learning styles, teachers have the opportunity to get to know their students better and can control the learning and teaching process better. Therefore, as Bozkurt (2013) underlined, teachers should be aware of which learning style their students have. Another advantage mentioned was the students' positive attitudes towards the lesson and its positive effect on significant learning. Some of the advantages suggested by the inspectors can be emphasized as individual differences. At this point, if expectations and needs of students towards learning are taken into consideration, it can have positive effects on the learning/teaching process. Moreover, to be able to give thought to these expectations, needs can be stated as the most concrete indication of a fair learning/teaching environment to be provided.

Analysis of the inspector responses to question three show the possible difficulties suggested by the inspectors include teachers and authorities missing information, an inadequate physical environment, crowded classes, the intensity of the curriculum, inexperienced teachers, and time and financial problems. At this point, the inadequacy of time and knowledge about lesson content stand out in preparing materials according to learning styles of students.

According to these findings, teachers should be supported with in-service training and guidelines are needed to be able to prepare lesson content, taking learning styles into consideration. Even though these needs are fulfilled, teacher awareness and motivation should be increased. A possible resistance against teacher time and self-sacrifice might cause a negative effect not only on lesson designs suitable for different learning styles but also for the learning/teaching process. In addition to this, overcoming financial and equipment inadequacies can eliminate an obstacle of designing lessons according to learning styles.

Discussion

This study shows that the difference between pre-post tests results of learners with different learning styles are statistically significant in favor of post-test results. Many of the studies on designed learning environments related to student learning styles show a relationship between learning styles and student success (Cano-Garcia & Hughes, 2000; Collison, 2000; Boatman Courtney & Lee, 2008). Moreover, studies

on learning styles showing a positive effect on student grades, more effective teaching taking learning styles into consideration, the positive effect of learning environments designed according to learning styles, and suitable teaching approaches support the conclusion of the research. (Grasha & Yangarber-Hicks, 2000; Wood, 2002).

Students' opinions on learning environments designed for different learning styles show that they generally appreciate the presentation of the lesson. According to student feedback, it is understood that Transformation was taught in an entertaining way and included many different kinds of activities. Mathematical concepts, to be explained and presented using mathematical language, depend on this development. Because of this, giving concrete examples from their surroundings can contribute to their imagining abstract structures. A similar approach is also applicable to other well-known disciplines or readiness and relating it to new concepts. For these reasons, in each process of this study, creating the ability to form relations between facts and concepts was considered important. Students found mathematics and daily life relationships meaningful in designed learning environments according to learning styles. It seems like it created curiosity towards learning. When students commented on whether or not they had difficulties during the lesson, some of the students stated that the timing during the lesson was not enough; others said they could not get enough support from the teacher due to the intensity of the lesson. Introducing different learning environments is actually more time consuming than traditional environments. The process progresses with activities such as interactive presentations, student presentations, and visuals. The majority of the students stated that the aforementioned activities used in the mathematics lesson could also be used in other school subjects. Student responses emphasized that learning environments should be designed according to student learning styles.

The inspectors' opinions on designed learning environments for different learning styles showed that designed learning styles according to students' individual learning styles might increase student success. The inspectors thought that some of the advantages of designing learning environments according to students' learning styles was that they created an opportunity to learn fairly, increasing student motivation towards the lesson and enabling students to learn at their own pace.

This study aimed to learn students' and inspectors' opinions on designed environments for their learning styles and its effect on student grades, and showed that this positively affects student grades. Not only the students' but also the inspectors' opinions on this application support these findings.

Suggestions

The studies on finding learning styles at the primary education step can support student achievement and can also avoid negative student attitudes towards some of

the lessons. The findings of the study and suggestions developed for further studies are listed below. Teachers can be encouraged to get in-service training to set strategies related to individual learning styles and to be able to determine student learning styles.

Different learning environments, designed and supported taking learning styles into consideration, for the geometry subject of Transformation can also be used on other subjects that students have difficulty understanding. In upcoming studies the student behaviors and motivations towards designed environments according to learning styles can be analyzed.

