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The Effect of Learning Integers Using Cartoons on 7th Grade Students' Attitude to Mathematics*

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Abstract

The purpose of this research is to investigate the effect on students' attitudes toward mathematics when cartoons are used in teaching integers. The research was designed in the form of a pre-test and post-test with a quasi experimental control group. The research participant group was composed of sixty-one (61) 7th grade students attending an elementary school in Bolu during the 2008-2009 academic year. "Integers" were taught during six weeks using seventeen cartoons developed for this study. 7 homogenous groups, each consisting of four students sharing the same opinions, were utilized in order to facilitate more comprehensive discussion on the concepts while at the same time encouraging them to question their own thinking patterns by creating a social learning environment. Data was collected using a "Mathematics Attitude Scale" and through the written opinions of the students concerning the implementation process. Whereas the quantitative data was analyzed by performing a t-test for dependent and independent samples, the qualitative data was analyzed descriptively. Furthermore, while the method of use of cartoons in teaching math lessons positively affected the interest in the mathematics course, the perceived benefits of mathematics and the perceived mathematics achievement levels, which are the sub-components of the attitude, compared to the conventional teaching, the conventional teaching method led to a decline in students' interest in the mathematics course. When the students were asked to describe their feelings toward cartoon based teaching, they responded by saying that they enjoyed the cartoons and that they increased their interest in the math lesson. In light of the findings of this study, the researchers have developed suggestions for those who are to conduct further research on cartoons.

Key Words

Attitude towards Mathematics, Cartoon, Mathematics Teachings, Integers.

Studies carried out by Bloom (1998) show that approximately one fourth of the differences arising in learning among individuals is fall into the category of affective learning, of which attitude is the most important of all affective characteristics (Caine & Caine, 1991; Morgon, 1981; Tekin, 1996). While the definition of attitude varies depending on the field of study and subjects, the most general definition as defined Turkish Language Association's dictionary (Türk Dil Kurumu [TDK], 1998) is "mental outlook, behavior." In reviewing the studies conducted on general attitude present

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in current literature, it is observed that Thurstone (1931) defines attitude as "the affect for or against a psychological object," while Allport (1935) describes it as "a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon an individual's response to all objects and situations with which it is related." Katz (1960) defines attitude as a preliminary way of thinking, in which an individual perceives a symbol, an object, a person or the world with its good, bad, or harmful aspects depending on a system of values possessed by that individual. Smith (1968) defines attitude as "the tendency which is attributed to the individual and which includes one's thoughts, feelings, and behavior about a psychological object" (as cited in Kağıtçıbaşı, 1999).

It has been stated that attitudes are gained through learning and that those characteristics gained through learning are themselves feelings that guide the behaviors of an individual causing biasness in the decision making process (Baysal, 1994; Demirel, 1993; Özgüven, 1994; Saka & Kıyıcı, 2004; Ülgen, 1995). Neale (1969) defines attitude particularly toward mathematics as "a total measure of liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics and a belief that mathematics is useful or useless" (Neale, 1969 as cited in Alkan, Güzel, & Elçi, 2004).

Attitude toward mathematics has been studied in many ways and on students of many grade levels, and it a general opinion has been observed in which students exhibit feelings of anxiety and fear of mathematics courses not only in Turkey, but throughout the world (Albayrak, 2000; Akgün, 2002; Başar, Ünal, &Yalçın, 2002; Umay, 1996; Yenilmez & Duman, 2008). Therefore, preparing an effective mathematics education is an absolute must if one is to eliminate this general opinion. It is therefore necessary that learning be organized in accordance with the rules of learning based on social interaction (Clark & Starr, 1991; Stones, 1994). In this way, meaning can be established and meaningful learning can be achieved (Finley, 2000).

