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# Increasing Mathematical Curiosity Using Simple AI Instruction In Primary School

**Büşra Usluoğlu***
Kırıkkale University, Turkey

**Veli Toptaş**
Kırıkkale University, Turkey

***Corresponding Author:** busrausluoglu38@hotmail.com

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**Abstract**
The abstract contains a brief description of the purpose: describes the objectives and In recent years, a new system has introduced itself to the world: Artificial intelligence (AI). Artificial intelligence, an active educator, has begun to take its place in our lives every day. Therefore, it has also taken its place in the education and training system. Artificial intelligence, which is also used in mathematics education, has become one of the shaping effects of the future. Therefore, it is important for education to start from a young age. The main purpose of this study is to explain the artificial intelligence system consisting of mathematical data in the language of primary school students and to increase mathematical curiosity with fun activities and applications. For this purpose, forty-five 4th grade students were studied. The study is a mixed-design study including quantitative and qualitative methods. Since the subject of data processing in mathematics was explained in the study, a pre- and post-test of success was applied. In addition, the opinions of the students were analyzed for the activities performed. In the light of the findings obtained from the study, it was observed that the students' mathematical success increased with simple artificial intelligence applications. In addition, the students whose opinions were taken stated that they discovered the relationship of the artificial intelligence system with the subject of data processing in mathematics as a result of the applications performed and that this increased their mathematical curiosity. These applications and evaluations developed suggestions for more artificial intelligence studies, especially in mathematics classes, at the primary school level.

## INTRODUCTION

In recent years, artificial intelligence (AI) applications have become popular in all world systems. With the development of technology, artificial intelligence applications that have progressed even more provide convenience in large systems such as health, education, economy and trade. Artificial intelligence applications, which are as close as mobile phones today, are popular because they produce information through their own resources as well as teaching existing information. Information is what individuals reach as a result of researching the topics they are curious about. With the development of the internet age, accessing information in all disciplines has become easier and more practical than before. It is now quite simple to save time and reach the answer to the topic of interest. Accessibility in the education and training system has increased with the ease of accessing information. A student who searches the internet about a topic he/she does not know can reach what he wants.

After World War II, many researchers, especially Alan Turing, began to work independently on artificial intelligence. Alan Turing gave the first conference on artificial intelligence in 1947 and explained that intelligent machines could be invented by combining artificial intelligence with computer programs (McCarthy, 2007). Artificial intelligence created with a machine system is a type of machine intelligence. With the artificial intelligence included in the internet system, information and

applications began to be produced by an artificial system. Thus, interest and need for educational applications with artificial intelligence increased.

Parlak (2017) raises curiosity about the place of artificial intelligence, which is popular with its interactions on social media, in digitalized education. When the systems within it are examined, artificial intelligence is actually a student. It processes the code information it receives, passes it through its own filter and creates a new scheme. It processes and advances the qualities with its flexible structure. Thus, it can present the code information it obtains as new information. Therefore, it can be interpreted that artificial intelligence is an active educator. Noe (2009) touched on several important points while talking about the benefits of artificial intelligence in education and training processes. These points are related to the fact that artificial intelligence increases the quality of the education process because it can meet the individual expectations of students, get answers to their questions without time and space limitations, and can be shaped according to the student. In fact, the artificial intelligence applications included in the process will ensure that the efficiency of the education is obtained and will also attract the curiosity of the learner on the subject. In his study, Cunska (2020) examined the opinions of students and teachers about mathematics education with artificial intelligence applications for a full 3 years. One of the results found by the researcher is that teaching mathematics with artificial intelligence increases the curiosity and excitement of both students and teachers and contributes to efficient mathematics teaching.

One of the foundations of the teaching process is the teaching of mathematics and its connection with other disciplines. Giving importance to teaching mathematics from an early age is essential in forming the basis of advanced mathematics and technology. Young children love to learn about the things they are curious about through games and entertainment. Similarly, De Lange (2019) stated that curiosity is high in young children and that this is quite natural. One of the ways to make teaching mathematics more fun is to adapt to the system and benefit from artificial intelligence technology. Kuprenko (2020) stated that teaching with artificial intelligence supports students' interests and curiosities individually. One of the most important triggers in mathematics is curiosity.

