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THE EFFECT OF ACTIVITIES BASED ON MULTIPLE INTELLIGENCES THEORY ON PRIMARY SCHOOL STUDENTS' ATTITUDES TOWARDS SCIENCE

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Abstract:
This research was conducted to determine whether there was a significant difference in the attitudes toward science between the experimental group, which was taught the "Human and Environment" unit in the fourth-grade science course, and the control group, which was taught activities from the 2018 Science curriculum. The study group consisted of 39 students at a primary school in the Central Anatolia Region. Data were obtained using the "Science Attitude Scale," which was administered as a pretest before the intervention and as a posttest after the intervention. During the research, lessons were taught according to a lesson plan prepared with activities based on the Multiple Intelligences Theory in the experimental group, while the control group was taught according to a lesson plan prepared with activities from the 2018 Science curriculum. Data were analyzed using independent and dependent sample t-tests. The results showed that there was no significant difference between the two groups before the experimental study, but that the experimental group's attitudes toward science were significantly higher than the control group's after the intervention. These findings reveal that teaching with activities based on the Multiple Intelligences Theory positively improves students' attitudes towards science.

Keywords: multiple intelligences theory, primary school science course, science teaching, attitude towards science

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1. Introduction

The phenomenon of learning has been one of the topics most frequently addressed by educational researchers throughout human history. Educators who have attempted to explain how learning occurs have approached the phenomenon of learning from different angles and developed numerous theories related to learning (Demir, 2012). These theories, which serve contemporary education, are actively used in science education today and influence students' attitudes toward science in different ways. Science is a fundamental discipline that contributes to individuals' understanding of nature, their ability to produce solutions to environmental problems, their ability to keep up with technological developments, and their development of scientific thinking skills (Gürdal, Şahin & Çağlar, 2001; Hastürk, 2017). In addition to understanding how the natural world works, it makes important contributions in many areas, from technological developments to solving environmental problems. Furthermore, it supports the development of conscious individuals by providing them with critical, rational, and systematic thinking skills (Harlen, 2010). Therefore, high-quality science education is necessary for students to understand nature and develop curiosity (Yılmaz Kalaycı, 2009; Osborne & Dillon, 2008). In this context, science education aims not only to impart scientific knowledge but also to develop critical, creative, and systematic thinking skills (Bransford, Brown & Cocking, 2000).

In science education, students are expected to be individuals who can use scientific process skills, solve problems, collaborate, research, question, and think critically (MNE, 2024). Qualified science education is necessary to adapt to rapidly developing technology and to succeed in science courses that involve abstract concepts. Furthermore, the development of individuals who are inquisitive, creative, and problem-solving depends on the community being composed of scientifically literate individuals (Yılmaz Kalaycı, 2009; OECD, 2019; National Research Council, 2012).

Science courses are among the most challenging subjects for individuals to understand due to the abstract topics and concepts they contain (Pınarbaşı, Doymuş, Canpolat, & Bayrakçeken, 1998). Academic research indicates (Aguilera & Perales-Palacios, 2020; Barmby, Kind, and Jones, 2008), it has been determined that students who constantly encounter these abstract topics and concepts develop a negative attitude toward science as they get older, i.e., as they advance through the grades. With their interest gradually diminishing, students develop a negative attitude toward science (Osborne, Simon & Collins, 2003). This also causes a decline in their success in science courses (Güney, 2019). The misconceptions students encounter in science classes, their difficulties in understanding abstract content, and the insufficient consideration of individual differences in the teaching process are among the main reasons for this negativity (Duit & Treagust, 2003; Tekkaya, Özkan & Sungur, 2001).

To overcome the difficulties encountered in learning science and negative attitudes towards science, a student-centered contemporary educational approach has been adopted, contrary to the traditional educational approach. In this context, the contemporary educational approach aims to develop teaching methods tailored to students' interests, needs, and abilities, taking into account their individual differences (Borko *et al.*, 2010). Student-centered approaches aim to nurture individuals who not only store knowledge but also research, question, collaborate, and solve problems (MNE, 2024). For quality science education to be achieved, students should be provided with opportunities to learn by doing and experiencing, scientific process skills should be imparted, and they should be helped to develop positive attitudes (Çepni, 2006; Osborne, Simon & Collins, 2003).