According to Novak and Gowin (1984), all classroom activities should be organized and implemented in such a way to guide students toward individual inventive learning, instead of rote learning. Therefore, it is important to use educational strategies that will enable the correct structuring of concepts so that meaningful learning can take place. The use of different approaches and teaching methods both broadens the contents of courses and enables students to overcome their prejudices thereby motivating them toward perceived difficult courses (Duatepe & Ersoy, 2003; Işık, 2007; Karaağaçlı & Mahiroğlu, 2005; Koşar & Çiğdem, 2003; Özalp, 2006). Cartoons, which are one of the ways that enable the use of visual content within the classroom, may be considered a strong tool in increases the motivation level of students in regard to their mathematics course as wel as in facilitating learning.

Cartoons "[are] an art of transforming ridiculous aspects of humans, creatures, events and even feelings and thoughts that contrast with the natural ones or contradict with the ordinary into humorous expressions using exaggerated illustrations (sometimes supported with a text)" (Alsaç, 1999; Milli Eğitim Bakanlığı [MEB], 2005; Selçuk, 1998). Cartoons are a medium that can be used to enable students to attain concepts correctly and enjoyably (Kete, Avcu, & Aydın, 2009), and they are visuals for students which motivate them, provide them with the opportunity to discuss, and make the subjects non-complex and non-abstract (Efe, 2005; Özer, 2004; Uğurel & Moralı, 2006).

Studies conducted in Turkey and throughout the world have shown that cartoons and concept cartoons increase motivation toward lessons (Cengizhan, 2011; Çiğdemtekin, 2007; Greenwald & Nestler; 2004; Keogh, Naylor, & Wilson, 1998; Rule & Auge, 2005; Üner, 2009; Üstün, 2007; Yoong, 2001); facilitate learning and the interpretation of knowledge (Keogh et al., 1998; Özalp, 2006); increase achievement (Rule & Auge, 2005; Üner, 2009); decrease students' mathematics anxiety (Greenwald & Nestler, 2004); develop a positive attitude (Hackett & Betz, 1989; Üner, 2009); develop a positive attitude toward textbooks (Özalp, 2006); reveal the reasons underlying misconceptions; encourage students to research; and eliminate misconceptions (Çiğdemtekin, 2007). Furthermore, they may be also used as a potentially invaluable evaluation method in teacher training (Keogh, Naylor, De Boo, & Feasey, 2001; Song, Heo, Krumenaker, & Tippins, 2008).

Purpose

The purpose of this research is to investigate the effect on students' attitudes toward mathematics when cartoons are used in teaching integers. In line with this purpose, the following sub-problems apparent in the use of a cartoon method in a mathematics course have also been studied:

Does the use of cartoon method influence:

- ✓ The perceived benefits of mathematics,
- ✓ Attention in the mathematics course,
- ✓ The perceived level of achievement in mathematics?

Method

Model

A quasi-experimental design with pre-test/post-test control group was used in this study. This model consists of an experimental group affected by the independent variable as well as an additional group that was not affected by that independent variable. The hypotheses were tested by comparing the variation in scores by both groups from the pre-test to the post-test in order to determine whether any significant differences exist (Bulduk, 2003; Christensen, 2004).

Study Group

The study was conducted on a total of 61 7th grade students studying at two different departments of a primary school located in Bolu province during the 2007-2008 school year. Of the total, 30 students were part of the experimental group and 31 of the control group. Eighteen (60%) students were female and 12 (40%) students were male in the experimental group. In the control group however, 14 (45.2%) students were female and 17 (54.8%) were male. Students' mathematics achievement levels in both the experimental and control groups were mediocre and similar to each other. Five students, who were most suitable for the purpose of the study and determined to represent the opinions of the experimental group, were selected from among the experimental group using a purposeful sampling method in order to collect qualitative data. In purposeful sampling, the researcher uses his/her own judgment to choose those who will be included in the sample, and while doing this, he/she includes those who are the most suitable for the purpose of the study (Balcı, 2005).