Beloglovsky and Daly (2015) explain that learning mathematics for young children aims to train logical and systematic thinking and to introduce the basics of mathematics as preparation for higher levels of complexity. Mathematical curiosity, in its simplest definition, is an interest in learning mathematics. However, previous studies (Usluoğlu and Toptaş, 2021) have shown that mathematical curiosity involves more than a desire to learn or know mathematics. Mathematical curiosity also includes a desire to explore mathematical ideas by posing mathematically interesting problems after completing a problem. At the same time, the individual should be able to reduce mathematics to his/her daily life and interpret the problems or events he/she encounters in mathematical terms.

In this study, we thought about how to activate artificial intelligence applications in primary school children with these mathematical curiosity definitions we made before. However, instead of showing these applications directly to children, we started by teaching how they are made and what they do. Before showing how artificial intelligence applications work, we wanted to introduce what they are. When introducing a concept, it is very important to distinguish between the real definition of the concept and the definition formed in the learner's mind. Dinçer (2019) mentioned that a structure is formed by including the concept image that comes to mind in the student's mind in the concept introduction and using the words he/she uses to explain it with his/her own words. In this case, it is also important for the learner to have a curiosity and interest in the concept other than his/her own definition. If the concept is to be introduced to a child, the child must be motivated about the concept. Because children are not curious and eager to learn anything they do not know. In order to increase their curiosity in mathematics, we aimed to satisfy their curiosity in artificial intelligence first.

McCarthy (2004) defined artificial intelligence as the calculated part of world systems in reaching their own goals. Therefore, artificial intelligence is a calculation task. Calculations are also done through mathematics. So what is the place of artificial intelligence, the new savior of these systems, in education, which is one of the most widespread branches of the system? How can we

integrate artificial intelligence, which produces information with its own system and codes, into children's education? It would be more useful to teach how the artificial intelligence system works before doing artificial intelligence applications with children. The aim of this research is to provide information about the artificial intelligence system to primary school children and to increase mathematical curiosity by exemplifying the system with the subject of data processing in mathematics class. The sub-problems of the research are as follows:

1.Do simple AI applications make a significant difference in the success of mathematical data analysis and processing?

2. What are the views of 4th grade students on increasing their mathematical curiosity with simple AI applications?

## METHODS

In general, this section describes how the study was conducted. The subject matters of this section are: (1) the study design; (2) the sample population or subject of the research; (3) data collection techniques and instrument development; (4) and data analysis techniques. Please use descriptive paragraphs. Use these questions as a guideline to write the method: (1) Is the design suitable for answering the question posed?; (2) Is there sufficient information present to replicate the research?;(3) Does the article identify the procedures followed?; (4) Are these ordered in a meaningful way?; (5) If the methods are new, are they explained in detail?; (6) Was the sampling appropriate?; (7) Have the equipment and materials been adequately described?; (8) Does it clear what type of data was recorded?; (9) Have the data been precise in describing measurements?

### *Research Design*

The purpose of this study is to increase mathematical curiosity in students by conducting sample activities on data processing in mathematics with simple artificial intelligence applications. In order to strengthen the studies carried out for this purpose, a mixed method, which combines qualitative and quantitative research methods, was used. It was decided to better understand and examine the problem to be solved by using mixed methods together with qualitative and quantitative methods. In this study, the embedded mixed method, which includes the simultaneous collection of data among the studies of Cresswell (2008), and is seen as a qualitative and quantitative support, was used.

A case study, which is a qualitative research design, was used to examine the qualitative data of the study. A single group pretest-posttest design, which is one of the weak experimental design types of quantitative research method, was used to examine the quantitative data of the study. A data processing test developed by the researchers was developed to obtain the quantitative data. In the 2023-2024 academic year, 45 primary school 4th grade students studying in Kırıkkale province were given 4-hour training and an application was made regarding this training. Quantitative data were analyzed with SPSS 25.0 program. Relevant sample T-test was used in the analysis of the data. Qualitative data were obtained using a semi-structured interview form and the obtained data were analyzed with the content analysis technique.