Many student-centered theories and approaches that influence the education system and serve education in a contemporary sense are used in our country, as well as around the world, particularly in science education. One of the prominent contemporary approaches in science education is the Theory of Multiple Intelligences (Gardner, 2011; Winarti, 2019). Gardner stated that intelligence is not one-dimensional, that individuals have eight different areas of intelligence, and that these areas are effective at different levels in learning processes. The Theory of Multiple Intelligences aims to increase students' motivation to learn by emphasizing not only their academic achievements but also their different talents and strengths (Saban, 2004). The application of the theory in education provides students with the opportunity to discover their own potential, while also enabling teachers to plan lessons that appeal to different areas of intelligence (Armstrong, 2009).

Recent studies show that Multiple Intelligences Theory positively affects students' attitudes, motivation, and academic achievement in science classes. For example, Lazear (2004) states that activities targeting different intelligence areas increase students' active participation in class, while Shearer (2018) states that the theory makes learning processes more meaningful by taking individual learning differences into account. Similarly, Korkmaz (2001) emphasize that the Theory of Multiple Intelligences helps students develop positive attitudes toward science. In this process, students' attitudes toward science should be considered not only cognitively but also emotionally. Osborne, Simon, and Collins (2003) state that students' interest in science lessons is decisive in the learning process. Therefore, in science education, methods that facilitate conceptual learning and support students' motivation and positive attitudes should be applied (Lin *et al.*, 2016). The Theory of Multiple Intelligences can be considered an effective tool at this point to both reduce students' learning difficulties and increase their interest in science courses by addressing their different learning styles (Winarti, 2019).

As a result, science education aims to develop individuals' scientific thinking skills and encourage them to adopt an environmentally conscious and inquisitive attitude. To achieve these goals, the methods used must be student-centered, take different areas of intelligence into account, and positively influence students' attitudes. The Multiple Intelligences Theory is an important approach in science education that supports meaningful and lasting learning by taking student differences into account, increases students' motivation towards the subject, and contributes to the development of scientific process skills.

2. Purpose of the Study

The purpose of this study is to determine the effect of activities based on Multiple Intelligence Theory on elementary school students' attitudes toward science. In line with this purpose, the study sought answers to the following questions:

1) Is there a significant difference between the pre-test scores of the experimental group, which was taught using activities based on the Theory of Multiple Intelligences, and the control group, which was taught using activities included in the 2018 Science teaching program?
2) Is there a significant difference between the pre-test and post-test scores of the control group students, who were taught using activities included in the 2018 Science teaching program, regarding their attitudes towards science?
3) Is there a significant difference between the pre-test and post-test scores of the experimental group students, who were taught using activities based on the Multiple Intelligence Theory, regarding their attitudes towards science?
4) Is there a significant difference between the post-test scores of the experimental group, who were taught using activities based on the Multiple Intelligences Theory, and the control group, who were taught using activities included in the 2018 Science Education Program, regarding their attitudes toward science?

2. Material and Methods

The study employed a quasi-experimental design with pre-test and post-test measures and unequal control groups, one of the quantitative research methods. This method was chosen because it is difficult to create experimental and control groups that are matched or unbiased in terms of control variables in existing school and classroom environments (Fraenkel & Wallen, 1990). In this study, two classes were randomly assigned from among the existing classes of two teachers with similar characteristics, one as the experimental group and the other as the control group. During the implementation phase, lessons were conducted using activities based on Multiple Intelligence Theory in the experimental group and activities included in the 2018 Science teaching program in the control group.

2.1 Working Group

The study group consists of 39 elementary school students in the fourth grade at an elementary school in the Central Anatolia Region during the 2023-2024 academic year. In determining the study group, the "convenience sampling" method was preferred among the sampling methods. This method was preferred because it is easier to include individuals or groups in the research process and because it is suitable for conditions such as time and space (Özmen & Karamustafaoğlu, 2019).

2.1.2 Data Collection Tools

In this study, the "Science Attitude Scale" was used as the data collection tool. Detailed information about the scale used in the study is provided below.

2.1.2.1 Science Attitude Scale

The "Science Attitude Scale" developed by Wang and Berlin (2010) and adapted into Turkish by Tosun and Genç (2015) was used in the study to measure students' attitudes towards science courses. This scale consists of 26 items and is a 5-point Likert scale. For each item, students were asked to select the option that best suited them from the following choices: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The "Strongly Agree" option was assigned a score of 5, "Agree" was assigned a score of 4, "Undecided" was assigned a score of 3, 'Disagree' was assigned a score of 2, and "Strongly Disagree" was assigned a score of 1. The sum of the points given to the positive statements in the survey, according to the above order (5, 4, 3, 2, 1) and the negative statements (1, 2, 3, 4, 5) was calculated. Of the 26 statements in the Science Attitude Scale, statements numbered 1, 2, 7, 8, 9, 10, 13, 14, 15, 20, 22, and 24 are negative, while the rest are positive statements.

