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FOSTERING SCIENCE PROCESS SKILLS IN EARLY CHILDHOOD: THE TRANSFORMATION IMPACT OF STEM-BASED ACTIVITIES ON PRESCHOOL EDUCATION

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ABSTRACT

This study examines how design-based STEM (Science, Technology, Engineering and Mathematics) activities in early childhood affect the development of science process skills of 60-72-month-old children attending preschool education. The study was conducted using a participatory action research design and the participants of the study consisted of fifteen students studying in preschool education. The study participants were selected according to the convenience sampling method from purposive sampling methods. The Science Process Skills Graded Scale and photographs were data collection tools. With this graded scale students' weekly activities based on STEM activities were evaluated and their progress was monitored. This process was supported and revealed with photographs. The research was conducted by applying eight STEM scenarios designed based on the 5E learning model. The students' work was scored by two different raters and the data were analysed using descriptive statistics. It was determined that science process skills were inadequate in the first week, but a significant improvement was observed in these skills during the implementation process. The results of the research show that students enjoyed STEM applications, their interest levels increased, and their science process skills improved. Based on the results of the research, various suggestions were presented.

Keywords: STEM, early childhood education, science education, science process skills, action research.

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INTRODUCTION

Today, the fast-evolving world of technology impacts all systems and fields, including education. Technological innovations, with their constant change and development, play a critical role in preparing students for their future careers. Science, Technology, Engineering, and Mathematics (STEM) has emerged as an approach that helps us understand this impact on education.

STEM, an acronym for science, technology, engineering, and mathematics, emphasizes the interaction and influence between these four key disciplines (Shelley & Kiray, 2018). It gained popularity in the 1990s and has significantly advanced in the field of education in recent years (Johnson, 2019). STEM education aims at providing knowledge and skills in these four areas using a holistic approach (Martín-Páez et al., 2019). STEM offers a comprehensive and integrated perspective, enhancing the ability to solve real-world problems (Kuş, Aydın & Karakurt, 2023). It is more than just an educational approach; it's a learning philosophy where these four disciplines are taught in an interconnected way (Çevik et al., 2023). By adopting an interdisciplinary approach, STEM education boosts students' problem-solving skills and encourages creative thinking.

STEM education is of great importance in providing the skills necessary for success in future work life (Fleer, 2013). Technological changes and innovation constantly affect and change the skill set demanded in the business world. This makes it even more important for students to develop their STEM skills. Because these skills will make them more competitive in the labour market. In this context, STEM education increases students' interest in technology while enhancing their critical thinking and problem-solving skills, and encourages them to think innovatively (Hebebci & Usta, 2022). STEM education also helps students improve their teamwork and communication skills. These skills are abilities that support students' success in their future work lives (Jafarov, 2023). Considering the impact of technological changes and digitalization on education, the importance of STEM education is increasingly growing today (Bybee, 2013). STEM education provides the opportunity for students to develop the skills necessary for success in their future work life (Özkan & Kettler, 2022). Therefore, education systems should attach more importance to STEM education and it should be popularized. In this context, STEM activities should be included at all levels of education, starting from pre-school education.

Preschool education is a fundamental stage that supports children's cognitive, emotional, social, and physical development (Bredekamp, 2016). In recent years, STEM has also made its mark in preschool education. STEM education contributes to the cognitive, emotional, and social development of children in the preschool period (Yücelyiğit & Toker, 2021). Therefore, STEM education holds an important place in preschool curricula. STEM applications in preschool education can stimulate children's curiosity and strengthen their desire to explore (Cohen & Waite-Stupiansky, 2019). Interactive and play-based learning activities can be organized to impart skills such as experimenting, observing, and finding different solutions to problems under STEM education. There are many contributions of STEM activities in preschool education to students. These activities develop children's critical thinking, problem-solving, and creative thinking skills (Akcay Malcok & Ceylan, 2022; Wan, Jiang & Zhan, 2021; Yalçın & Erden, 2021). Also, STEM activities help children improve their collaboration and communication skills (Clements & Sarama, 2011). These skills will contribute to increasing students' success in their education life from the preschool period by forming a strong foundation. STEM activities can also improve students' science process skills.