Data Collection Tools

Data collection tools are divided into two categories: qualitative and quantitative. The "Mathematics Attitude Scale" (MAS), developed by Nazlıçiçek and Erktin (2002), was used for measuring students' attitudes toward mathematics during the collection of quantitative data for the study. The Likert-type scale contains a total of 20 items. A Likert scale made up of the following response categories was used: Never (1), Rarely (2), Sometimes (3), Usually (4), Always (5). In this attitude scale, the item "I am successful in subjects requiring mathematics knowledge" indicates the perceived level of achievement in mathematics; "Knowing mathematics will be beneficial for me in the future" indicates the perceived benefits of mathematics; and "I pay attention to different things during the mathematics course" indicates attention to the mathematics course. Items 3, 6, 7, 13, 14 and 19 of the scale show the perceived level of achievement in mathematics, and their alpha reliability coefficient is a= 0.67. Items 10, 11, 15, 16 and 18 show the perceived benefits of the mathematics, and their alpha reliability coefficient is a=0.59. Items 1, 2, 4, 5, 8, 9, 12, 17 and 20 depict the attention toward the mathematics course, and their alpha reliability coefficient is a=0.69. The researcher calculated the reliability coefficient of the scale as .841. The Cronbach alpha coefficient of the scale for this study was .73.

A document review method, one of the qualitative research techniques, was used to obtain qualitative data (Lee, 2005). The personal documents used in this study consisted of the written materials containing the answers to the open-ended question "What are your opinions about teaching via cartoons? Please explain."

Procedures

The "Whole Numbers" subject from the 6th and 7th grade Numbers Learning Field was selected for this study. In determining that this subject should be used, two variables were taken into consideration. Firstly, according to the recent mathematics curriculum in Turkey (MEB, 2007), 6th grade students are expected to explain the meaning of integers and absolute values, compare and order the integers, and to do addition and subtraction using integers. Seventh grade students, however, are expected to do multiplication and division using integers and to solve and pose problems involving integers. Secondly, studies conducted have reveal findings showing that students experience difficulty in this subject (Altun, 2006; Baykul, 2004; Hayes & Stacey, 1990; Kilhamn, 2008). According to Linchevski and Williams (1999), the feeling that it is required to enhance the concept of numbers is difficult for students. The pre-assumed structure of natural numbers that exists in students' minds

can serve as an auxiliary element in the learning the positive numbers. On the other hand, in the case of negative numbers, because there are no non-positive objects or groups of objects, it is not possible to reach informal information by observing the physical world (Davidson, 1992; McCorkle, 2001). At this stage, while the cardinal numbers may be conceptualized through the observation of real objects, performing arithmetical operations using negative numbers can make sense only with mathematical logic, and what is more, some characteristics of the negative numbers may contradict the way of perceiving cardinal numbers (Linchevski & Williams, 1999).

After having evaluated the cartoons in terms of content and suitability, a total of 17 cartoons were developed by the researcher and two mathematics education specialists. Concordance between the researcher's evaluations and those of the three specialists was calculated by the following formula indicated by Miles and Huberman (1994): Concordance Percentage = [Agreements / (Agreements + Disagreements)] x100. The concordance percentage was calculated at 94 as a result.

Whereas classes were taught using teacher-centered activities in the control group, cartoons were used in the experimental group. The cartoons were prepared in the form of worksheets and projected on a screen using an overhead projector and were also distributed to students as color printouts. Four-person homogeneous groups were constructed to enable the students to create a social learning environment and discuss the concepts more comprehensively.

Prior to application, students were informed of the concept cartoons as a teaching method, and the cartoons to be used were introduced. Then, after having handed out the activity sheets containing the cartoons to the groups, students were given time to respond to the problem forming the main theme on each sheet. Dialogues in each activity sheet were discussed upon selecting one of the seven groups identified respectively. In this case, existence of distinctive answers enabled discussions among groups. In this case, the existence of distinctive answers enabled discussions among the different groups. Following the discussion session, the teacher asked questions such as "What happened? How did you understand? What is the result? Why is it so? Then, what should it be? Which character's opinion turned out to be true? Where did we go wrong?" in order to enable students to question themselves with respect to the opinion which proved to be true and the reasons for any discord (Wertsch, 1991).

The "Mathematics Attitude Scale" was re-applied to the experimental and control groups following the 6-week research after completion of the aforementioned questioning process. Furthermore, students' written opinions were obtained using the question "What are your opinions about teaching via cartoons?" in order to enable them to evaluate the application process.