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Öğrenme Stillerine Gore Tasarlanan Öğrenme Ortamları ve Matematik Başarısına Etkisi

Özet

Problem Durumu: Öğrenme ortamları tasarlanırken, öğrenme stilleri, öğrenme yaklaşımları, motivasyon ve ilgiler gibi öğrenen karakteristiklerinin göz önünde bulundurulması etkili öğrenmeler için büyük önem arz etmektedir. Öğrenme ortamları ve öğrenme süreçleri öğrencilerin eşit koşullarda öğrenmelerini sağlayabileceği gibi, öğrenme stilleri de göz önüne alındığında onlara daha zengin öğrenme süreçlerinin yasatılabileceği söylenebilir. Farklı öğrenme ortamları, çeşitli kaynaklar ile öğrenme-öğretme ortamlarını daha çok duyuya hitap eden cevreler haline getirerek, öğrenci motivasyon ve başarısını da artırmaktadır. Birden fazla duyu organına hitap eden öğrenme ortamlarının düzenlemenin, öğrenmenin başarısını artırdığını belirten araştırmalarda bunun nedenleri; gerçek yasama yakınlık, kalıcılık, dikkat çekicilik ve esnek öğrenme ortamları ile açıklanmaktadır.

Araştırmanın Amacı: Yapılan çeşitli tanımlamalar incelendiğinde, öğrenme stillerinin her bireyin kendisine özel olduğu sonucu ortaya çıkmaktadır. Aynı ortamda, aynı zamanda, aynı olgu ve olaylar içselleştirilerek öğrenilirken bile, her bireyin yaklaşımları farklı olabilmektedir. Öğrenme stilleri sabit ve değişmez unsurlar olmamakla birlikte, değişmelerinin zaman alacağı söylenebilir. Bu bağlamda bu çalışmanın amacı, ilköğretim öğrencilerinin ve müfettişlerin, öğrenenlerin öğrenme stillerini dikkate alarak tasarlanan ortamlara ilişkin görüşlerini belirleyebilmek ve bu ortamların öğrenci başarısındaki etkisini araştırmaktır.

Araştırmanın Yöntemi: Araştırmanın çalışma grubunu 55 ilköğretim 7. sınıf öğrencisi ve 7 müfettiş oluşturmaktadır. Araştırmada veri toplama aracı olarak, öğrenci ve öğretmenlere yönelik acık uçlu sorulardan oluşan birer görüşme formu, matematik başarı testi ve Pat Ayman Kişisel Öğrenme Stili Envanteri kullanılmıştır. Pat Ayman Kişisel Öğrenme Stili Envanterinin güvenirlik katsayısı $\alpha = .73$ olarak hesaplanmıştır. Başarı testinde, öğrencilerin düşünce sistemlerini harekete geçirecek bilgiyi kullanma, yorumlama, analiz etme, çıkarımda bulunma ve değerlendirme, güncel hayatla ilişkilendirme ve problem çözme becerilerini kullanmalarını gerektiren sorular sorulması hedeflenmiştir ve test, basitten karmaşığa doğru giden 10 soru ile sınırlandırılmıştır. Sorular zorluk derecesine göre planlanmıştır, başka bir deyişle, zorluk derecesi yüksek olan sorulara daha fazla puan verilmiştir. Araştırma kapsamında, öncelikle öğrencilerin öğrenme stilleri belirlenmiş, daha sonra Donuşum konusu ile ilgili olarak, öğrencilerin öğrenme stillerine göre öğrenme ortamları düzenlenmiştir. Donuşum geometrisi konusu okullarda sadece yazılı dokumanlar ve aydınger kâğıdı yardımıyla anlatıldığı ve işitsel, kin estetik ve görsel öğrenen öğrencilerin nasıl öğrendiklerini derinlemesine araştırma yapılmasının

önemli görüldüğü için bu konu seçilmiştir. Verilerin analizi için, grup büyüklükleri 30'dan küçük olduğundan İlişkili Ölçümler İçin Wilson Isa retli Sıralar Testi kullanılmıştır.