Science process skills form the basis of scientific thought and deepen students' understanding of science (Tan, Yangco & Que, 2020). These skills include important steps such as making observations, forming hypotheses, designing experiments, collecting data, analyzing results, and making inferences based on results (Aktamış & Yenice, 2010; Beaumont-Walters & Soyibo, 2001). In early childhood, children are usually imparted basic science process skills such as making observations, predicting, measuring, comparing, classifying, and collecting/recording data (Husaini, Ikhsan & Toran, 2019). Observation is an important part of these skills and forms the basis of the discovery process in science. Making observations is an important step in carefully examining objects, collecting data, and identifying similarities and differences between objects (Kraus, 2023; Tan & Temiz, 2003). Measurement is another skill included in science process skills. The skill of measurement is the process of comparing an unknown quantity with a known quantity of the same kind, quantitatively evaluating an object or event, determining its characteristics, or expressing it with numbers (Chiappetta, Koballa & Collete, 2015). Making inferences emerges as another element of science process skills. The skill of making inferences can be defined as people's ability to best guess why things happen (Martin, 2003). Making inferences is the explanation of the observation. Inferences are heavily reliant on past experiences. Classification is another sub-skill of science process skills. Classification involves grouping objects or events according to similar characteristics (Martin, 2003). Prediction is forming an idea about the possible results of future events and situations based on evidence and information obtained as a result of observations and experiences (Ostlund, 1992). Making predictions is a process based on observations, experiences, and information. To make reliable predictions, effective observations must be made and the relationship between observed events, situations, and objects must be well analyzed.

In the preschool period, children start to explore the world and develop their curiosity by acquiring these skills. The preschool period is a critical period when children start to acquire these basic science process skills (Jones, Lake & Lin, 2008). STEM education in the preschool period can help children develop their science process skills. For example, simple experiments and observation activities can help children develop their observation and data-collection skills. Also, the process of designing and building engineering projects using construction materials can strengthen children's problem-solving and hypothesis-formation skills. Mathematical skills can also be improved through STEM activities. In particular, recognizing patterns and measurement skills can increase children's scientific understanding and problem-solving abilities. Technology can also be used as a tool to improve children's data analysis and presentation skills. Computers, tablets, and other technological tools can enable children to collect, analyze, and present scientific data. This not only helps children improve their science process skills but can also enhance their technological literacy skills.

Research conducted in Turkey on STEM education has shown that STEM-focused applications enhance students' problem-solving, scientific thinking, visual-spatial abilities, reasoning, science process, and creative thinking skills, while also increasing their intrinsic motivation levels (Abanoz, 2020; Asığığan, 2019; Bal, 2018; Başaran, 2018; Behram, 2019; Güldemir & Çınar, 2021; Kavak, 2020; Öztürk, 2020; Şimşek, 2022; Ünal, 2019; Üret, 2019). However, when the related literature in Turkey is examined, it is found that studies on STEM activities in the preschool period are limited. This points to a significant gap in the literature. Therefore, it is thought that such research will contribute to the literature and it was decided to conduct this research. However, a review of the relevant literature in Turkey reveals a limited number of studies on STEM activities in preschool. This situation points to a significant gap in the literature. Therefore, it is believed that this research will contribute to the literature, and thus the decision was made to conduct it. This research aims to address the gap in the literature regarding the limited number of studies on STEM activities in preschool education in Turkey. Specifically, it aims to fill the knowledge gap in this area by examining the impact of STEM activities on the science process skills of preschool children. Most of the studies mentioned above show that STEM activities improve students' various skills and increase their motivation. However, most of these studies were conducted on school-aged children. This research, by focusing on the preschool period, aims to address this deficiency in the literature.

One of the researchers also serves as a preschool teacher and has observed that STEM activities are not given enough attention in preschool education institutions around her, and activities supporting students' science process skills are not implemented adequately. This observation has been confirmed in a study conducted by Aslan and Uyulan (2023); the study concluded that teachers do not apply STEM activities in science education. These results indicate that the STEM approach in science education during early childhood is not adequately adopted. The early childhood period is a critical period when individuals acquire basic skills and the foundations of cognitive development are laid (Essa & Burnham, 2019). Acquiring science process skills during early education can lead to deeper and more lasting understanding, positively impacting students' future educational experiences. These skills can heighten students' interest in science, enhance their critical thinking abilities, and fortify their problem-solving skills. They may also increase academic achievement and make students more effective learners. Given this, the importance of research focusing on preschool science education is clear. This research allows children to engage in STEM activities at an early age and improve their science process skills. It can also inform preschool teachers' and educational institutions' practices in this field, laying a strong foundation for children's future academic and professional success. The experiences and observations of researchers highlight the need for further research to improve STEM activities and science process skills in early childhood.