Analysis of Data

The scores obtained by students from the "Mathematics Attitude Scale" pre-test/post-test were evaluated using the SPSS software package on a computer environment. The "independent group t-test" was used in paired comparisons between different groups, and "dependent group t-test" in paired comparisons within groups themselves depending on the type of data. Differences between the experimental and control groups were found to have a significance level of $p<.05$ according to the relevant variables. The opinions of students concering the lessons taught via cartoons were subjected to a descriptive analysis. Additionally, magnitudes of influence were also calculated along with all relational analyses, for although the T-test can show whether there is a significant difference, it does not give information as to the magnitude of that difference. It is important to know the magnitude of the influence in addition to statistical significance (Morgan, Leech, Gloeckner, & Barrett, 2004) because according to Cohen (1988), if the magnitude of influence is $01< \eta 2 <.06$, then the influence is low, and if it is $.06\leq \eta 2 <.14$, then the level of influence is medium; and if it is $.14\leq \eta 2$, then the influence is high.

Results

This section provides the findings obtained from the "Mathematics Attitute Scale" pre-test/post-test administered to students in the experimental and control groups. However, Kolmogorov-Smimov tests were conducted to establish whether the results exhibited normal distribution prior to analyzing the tests. According to this test, if the $p> .05$, then the data exhibits normal distribution, which may then be analyzed with the t-test. Accordingly, the results of the Kolmogorov-Smimov test conducted on the results of the mathematics attitude scale pre-

test administered to the experimental and control groups are as follows, respectively: (KSZ=.758, p=.613>.05) and (KSZ=.800, p=.543>.05); and the results of the Kolmogorov-Smimov test conducted on the results of the post-test are as follows, respectively: (KSZ=.755, p=.618>.05) and (KSZ=.547, p=.931>.05). Because it was seen that the tests displayed normal distribution on the basis of these results, it was decided to use the t-test in other analyses.

The results of the independent group t-test conducted on the mathematics attitude scale pre-test scores of the experimental and control groups showed no significant difference, as there was only a statistical level of significance of 0.05 in terms of the attitude toward mathematics between the two groups [t(59) = -0.368, p>.05. This shows that both groups' attitudes toward mathematics were equal prior to introducing cartoon enriched lessons.

According to the scores obtained by the experimental and control groups from the sub-dimensions of the preliminary attitude scale based on the dependent group's t-test results, students' perceived level of mathematic achievement [t(59)=-0.061, p>.05]; the perceived benefit offer by mathematics [t(59)=-0.391, p>.05], and the amount of attention they paid in the mathematics course [t(59)= 1.129, p>.05] are 0.05 higher than those of p values in the independent T-test results. It was also determined that the students in the experimental and control groups were equal in terms of the sub-fields of the preliminary attitude scale.

The results of the dependent group t-test conducted on the mathematics attitude scale pre-test and post-test scores of the experimental group showed, at a statistical level of significance of 0.05. [t(29)= -4.395, p<.05], significant difference. Consequently, it may be argued that the cartoons exerted a positive effect on students' attitudes toward mathematics. That the magnitude of influence calculated as a result of the test was η2 = .71 can be interpreted as follows: teaching using cartoons improves students' attitudes toward mathematics.

The results of the dependent group t-test conducted on the mathematics self-efficacy perception scale pre-test and post-test scores of the control group showed, at a statistical level of significance of 0.05 [t(29)= 1.025, p>.05], no significant difference. Consequently, this illustrates that there was no change in students' attitudes toward mathematics in the control group. Furthermore, the fact that the magnitude of the influence calculated as a result of the test was η2 = . 92 can be interpreted as follows: conventional teaching encourages students to develop negative attitudes toward mathematics.