### *Research Process*

The research process of the study consists of 3 phases. It includes three phases: pre-application preparation phase, application phase, and post-application phase. Before the application, it includes the selection of the research topic and the school where the application will be made, interviews with class teachers, preparation of materials and planning of the applications. The application phase includes 4 hours of activity applications and the post-test after the data processing tests are given to the students. The process after the application is to obtain the opinions of the students about the applications and to analyze and report all the data obtained.

***Study Group***

The study examined the data of 4th grade students studying in a primary school in Kırıkkale city center in the 2nd semester of the 2023-2024 academic year. Information on the study group is presented in Table 1.

| Gender | f | % |
|---|---|---|
| **Female** | 23 | 51,1 |
| **Male** | 22 | 48,9 |
| **Total** | 45 | 100 |

When the distribution of the study group by gender is examined, it is seen that it consists of 45 participants, 23 female students (51.1%) and 22 male students (48.9%).

***Data Collection Process and Analysis***

In order to obtain the data of the research, interviews were conducted with four 4th graders before the application and the two classes where the application would be conducted were decided. Then, a test was conducted with the selected sample class to measure their knowledge of data collection and organization that they had learned within the framework of the curriculum up to this time. The test was prepared in accordance with the 4th grade mathematics curriculum and included column chart, shape chart, object chart, and tally table (Appendix-1/Turkish version). Students were asked to collect information in the classroom about any selected topic and display the data with a graph. For example, the information about the favorite color of the students in a class was collected and displayed with a tally chart. It was observed and recorded how the data related to the 5 selected topics were processed and analyzed. The data processing and graphic information of each student in the class was noted.

Then, students were chatted about artificial intelligence and their first impressions were noted. Semi-structured interviews provided information about what artificial intelligence is and how it is created. Students were asked to give examples of an artificial intelligence application and device they know. With the examples given, a brainstorming session on the subject of 'artificial intelligence' was held in the classroom. The researchers guided the discussion on the fact that the sub-base of artificial intelligence consists of data and listened to the students' opinions on this subject. Information on the creation and use of artificial intelligence was given by reducing it to a simple primary school level.

The researchers made the students see that there is a strong relationship between artificial intelligence and mathematics. Thus, the idea that the basis of artificial intelligence in the classroom is created by processing data in mathematics was strengthened. After this, a simple artificial intelligence example was designed and implemented in the classroom using data in mathematics but without using a computer. The researchers exemplified how the phone lock feature, one of the most well-known artificial intelligence examples in the classroom, is written with the characters of their favorite cartoons. The use of beloved cartoon characters in the activity attracted the attention of the students. In the activity, the students who were selected to represent the cartoon characters were given character pictures and were asked to hide them in the entire class. One of the researchers collected information about the characters like an artificial intelligence program and showed the data they obtained with a graph on the board. After collecting information about all five characters (for example, the character's hair color, eye color, gender, age, etc.), a sixth student was brought to the board. The sixth student was given a picture of one of the five characters given to the other students. The researcher, who collected and analyzed the data, also obtained information about the character of the sixth student and wrote it on the table. After all the information he obtained, the researcher analyzed the data (character features) one by one and made comparisons. As a result of the comparison, the matching data were matched and two identical data (the characters) were found.

In summary, the data collection and processing of artificial intelligence has been reduced to a simple language with primary school level data graphs. Finally, the opinions of the students, whose

curiosity and interest increased considerably with the information they acquired about artificial intelligence, were collected and evaluated. In the continuation of the activity, the students were asked to create their own simple artificial intelligence systems. Data on new topics were collected with the students and the data was analyzed by showing them with graphs/tables.

At the end of the applications, the students' knowledge and opinions on data collection and processing were examined and evaluated. The students' data collection and analysis before and after the application were observed and compared. The students were asked 10 questions about the data on different topics before and after the application and their answers were compared. In the study, the single group pretest-posttest design, which is one of the weak experimental design types, was found appropriate, and the analysis process was carried out using the T-test statistical method to reveal the pretest and posttest results applied to the group, arithmetic means, standard deviations, the difference between the pretest and posttest applied to the group and the changes within the group. In addition, the semi-structured interviews conducted with the students during and after the application were analyzed with content analysis. The opinions of the students were tabulated under common headings.