If research determines that STEM activities enhance the development of students' science process skills, these results will serve as a guide for preschool teachers. In this case, teachers will be able to use contemporary learning-teaching models more effectively and raise children with the knowledge and skills required by their age. Similarly, if it is concluded that STEM activities contribute to the development of science process skills, the feedback from this research will be provided to faculty members in teacher training programs. This feedback could encourage planning STEM education as a separate course in early childhood teacher training programs and provide faculty members with information and opportunities for how to plan activities based on science process skills. In conclusion, this research will be an important step towards improving science process skills with STEM activities in early childhood. The research aims to develop the science process skills of children aged 60-72 months in science education in early childhood based on STEM activities through action research. In line with this goal, the following question was sought:

"How do STEM activities in early childhood cause a change and development in students' science process skills?"

METHOD

Research Design

This research was designed and conducted with an action research design aiming to improve students' science process skills with STEM activities in early childhood. Action research is a research process conducted to solve a problem or improve a situation in real-world conditions together with participants (Reason & Bradbury, 2008). Action research provides teachers with the opportunity to examine their classrooms. Through action research, teachers strive to better understand their teaching methods and improve their classroom practices to enhance students' skills (Mertler, 2020). There are different types of action research, and in this study, the participatory action research type was adopted. Participatory action research is a type where the researcher who investigates to achieve change and development based on a problem, subject, or program carries out the action research design him/herself (Mills, 2014). In this research, based on the research problem, the first researcher conducted the research in the school where he works and carried out interventions to improve students' science process skills. Therefore, participatory action research was preferred.

Study Group

In action research, small groups are usually studied based on purposive sampling (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz & Demirel, 2016, p. 267). In this context, the purposive sampling method was used in the research. Purposive sampling is the process of selecting a sample believed to represent a certain population. In other words, the researcher makes the sample selection based on the knowledge and experience of the group to be sampled (Mills & Gay, 2019). In this research, convenience sampling, which is one of the types of purposive sampling, was used. Convenience sampling refers to the selection of people who are readily available, volunteers, or easily found for inclusion in the sample (Christensen, Johnson & Turner, 2015). This method allows the researcher to save time and practice with the children at the school where the researcher works. The observation of deficiencies in the science process skills of the group in which the research was conducted and the expression of these by teachers constituted the reason for the research to focus on this group. In this context, students' science process skills were measured using the measurement tool developed within the scope of the research, and it was determined to be at a low level. In light of this information, the study group consists of 15 students aged 60-72 months receiving preschool education in a city in the Central Anatolia Region in the 2022-2023 academic year. The information on the children participating in the research is presented in Table 1.

Table 1: Information on the Study Group

Student Code	Gender	Mother Occupation	Father Occupation	Socio-economic level	Mother and Father	Place of residence
S1	M	Homemakers	Imam	Low	Alive	District centre
S2	M	Teacher	Teacher	Medium	Alive	District centre
S3	M	Teacher	Teacher	Medium	Alive	District centre
S4	F	Nurse	Engineer	High	Alive	District centre
S5	F	Homemakers	Teacher	Medium	Alive	District centre
S6	M	Teacher	Civil servants	Medium	Alive	District centre
S7	F	Civil servants	Civil servants	Medium	Alive	District centre
S8	F	Homemakers	Farmer	Medium	Alive	District centre
S9	M	Homemakers	Teacher	Medium	Alive	District centre
S10	M	Homemakers	Farmer	Low	Alive	District centre
S11	M	Teacher	School principals	Medium	Alive	District centre
S12	F	Nurse	Teacher	Medium	Alive	District centre
S13	F	Teacher	School principals	Medium	Alive	District centre
S14	M	Civil servants	Teacher	Medium	Alive	District centre
S15	F	Teacher	Teacher	Medium	Alive	District centre

According to the data obtained from Table 1, there are 7 girls and 8 boys in the study group. When the occupational status of the mothers is examined, it is seen that 5 are housewives, 6 are teachers, 2 are nurses, and 2 are civil servants. Looking at the occupational status of the fathers, it is determined that 7 are teachers, 2 are civil servants, 2 are farmers, 2 are managers, and 2 are civil servants. In the research related to the socio-economic status of the families, it was determined that 3 families have good income, 1 family has very good income and 11 families have middle-class income. Looking at the survival status of the mother and father, it is seen that all children's families are alive. In the examination about the places where students live, it has been determined that all students live in the district centre. The general characteristics of the students are explained in detail below:

S1: Academic performance is average. Eager and enthusiastic about participating in activities. Socially extroverted and can express himself comfortably. His relations with his friends are good and he strives to fulfill his responsibilities.