According to the results of the dependent group T-test for the pre- and post-test scores for the sub-dimensions of the mathematics attitude scale of the experimental group, students' perceived level of mathematic achievement was [t(29)= -2.740, p<.05], their perceived benefits of mathematics was [t(29)= -3.081, p<.05], and the amount of attention paid in their mathematics course was [t29)= -3.016, p<.05]. Statistically significant differences at a level of 0.05 as a result of the dependent group t-test were observed. Based on this finding, it may be said that teaching using cartoons increases the students' perceived mathematical achievement in the experimental group just as it increased their perceived benefits of mathematics and the amount of attention paid in their mathematics course after teaching. On the other hand, the magnitude of influence on students' perceived level of achievement in their mathematics class, calculated after the test, was η2 =.81, η2 =.59 for the perceived benefits of mathematics, and η2 =.58 for the attention paid in the mathematics course. Based on these results, it may be stated that teaching using cartoons exerts a significantly positive influence on all sub-components of the attitude scale. Considering the magnitude of influence, it may be said that teaching using cartoons has more influence on students' perceived level of achievement in mathematics than any other components.

According to the results of the dependent group T-test of the pre- and post-test scores for the sub-dimensions of the mathematics attitude scale of the control group; students' perceived level of mathematic achievement was [t(30)= 0.403, p>.05] while the perceived benefits of mathematics was [t(30)= -0.805, p>.05], and were not found to have statistically significant differences at the level of 0.05 as a result of the dependent group t-test. On the other hand, the amount of attention paid in the mathematics course [t(30)= 2.590, p<.05] showed statistically significant differences at the level of 0.05 as a result of the dependent group t-test. However, this differentiation is in favor of the preliminary attitude. Based on this finding, it is observed that there was no positive changes in either the level of perceived mathematics achievement by students in the control group that involved teaching using the conventional method, in the amount of attention they paid to their mathematics course, or in their perceived benefits of mathematics. Furthermore, the magnitude of influence on students' perceived

level of achievement in mathematics, calculated as a result of the test, was η2 =.72. As for the perceived benefits of mathematics, it was η2 =.37 and η2 =.39 for the amount of attention paid in their mathematics course. Based on these results, it may be argued that the conventional teaching method had significant influences on all sub-components of the attitude scale, but that this influence was negative.

The results of the independent group t-test conducted on the mathematics attitude scale post-test scores of both the experimental and control groups showed a significant difference at a statistical level of significance of 0.05 in terms of the two groups' attitudes toward mathematics: [t(59)= 4.070, p<.05]. This difference is in the experimental group's favor. It may be said that this is because cartoons concretize the abstract concepts and facilitate comprehension of these abstract concepts, give students the feeling of achievement in mathematics, and increase the amount of attention paid in the course.

According to the results of the independent group t-test conducted on the post-test scores of the sub-dimensions of the mathematics attitude scale of both the experimental and control groups, the perceived level of mathematic achievement was [t(59)= 2.713, p<.05], the perceived benefits of mathematics was [t(59)=2.179, p<.05], and the amount of attention paid in their mathematics course was [t(59)= 3.007, p<.05]. These figures illustrate that the students of both the experimental and control groups were significantly different statistically at a level of 0.05 in favor of the experimental group, whose lessons were enriched with the use of cartoons. Based on this finding, it may be said that teaching using cartoons significantly increases students' perceived level of mathematics achievement, the perceived benefits of mathematics, and the amount of attention students pay in their mathematics course as compared to the conventional teaching method.

Considering student opinions in regard to the mathematics course that involved teaching using cartoons, it was observed that cartoons enabled students to enjoy mathematics, increased their attention to the course, and helped them to develop a positive attitude toward mathematics.