## RESULTS AND DISCUSSION

### *Findings Regarding the First Sub-Problem*

A dependent samples t-test was conducted between the pre-test and post-test scores of the students in order to determine whether the simple artificial intelligence applications implemented within the scope of the study created a significant difference in the success of mathematical data analysis and processing. The findings of the analysis are shown in Table 2.

**Table 2.** Analysis of Pre-test-Post-test Scores

| Measure | f | $\bar{x}$ | Min. | Max. | sd | p |
|---|---|---|---|---|---|---|
| **Pre-test** | 45 | 21,07 | 15,00 | 40,00 | 3,75 | |
| **Post-test** | 45 | 22,43 | 18,00 | 40,00 | 3,38 | ,039 |

p<,05

As seen in Table 2, there is a significant difference between the pre-test mean score (21,07) and the post-test mean score (22,43) of the study group in favor of the post-test results. In order to determine whether the difference between the students' success in data processing before the application and the success in data processing after the application is significant, the pre-test and post-test mean scores were compared with the dependent t-test. The calculated t-value is significant at the ,05 level. Accordingly, the difference between the pre-test and post-test mean scores of the experimental group is significant. This result shows that there is a significant difference between the pre-test and post-test results of the students participating in simple artificial intelligence studies in terms of their success in data processing in mathematics.

### *Findings Regarding the Second Sub-Problem*

Within the scope of the study, the views of 4th grade students on simple artificial intelligence applications to increase their mathematical curiosity were examined and analyzed. The views of the students on the application were collected and evaluated under common headings. Headings with the same opinion were expressed as common. The findings obtained from the interviews are presented in Table 3 and Table 4.

***Views on The Relationship Between Simple Artificial Intelligence Applications and Mathematics***

**Table 3.** Views on the relationship between artificial intelligence and mathematics

| Topics | f | % |
|---|---|---|
| Mathematics forms the basis of artificial intelligence. | 25 | 55,5 |
| The artificial intelligence studies are supported by mathematics. | 16 | 35,5 |
| The artificial intelligence is written with mathematical data. | 32 | 71,1 |

The students who examined the themes given in Table 3 presented the following views regarding establishing a connection between artificial intelligence and mathematics:

S12: *'With the activity we did, we learned that the data of artificial intelligence is mathematical data. This is really interesting. I didn't know that mathematics was useful in unlocking phones.'*

S28: *'We wrote the artificial intelligence data with the graphics we learned in mathematics class. Artificial intelligence data consists of mathematics.'*

S43: *'I learned that artificial intelligence is done by collecting and analyzing data.'*

When Table 3 is examined, it is seen that 4th grade students have formed an idea about what artificial intelligence applications are. Most of the students (71,1%) realized how artificial intelligence data is written with mathematical data after the applications. In addition, more than half of the students (55,5%) realized that mathematics is needed to form the basis of artificial intelligence.

***Views on how simple AI applications increase mathematical curiosity***

**Table 4.** Views on the relationship between AI and mathematical curiosity

| Topics | f | % |
|---|---|---|
| I can understand what artificial intelligence is and its relationship with mathematics. | 42 | 93,3 |
| I can now realize the contribution of artificial intelligence applications to my mathematics course. | 37 | 82,2 |
| I was interested in doing activities between artificial intelligence and the data processing topic we learned in math class. | 45 | 100 |
| I am curious about the relationship between artificial intelligence and other topics in math class. | 29 | 64,4 |
| Because I loved math, my interest in artificial intelligence increased. | 22 | 48,8 |
| I am motivated to create AI applications with mathematics. | 30 | 66,6 |

The students whose themes are examined in Table 4 have expressed the following views regarding the increase in their mathematical curiosity with artificial intelligence:

S37: *'It was very fun to write artificial intelligence with mathematics. We were able to create the data of facial recognition systems with mathematics.'*