S2: Academically average with underdeveloped social skills. He is reticent about expressing his thoughts and has limited problem-solving abilities. However, he eagerly participates in activities.

S3: Academically average with good social skills and an enterprising spirit. He sometimes struggles to follow rules and requires external supervision.

S4: Above-average academic performance. She has strong social skills and shows interest in science, mathematics, and engineering. Her communication skills are advanced, and she provides logical responses to questions.

S5: Below-average academic performance with weak social skills. She participates minimally in activities, struggles with attention deficit, and has difficulties fulfilling her responsibilities.

S6: Low academic performance and very weak social skills. He has difficulty assuming responsibilities and expressing himself.

S7: Average academic performance with developed social skills. She communicates well but sometimes struggles to follow rules.

S8: Average academic performance, but her communication skills are undeveloped. She usually prefers solitary play but makes an effort to fulfil her responsibilities.

S9: Low academic performance with weak social skills. He is reluctant to participate in activities and struggles with attention deficit.

S10: Low academic performance but has self-confidence. He maintains limited communication with a select group of friends and struggles to grasp concepts.

S11: Below-average academic performance. He is hesitant to participate in activities but has developed communication skills, even though he sometimes engages in irrelevant conversations.

S12: She is the most successful student in the class and her social skills are developed. Her communication skills are high, and she is loved by her friends.

S13: Academically at a mid-level and has a harmonious structure. She strives to fulfil her responsibilities but sometimes has difficulty in drawing and painting.

S14: Academic achievement is average and has a social structure. He is interested in books and can express himself comfortably.

S15: Academic achievement is low and social skills are weak. She is reluctant to participate in activities and has an attention deficit. However, she is eager about drawing and painting.

Research Environment

After obtaining the research permits, the research was conducted by the first researcher at the school where the researcher works. The mentioned school is a single-story, independent kindergarten located in the district centre. The school hosts four different classrooms, and the number of students in the classrooms usually varies between 15 and 18. Each class includes students from different age groups (36-48, 48-60, and 60-72 months). The class where the research was applied is teaching 60-72 month-old children. There is a playground with a soft floor in the school garden. Some of the applications were carried out using the school garden when needed. In the classroom where the application was made, there are areas such as block centre, art centre, book centre and dramatic play centre in the preschool curriculum. Each child has a locker to keep his materials. The classroom physically has enough space but it has been observed that it is insufficient in terms of lighting. This sometimes leads to problems related to heat in the classroom. There is an internet-compatible interactive board in the classroom within the scope of the Fatih Project. In addition, there are panels where children display their activities. Photos related to the environment where the research was carried out are presented below.

Photo 1. Classroom environment

Data Collection Tool

In the research, two types of data collection tools were used. These are;

Science Process Skills Graded Scale

In this research, a science process skills graded scale has been developed to determine whether the science process skills of students participating in STEM activities in preschool education have improved or not. The graded scale is a guide used in evaluating students' responses and success levels according to specified criteria (Turgut & Baykul, 2019). These scales grade the situations between the lowest and highest levels of performance (Bıkmaz Bilgen, 2019). In this research, a graded scale was used to describe students' performances in a more detailed way. The main reason for this is the thought of determining whether the sub-skills of science process skills, which consist of sub-skills, are acquired or not by the students. The Science Process Skills Graded Scale contains five dimensions (observation, prediction, classification and ranking, measurement and inference), and has been graded in the form of a triple Likert. During the development process of DPA, 10 different expert opinions were received and the content validity index was examined. It was determined that the content validity ratio (CVR) values of the developed graded scale varied between 0.8 and 1.00, and the content validity index (CVI) value was 0.88. When CVR and CVI values were examined, it was observed that the content validity of the science process skills graded scale was ensured (Ayre & Scally, 2014). A total of 52 students applied STEM activities within the scope of the research, and the graded scale developed to evaluate the science process skills of the students during these activities was filled by three observers. Selection was made considering criteria such as high seniority and having a master's degree in their fields among the scorers. Pearson correlation analysis, Cronbach Alpha reliability coefficients and Kendall fit coefficients were examined in the analysis of the data obtained from three scorers (Kutlu, Doğan & Karakaya, 2023). As a result of the analyses, a moderate and high correlation coefficient was obtained. The Cronbach Alpha coefficient of the science process skills graded scale was found to be .77. This result showed that the reliability was high (Can, 2023). The Kendall fit coefficient was also looked at. As a result of the analysis, the result of the Kendall fit test ($w=.87$, $p<.05$) came out high. This result can be interpreted as high harmony between the evaluators (Can, 2023). There are 17 items in the Science Process Skills Graded Scale. An evaluator can give a maximum of 3 and a minimum of 1 point to each item. Accordingly, each student can get a maximum of 51 and a minimum of 17 points in total. The scores obtained; It has been interpreted as low between 17-28, medium between 29-40 and high between 41-51. The science process skills graded scale was scored by the teachers, considering the activities carried out by the students within the scope of the STEM activities and the students' explanations about the activities.