Cronbach's Alpha value was used to examine the reliability level of the science attitude scale in relation to internal consistency. Cronbach's Alpha value ranges from "0" to "1". An alpha value between 0.60 and 0.80 indicates good reliability, while a value between 0.80 and 1.00 indicates high reliability (Kozak, 2015). The reliability coefficients for the science attitude scale are presented in Table 1.

Table 1: Reliability Coefficients for the Science Attitude Scale

Scale	Test	Number of Items	Cronbach's Alpha
Science Attitude Scale	Pre-test	26	0.91
	Post-test	26	0.95

Table 1 shows that the Cronbach alpha coefficient calculated for the pre-test of the Science Attitude Scale used to collect research data was 0.91, while the Cronbach alpha coefficient calculated for the post-test was 0.95. Looking at the Cronbach's alpha coefficients of the science attitude scale, it can be seen that the reliability of the scale's internal consistency is high for both the pre-test and post-test. The Cronbach's alpha value ranges between "0" and "1". An alpha value between 0.60 and 0.80 indicates good reliability, while a value between 0.80 and 1.00 indicates high reliability (Kozak, 2015).

2.1.3 Data Analysis

After the scale application sampling was successfully completed, the data obtained were checked for proper completion of the science attitude scale before being analyzed electronically. In order to explain the analysis results of the data collected with the science attitude scale in a scientific manner, the quantitative data were entered into the SPSS (Statistical Package for Social Sciences) statistical program. The data collected in the study were analyzed using the SPSS for Windows 22.0 program. The normality of the data distribution was determined using skewness, kurtosis, and standard error values.

Table 2: Skewness and Kurtosis Values for the Science Attitude Scale

Scale	Test	N	Skewness		Kurtosis	
			Value	Std. Error	Value	Std. Error
Science Attitude Scale	Pre-test	39	0.14	0.38	-1.07	0.74
	Post-test	39	-0.79	0.38	-0.50	0.74

Table 2 was examined to determine whether the skewness and kurtosis values obtained from the science attitude scale scores indicated a normal distribution. Values within the ±2 range are considered sufficient for a normal distribution (George & Mallery, 2010). The values calculated for the pre-test and post-test data of the science attitude scale were found to be within the specified range and to show a normal distribution.

To determine the relationship between the pre-test and post-test scores on the science attitude scale of the students participating in the study, comparisons were made using parametric tests, namely the independent samples t-test and the dependent samples t-test. The minimum, maximum, mean, and standard deviation values were used in the descriptive evaluation of the science attitude scale.

3. Findings

This section presents the results obtained from analyzing the data collected from the science attitude scale administered to the students participating in the study. During the data analysis process, descriptive statistics, independent samples t-test, and dependent samples t-test were applied. The results obtained were converted into tables and explained. The minimum, maximum, mean, and standard deviation values of the responses to the science attitude scale administered to the experimental group are shown in Table 3.

Table 3: Descriptive Statistics for the Science Attitude Scale of the Experimental Group

Scale	Test	N	Minimum	Maximum	X	Ss
Science Attitude Scale	Pre-test	20	2.00	4.69	3.12	0.73
	Post-test	20	3.32	4.72	4.13	0.37

Table 3 shows that the experimental group's science attitude scale pre-test score had a minimum of 2.00; maximum 4.69, the mean was 3.12; the standard deviation was 0.73; the experimental group's post-test science attitude scale score had a minimum of 3.32; maximum 4.72; the mean was 4.13; the standard deviation was 0.37. It was observed that the experimental group's science attitude was at a medium level (3.12±0.73) before the teaching application based on Multiple Intelligence Theory activities; after the teaching application based on Multiple Intelligence Theory activities, the science attitude was at a high level (4.13±0.37).

The minimum, maximum, mean, and standard deviation values of the responses to the science attitude scale administered to the control group are shown in Table 4.