S29: *'The activities we did showed us that we, humans, create artificial intelligence using mathematics. The people who create artificial intelligence benefit from the numbers and operations in mathematics.'*

S4: *'We did an artificial intelligence activity with the graphs we learned in mathematics class in class. I liked knowing how to use mathematics to design artificial intelligence studies in the future.'*

According to Table 4, all of the students stated that the artificial intelligence applications made in mathematics class attracted their attention. Most of the students who stated that they had a lot of fun with the applications (64.4%) stated that their interest and curiosity in mathematics also increased. In addition, the majority of the students (66.6%) said that they were motivated to create artificial intelligence applications made with mathematical data and that their curiosity increased.

## CONCLUSION

The main purpose of the study is to explain artificial intelligence to students in their language and to enrich this by appealing to their mathematical curiosity. For this purpose, the subject of data processing was discussed in mathematics class and was used to create the data of an artificial intelligence application. The students were expected to discover how artificial intelligence codes used in many areas of daily life were written with mathematical data. In addition, students were asked to overcome the prejudice that it is difficult to make artificial intelligence applications and develop the view that it is quite simple with mathematics. The AI activities carried out in the study were prepared in light of this purpose and designed to attract the attention of students. In addition, it was considered important to increase students' mathematical curiosity by making mathematics fun in applications. Similarly, Lundin (2012) showed that mathematics can be seen as a game or form of game in which it is claimed that it is useful in a way that it is not in real life with the activities he/she conducted. It is a known fact that children love mathematics when they can play.

The first sub-problem within the scope of the research is whether the students' achievement tests before and after the application on data processing in mathematics are significant. It was observed that there was a significant difference (p=.039) in the achievement test applied before and after the application carried out within the scope of the study. This means that the artificial intelligence activities and applications carried out with the students bring success in the subject. Especially for primary school students who are in the concrete period, feeding the lesson with concrete applications in the mathematics lesson is beneficial for their understanding and success. Studies (Edens et al., 2013; Duran et al., 2018; Efe Kendüzler, 2023) have shown that concrete mathematics applications have significant effects on mathematics success. Explaining a complex system such as artificial intelligence by reducing it to a simple level for primary school students and enriching it with the subject of data processing in mathematics increases the students' interest and curiosity in the subject. This interest and curiosity triggers success in mathematics.

Within the scope of the research, the second sub-problem was about whether students established a connection between artificial intelligence and mathematics. It was important to see whether students established this connection in addition to the success achieved in data processing in mathematics with the simple artificial intelligence applications. The students saw the concrete relationships between the activities carried out and the data processing subject that was intended to be explained and stated this in their opinions. The students, who stated that they experienced that the data of the artificial intelligence system was created with mathematical data through the activities carried out, said that they liked this analysis. Similarly, Karadeniz (2016) mentioned in his study that while students gained experience in data; they were presented with various examples from their close environment regarding their representations in the form of tables, graphs and diagrams, their attention was drawn by supporting them with materials, and they understood the subject better by using various methods and techniques.

The other question of the second sub-problem in the study is the students' views on the increase in mathematical curiosity of the artificial intelligence system solutions with the mathematical data. The 4th grade students stated that the applications made in 4 hours increased their mathematical curiosity. In addition, the students stated that they developed a positive attitude towards the mathematics lessons and data processing. Şentürk (2010) stated that success and attitude in mathematics lessons support each other and develop. The study increased mathematical curiosity and achieved its purpose.

This study aims to introduce the artificial intelligence system to 4th grade students in a simple way and to explain artificial intelligence data by blending it with the subject of data processing in mathematics. For this purpose, it is emphasized that students both gain knowledge about the artificial intelligence system and establish a relationship between artificial intelligence and the subject of data processing in mathematics. In addition, fun activities and applications contributed to the development of students' curiosity in mathematics and positive opinions were obtained. The findings obtained from the research were evaluated and it is recommended that primary school students participate more in simple artificial intelligence applications and establish more connections with mathematics lessons through this path. Since artificial intelligence has taken its place in all world systems, it will be important to increase children's curiosity in mathematics and artificial intelligence by reducing their education to younger ages.

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