Araştırmanın Bulguları: Araştırma bulguları, öğrencilerin % 47,3'unun Görsel – İşitsel, % 23,6'sının İşitsel – Kin estetik, % 29,1'i Görsel – İşitsel – Kin estetik öğrenme stillerine sahip olduğunu göstermiştir. Öğrencilerin öğrenme stillerine göre dağılımları incelendiğinde öğrencilerin çoğunluğunun Görsel – İşitsel öğrenen olduğu, İşitsel – Kin estetik öğrenenler ile Görsel – İşitsel – Kin estetik öğrenenlerin oranlarının birbirine yakın olduğu görülmüştür. Görsel – İşitsel öğrenme stiline ilişkin on test ve son test puanları arasındaki farkın istatistiksel acıdan anlamlı olduğu sonucuna ulaşılmıştır (z=-4,600; p<.05). Ayrıca İşitsel – Kin estetik öğrenme stiline ilişkin on test ve son test puanları arasındaki farkın istatistiksel acıdan anlamlı olduğu görülmüştür (z=-3,110; p<.05). Aynı şekilde Görsel – işitsel – Kin estetik öğrenme stiline ilişkin on test ve son test puanları arasındaki farkın istatistiksel acıdan anlamlı olduğu sonucuna ulaşılmıştır (z=-3,197; p<.05). Öğrencilerin acık uçlu sorulara verdikleri yanıtlar incelendiğinde, öğrencilerin dersin islenis bicimi ile ilgili genel olarak memnuniyetlerini dile getirdikleri görülmüştür. Öğrencilerden gelen dönütler doğrultusunda Donuşum konusunun eğlenceli bir şekilde anlatıldığı ve farklı türden etkinlikleri barındırdığı bulgusuna ulaşılmıştır. Dersin öğrenme stillerini dikkate alan bir bicimde islenmesinin konunun daha iyi anlaşılmasına katkı getirdiğini ifade edilmiştir. Öğretmenin sınıf içindeki ders anlatım seklinin ve dersin farklı tur aktivitelerle desteklenmesinin konunun anlaşılırlığını sağladığı belirtilmiştir. Öğrencilerin büyük çoğunluğu, matematik dersinde kullandıkları söz konusu etkinliklerin başka derslerde de kullanılabileceğini belirtmişler ve bu etkinliklerin dersi pekiştirdiğini, daha iyi anlamalarına imkân verdiğini, sınıf içi motivasyonun yüksek olduğunu ifade etmişlerdir. Elde edilen bu bulgular alan yazında var olan diğer araştırma sonuçlarıyla da örtüşmüştür.

Müfettişlerle yapılan görüşmelerde, öğrenme stillerine göre düzenlenen öğrenme ortamlarının öğrenci başarısını arttıracağına ilişkin görüşlerin ağırlık kazandığı görülmektedir. Görüşme yapılan müfettişlerin tamamı bireysel farklılıklar vurgusu yapmakta ve çoklu zekâ kuramını farklı türdeki öğrenmeler için dayanak olarak göstermektedirler. Ayrıca müfettişler öğrenme stilleri göz önüne alınarak tasarlanan derslerde öğrenci başarının artacağını, adil öğrenme olanağının sağlanacağını, derse yönelik ilgi ve motivasyonun artacağını ve öğrencilerin kendi hızlarında öğrenmelerine fırsat tanınacağını ileri sürmektedirler. Müfettişler, öğrenme ortamları düzenlenirken öğrenme stillerinin dikkate alınması sırasında yaşanabilecek olası zorluklar arasında, öğretmenlerin ve yöneticilerin bilgi eksiklerini, fiziki ortamların yetersizliğini ve kalabalık sınıfları, ders müfredatlarının yoğunluğunu, öğretmenlerin deneyimsizliğini, zaman ve maliyet yetersizliklerini göstermişlerdir. Bu noktada öğretmenlerin ders içeriklerini, öğrenme stillerini göz önüne alarak hazırlayabilmeleri bakımından zaman ve bilgi yetersizlikleri öne çıktığı söylenebilir.

Araştırmanın Sonuçları ve Önerileri: Araştırmadan elde edilen bulgular ve sonuçlar doğrultusunda, öğretmenlerin öğrencilerinin öğrenme stillerini belirleme ve stil özelliklerine uygun öğrenme stratejileri belirleme konusunda hizmet-içi eğitim

almaları önerilebilir. Ayrıca, bu çalışma tek çalışma grubu ile yürütüldüğü için, birden fazla çalışma grubu ile farklı araştırmaların yürütülüp, elde edilen sonuçların karşılaştırılmasının daha etkili sonuçlar üretebileceği söylenebilir. Bu bağlamda geliştirilen farklı öğrenme ortamları ile geleneksel öğrenme ortamları arasındaki farkın incelenmesinin de alan yazına katkı getireceği ileri sürülebilir.

Anahtar Sözcükler: Öğrenme stilleri, başarı, öğrenci görüşleri