Table 4: Descriptive Statistics for the Control Group Science Attitude Scale

Scale	Test	N	Minimum	Maximum	X	Ss
Science Attitude Scale	Pre-test	19	1.85	4.42	3.04	0.82
	Post-test	19	1.80	4.24	3.00	0.81

Table 4 shows that the control group's science attitude scale pre-test score had a minimum of 1.85, a maximum of 4.42, and an average of 3.04; a standard deviation of 0.82; the control group's post-test science attitude scale score was a minimum of 1.80, a maximum of 4.24, an average of 3.00, and a standard deviation of 0.81. It was observed that the control group's attitude towards science was at a moderate level (3.04±0.82) before the implementation of the teaching method included in the teaching program. After its implementation, the attitude towards science was again at a moderate level (3.00±0.81).

The first sub-problem of the study was "Is there a significant difference between the pre-test scores of the experimental group, which was taught using activities based on the Multiple Intelligence Theory, and the control group, which was taught using activities included in the 2018 Science Teaching Program?"

The pre-test scores of the experimental and control groups on the science attitude scale, as determined by an independent-samples t-test, are presented in Table 5.

Table 5: Experimental and Control Group Science
Attitude Scale Pre-test Scores Independent Samples t-Test

Scale	Test	Group	N	X	Ss	t	p
Science Attitude Scale	Pre test	ExperimentalGroup	20	3.12	0.73	0.29	0.77
		Control Group	19	3.04	0.82		

**p<0.01; *p<0.05

Table 5 shows that there was no significant difference between the pre-test scores of the experimental group and the control group on the science attitude scale (p>0.05). The pre-test science attitude score of the experimental group (3.12±0.73) was close to that of the control group (3.04±0.82); the pre-intervention science attitude levels of the experimental and control groups were found to be similar.

The second sub-problem of the study was "Is there a significant difference between the pre-test and post-test scores of the control group students' attitudes towards science when teaching with activities included in the 2018 Science Teaching Program?"

The minimum, maximum, mean, and standard deviation values of the responses to the science attitude scale administered to the control group are presented in Table 6.

Table 6: Control Group Science Attitude Scale
Pre-test and Post-test Scores Dependent Sample t-Test

Scale	Group	Test	N	X	Ss	T	p
Science Attitude Scale	Control Group	Pre-test	19	3.04	0.82	1.58	0.13
		Post-test	19	3.00	0.81		

**p<0.01; *p<0.05

Table 6 shows that there was no significant difference between the pre-test and post-test scores of the control group on the science attitude scale (p>0.05). The control group's science attitude pre-test score (3.04±0.82) was close to the science attitude post-test score (3.00±0.81); it was observed that there was no change in the science attitude level of the control group after the application.

The third sub-problem of the study was "Is there a significant difference between the pre-test and post-test scores of the experimental group students who were taught with activities based on the Multiple Intelligence Theory?"

The minimum, maximum, mean, and standard deviation values of the responses to the science attitude scale applied to the experimental group are shown in Table 7.

Table 7: Experimental Group Science Attitude Scale
Pre-test and Post-test Scores Dependent Sample t-Test

Scale	Group	Test	N	X	Ss	T	p
Science Attitude Scale	Experimental Group	Pre-test	20	3.12	0.73	-8.03	0.00**
		Post-test	20	4.13	0.37		

**p<0.01; *p<0.05

Table 7 shows that there was a significant difference between the pre-test and post-test scores of the experimental group on the science attitude scale (p<0.05). The post-test science attitude score of the experimental group (4.13±0.37) was higher than the pre-test science attitude score (3.12±0.73); it was observed that the science attitude levels of the experimental group increased after the application.

The fourth sub-problem of the study was "Is there a significant difference between the science attitude post-test scores of the experimental group, which was taught using activities based on the Multiple Intelligence Theory, and the control group, which was taught using activities included in the 2018 Science Teaching Program? The results of the significant difference between the science attitude scale post-test scores of the experimental and control groups are shown in Table 8.

Table 8: Experimental and Control Group Science
Attitude Scale Posttest Scores Independent Samples t-Test

Scale	Test	Group	N	X	Ss	t	p
Science Attitude Scale	Post-test	Experimental Group	20	4.13	0.37	5.55	0.00**
		Control Group	19	3.00	0.81		

**p<0.01; *p<0.05

Table 8 shows that there was a significant difference between the science attitude scale post-test scores of the experimental group and the control group ($p<0.05$). The experimental group's science attitude post-test score (4.13±0.37) was higher than the control group's science attitude post-test score (3.00±0.81); after the intervention, the experimental group's science attitude levels were higher than the control group's science attitude levels.

4. Conclusions and Discussion

This study was conducted to determine whether there was a significant difference in attitudes toward science between the experimental group, which was taught using activities based on Multiple Intelligence Theory in the fourth-grade Science course, "Human and Environment" unit, and the control group, which was taught using activities included in the 2018 Science teaching program.