Photos

In this research, Photos have been used to reflect the products and processes made by the students in the actions performed based on STEM activities. Choen, Manion and Morrison (2017) have stated that Photos can be used to support different data collection tools. In this research, photos of the products made by the students were taken and it was attempted to reveal the development of science process skills.

Action Plan

The research was conducted in the 2022-2023 academic year and was carried out between March 6, 2023, and May 2, 2023. Necessary permissions were obtained from the Provincial Directorate of National Education and the school administration for the research to be carried out. STEM activities were applied one day a week, in 5 activity hours. Within the scope of the research, 8-week STEM activity plans containing different themes were prepared. These plans were shared with the teacher of the class to be applied, and their opinions were taken and finalized. For the plans to be suitable for the research, they were developed by taking the opinions of three teaching members working in preschool education a science education and two preschool teachers. Then, a one-week STEM activity plan was applied to three different classes, and a pilot application was made. After this pilot application, the detected deficiencies were corrected. Within the scope of the study, an 8-week action plan was prepared considering the Preschool Curriculum gains and indicators. The created action plan is presented in Table 2.

Table 2: Action Plan Applied in the Research

Week	Activity	Relation with Science	Relation with Technology	Relation with Engineering	Relation with Mathematics
March 6	Let's Make a Water Mill	Energy	Renewable Energy Technologies	Product Design	Sequencing

March 13	Building a Bridge	Weight-Balance	Technological Developments	Product Design	Calculation
March 20	My Rocket on the Space Road	Space	Technological Developments	Product Design	Length Measurement
March 27	Our Body	Systems	Technological Developments	Model Design	Measurement
April 3	Periscope Under the Sea	Light, Reflection	Underwater Technologies	Product Design	Measurement, Calculation
April 10	What's a Catapult?	Energy Transformation	Technological Developments	Product Design	Length Measurement
April 24	Insect Hotel	Life of Organisms	Technological Developments	Product Development	Mathematical Expressions
May 2	Crazy Robots	Robotics, Coding	Technological Developments	Product Development	Classification

In the context of the research, as stated in Table 2, on March 6, 2023, the "Let's Make a Watermill" activity, on March 13, 2023, the "We Are Building a Bridge" activity, on March 20, 2023, the "My Rocket on the Space Road" activity, on March 27, 2023, the "Our Body" activity, on April 3, 2023, the "Periscope Under the Sea" activity, on April 10, 2023, the "What's a Catapul?" activity t, on April 24, 2023, the "Insect Hotel" activity, and on May 2, 2023, the "Crazy Robots" activity were implemented. A total of 8 different STEM activities were implemented in the research and data was collected through these activities. The action plans implemented weekly are explained in detail below:

1. Week Watermill Let's Make STEM Activity Action: This activity aims to focus on the power of water in the field of science, focusing on objects, situations and events. In mathematics, it aims to develop the ability to compare objects and entities by focusing on measurement and sorting topics. The use of Web 2.0 tools is experienced in the field of technology. In the field of engineering, it aims to prototype, problem-solving and product development skills. An activity plan based on the 5E learning model has been prepared with a learning plan that includes these gains. These activities aim to develop science process skills, scientific process, collaboration and communication skills. During the activity, a storybook titled "What They Call Water" has been read and discussions have been made about the importance and use of water. Then, a water-carrying game was played and animations were watched to emphasize the subject after the game. After watching the animations and focusing on the subject, the children completed their worksheets. At the end of the activity, watermill designs were developed using cardboard cups, egg crates and skewers.