Conclusion and Discussion

Just as both mental and emotional processes are integral parts of learning, there exists a relation and interaction between them. Although students may forget information regarding a specific subject, they do maintain their attitude and penchant toward that subject, be they positive or negative (Stodolsky, Salk, & Glaessner, 1991). Studies conducted have shown that there is a significant positive relation between one's attitude toward mathematics and his/her level of mathematical achievement (Katrancı, 2009; Peker & Mirasyedioğlu, 2003; Rule & Auge, 2005; Tapia & Marsh, 2000; Yenilmez & Özabacı, 2003; Yücel & Koç, 2011). Considering the low levels of mathematic achievement in Turkey, the importance of developing positive attitude towards mathematics is manifest. As a result of this study, it has been established that students found social learning environment enriched by the use of cartoons to be very enjoyable during which their attention toward the course increased. As such, it may be argued that teaching using cartoons positively influenced students' affective characteristics and their attitude toward mathematics. Student responses, such as "Mathematics has become my most favorite course. I used to find it boring and difficult previously, but I don't think that way any longer," and "I have started enjoying the mathematics course. My attention toward mathematics will increase more" may be considered as an indication of this fact. This result, as suggested by the study, parallels the finding that cartoons positively influence the attitude, as suggested by Üstün (2007), Çiğdemtekin (2007) and Üner (2009) in their studies. Furthermore, is the results are also consistent with the finding that it would be important to use concept cartoons in teaching abstract disciplines, like mathematics, and in developing students' affective characteristics as suggested by Durmaz (2007), Keogh and Naylor (1999) and Keogh et al. (1998) in their studies.

According to Tobias (1993), among the factors forming one's attitude toward mathematics are: the form of perception of the mathematics, belief in the usefulness of the mathematics, belief that the individual will experience success in mathematical activities and self confidence, the sense of enjoying the mathematics, enjoying solving mathematical problems, and experiences gained during learning mathematics. When the perceived level of mathematical achievement, the perceived benefits of mathematics, and attention toward mathematics – all factors found in the mathematics attitude scale used in this study – are examined, it is observed that those teaching activities enriched with cartoons display positive effects on the specified sub-components of the mathematics attitude scale. It is further observed that the conventional teaching method had no effect on the sub-components of the mathematics attitude scale, and even caused a decrease in attention toward

the mathematics course. Taking into consideration that students receive knowledge as a passive receiver, fail to find the opportunities to structure the concepts at required levels, and the difficulty of subjects when taught using the conventional teaching method, it may be argued that the conventional teaching method causes a decrease in students' attention toward to course (Şengül, 2011). In their study, Keogh et al. (1998) stated that students' attention toward numerical courses decreases in parallel with age, but that teaching using cartoons changes the situation in that students experienced more joy in school and in their numerical courses. Student responses, such as "I used to think that mathematics was always boring; you just keep solving tests and questions. You just sit there and listen to what the teacher says. After this experience, my thoughts have changed. Now I know that it can be more enjoyable" support this conclusion. Furthermore, thes results obtained in this study support the finding that concept cartoons facilitate students' focusing on the subject and increase their motivation, as suggested by Cengizhan (2011), Çiğdemtekin (2007), Greenwald and Nestler (2004), Keogh et al. (1998), Long and Marson (2003), and Özalp (2006) in their studies.

Although mathematics is related to everyday life to a large extent, it is clear that whatever teaching methods are employed in lessons play a considerable role in making mathematics the most disliked course, while it is possible to make it far more enjoyable (Campbell, 1996). The important thing is to demonstrate to students that they can experience success, make them believe that they can do the mathematics, and increase their attention toward mathematics by influencing their attitude positively. At this point, it is apparent that cartoon activities have proven to be effective. According to the results obtained, it may be stated that:

- ✓ Teachers can benefit from cartoons to draw student attention to the lesson and to facilitate active participation in the lesson;
- ✓ Considering that there is a positive relationship between one's attitude toward mathematic and achievement therein, it would be worthwhile for teachers to use cartoons in order to increase mathematic achievement;
- ✓ Considering the results Hackett and Betz's study (1989) concering the relations among mathematic achievement, mathematic self-efficacy, and one's attitude toward mathematics, cartoons may be considered effective in developing self-efficacy in mathematics.

In light of the findings, if we were to consider attitude to be the determining factor as to whether individuals exhibit either a positive or negative response to objects and situations in which individuals are interested and as a result of their experiences (Baykul, 2005), it would be worthwhile to conduct more comprehensive studies covering a longer period of time to gauge whether the method would have any significant effects on students' logical thinking and critical thinking skills. Moreover, it would also be beneficial to study just what influences exist on students' self-regulation strategies and motivational beliefs when cartoons are used during the teacher process.

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