To measure the attitudes toward science of fourth-grade elementary school students, the Science Attitude Scale was administered as a pre-test to both groups before the teaching of the "Human and Environment" unit and as a post-test after the experimental study. Before the experimental study, no significant difference was found between the students of both groups in terms of their attitudes toward the Science course. The pre-test science attitude score of the experimental group (3.12±0.73) was close to that of the control group (3.04±0.82); the pre-application science attitude levels of the experimental and control groups were found to be close to each other (Table 6). After the application, a significant difference was observed between the science attitude scale post-test scores of the experimental group and the control group ($p<0.05$). The experimental group's science attitude post-test score (4.13±0.37) was higher than the control group's science attitude post-test score (3.00±0.81); it was observed that the experimental group's science attitude levels after the application were higher than the control group's science attitude levels. This result supports studies conducted in our country and abroad at different levels and in different fields to investigate the effect of Multiple Intelligence Theory-based teaching on student achievement. For example, Çırakoğlu and Saracaloğlu (2009), Uçak (2006), Şahin, Öngören, and Çokadar (2010), Öngören (2007), Akamca and Hamurcu (2005), Şahan (2018), Ratnasari, Wardani, and Nuswowati (2018), and Gomaa (2014) in science education; Suleymani, Moinnzadeh, Kassayan, and Ketabi (2012) in English education; and Kuloğlu (2005) in mathematics education found that activities organized for multiple intelligences were effective in students' attitudes toward the relevant course. Furthermore, according to the results of a study conducted by Aslan Efe and Bakçı (2022), which presents a meta-synthesis of studies conducted on science education in our country, activities based on the Multiple Intelligences Theory have been found to increase students' success and the retention of information, as well as positively develop their motivation, attitudes, and interest in science.

Teaching based on Multiple Intelligence Theory activities also develops alternative skills in students, such as communication skills, cooperation, creativity, and tolerance.

Thanks to these different gains, students' attitudes towards the lesson develop in a positive direction in Multiple Intelligence Theory-based teaching, which is based on meaningful learning and a student-centered approach.

Considering the fundamental goals of education, one of the ways to get the most out of the education and teaching process is to improve the quality of teaching. Teachers who insist on traditional teaching prevent students from becoming aware of their own cognitive processes and hinder the development of alternative skills in students.

However, in a globalizing world, there is a growing need for people who are open to innovation, capable of self-improvement, inquisitive, aware of technological developments and able to apply and use them, and who have practical and creative ideas. Helping to develop the type of people our country needs is only possible by moving away from traditional teacher-centered teaching techniques and choosing student-centered teaching methods that address eight different areas of intelligence (Öngören, 2007). The findings obtained from the research can be summarized as follows:

While there was no significant difference between the two groups before the experimental study within the scope of the "Human and Environment" unit of the Science course, a significant difference emerged in favor of the experimental group that participated in activities based on the Multiple Intelligences Theory after the experimental study. According to these results, teaching based on Multiple Intelligence Theory activities has been successful in increasing students' attitudes towards science.

Although not included in the research problems and results, it was observed that applications based on the Multiple Intelligence Theory increased students' interest in the course and facilitated their motivation towards the course. Changes in students' attitudes towards science during these applications are expressed both by statistical data and by the researcher's observations during the course.

5. Recommendations

In light of the results obtained in the study, the following recommendations are presented:

In order to determine the effect of the Multiple Intelligence Theory-supported learning method related to science education, similar studies can be repeated in different units, different schools, different classes and different levels, or the same study can be repeated with more student groups.

Considering the research results, it is observed that students' attitudes towards science lessons using the learning method supported by the Multiple Intelligence Theory are high in the "Human and Environment" unit. In addition, studies supporting these results are also included in the research. Therefore, in fourth-grade elementary school, learning methods supported by activities based on the Multiple Intelligences Theory should be widely used in science education.

To provide a learning environment supported by the Multiple Intelligences Theory, the development of teaching materials and the preparation of activities and lesson plans aligned with the theory's essence should be encouraged.

For Multiple Intelligence Theory-supported education to be implemented in the best possible way, classroom teachers must possess the competencies required by the theory. Therefore, in-service training related to this theory should be provided to classroom teachers. Applications should also be developed for prospective classroom teachers currently pursuing university education to teach based on Multiple Intelligence Theory.

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Conflict of Interest Statement
The authors have no conflicts of interest to declare.

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