2. Week My Rocket on the Space Road STEM Activity Action: The activity application aimed to develop the ability to "observe objects and entities" in the field of science by focusing on space and planets. In the subject of mathematics, it addressed the skills of comparing the properties of objects, sorting and "comparing objects and entities". In the field of technology, a technology experience was provided using rocket brochures sent to space and the Web 2.0 tool. In the field of engineering, problem-solving, drawing and design creation skills have been acquired. An activity plan based on the 5E learning model has been prepared in line with these gains and aimed to develop leadership, collaboration, scientific process and science process skills. At the beginning of the activity, a book called "Astronaut" was read and games aimed at mathematical skills were played after the story. Later, detailed information about space and rockets was provided by watching animations and cartoons. Design drawings were made during the activity and rocket designs were developed. Balloons, toilet paper rolls, play dough and pet bottles were used in this process.

3. Week We Are Building a Bridge STEM Activity Action: The activity application aimed to target the skill of "implementing instructions related to location in space" by focusing on the subject of weight and balance in the field of science. In mathematics, it aimed to develop comparison and sorting skills by focusing on the ability to compare the properties of objects and entities. In the field of technology, a technological experience was provided using the MERGE Explorer application. In the field of engineering, it has aimed to develop the skills of students in these fields by addressing problem-solving, drawing, design creation and engineering concepts. At the beginning of the activity, finger games were played and a book called "We Need a Bridge" was read. After the story, a ball-knocking game was played aimed at mathematical skills. Later, a discussion was held with the students by showing pictures of bridges and their features. Different objects' weights were measured using a scale to make measurements and comparisons were made. The students were allowed to make a design drawing to develop bridge designs for the activity application. During this process, materials such as tongue sticks, scissors, tape, glue, play dough, pet bottles and white cardboard were used.

4. Week Our Body STEM Activity Action: The activity application aimed to develop the skill of "observing objects and entities" by focusing on our body and systems in the field of science. Mathematics aims to develop comparison and sorting skills by supporting the skill of grouping the properties of objects and entities. In technology, a technological experience was provided to students using the Wordwall web 2.0 tool. In the field of engineering, the skills of recognizing engineering concepts, drawing and creating designs have been acquired. The activity plan prepared in line with these gains aimed to develop collaboration, scientific process and science process skills. At the beginning of the activity, the "Skeleton Dance" was performed to attract the children's attention. Later, a storybook titled "Our Body" was read and games aimed at mathematical skills were played at the end of the story. After the game, the necessary materials to create the skeletal system were collected by going out to the garden and games were played with the skeleton model. Various cartoons about our body were watched and activity pages related to rhythmic numbers were completed. The students then proceeded to the product creation stage and developed skeleton designs using different sizes of pet bottles, toilet paper, glue and earsticks.

5. Week Under the Sea Periscope STEM Activity Action: This activity application aims to develop the skills of students to pay attention to objects, situations and events by dealing with the reflection of light in the field of science. It also includes classification and sorting gains to support the skill of sorting objects or entities according to their properties in the field of mathematics. In technology integration, a technological approach has been adopted to benefit from videos related to research and problem situations, and the Web 2.0 tool has been used. In the field of engineering, it aims to support the skills of recognizing engineering concepts, solving problems and creating designs. At the beginning of the activity, "How Deep Are the Seas" a storybook is read to attract the students' interest and then a submarine drama is performed. A question about the meaning of the word periscope is asked and the students' thoughts are transferred to paper. Then, a game involving shallow and deep concepts is played and educational videos are watched at the end of this game to provide the students with more information about the periscope. Periscope pictures are distributed to the students and they are made to do sorting work and they are allowed to design and transform the periscopes they imagine. At the end of the activity, evaluators allow students to evaluate themselves and their designs using scoring scales.

6. Week What's a Catapult STEM Activity Action: This activity application aims to develop the student's problem-solving skills by dealing with energy transformation in the field of science. It also includes counting objects in mathematics, aiming to support counting and sorting skills. Technology integration is aimed at doing research using technology and benefiting from videos related to problem situations. In the field of engineering, it aims to support problem-solving and design creation skills. At the beginning of the activity, children were asked to make predictions about what the word "catapult" could mean and draw these predictions. Then, an educational video giving information about the catapult was shown to the children. At the end of the video, a catapult-themed game was played with the children and they were given catapult puzzles to complete. After having enough information about the catapult, the students were asked to make their catapult designs and turn these designs into reality. After the products were created, the children were asked to make drawings containing their initial predictions about the word catapult and these drawings were compared with the designs made.

7. Week Insect Hotel STEM Activity Action: This activity application aims to develop the skills of students to observe objects or entities by dealing with creatures and habitats in the field of science. It also includes grouping gains according to the properties of objects or entities in the field of mathematics, aiming to support classification and measurement skills. In technology integration, it is envisaged to do research using technology, benefit from videos related to problem situations and use the web 2.0 tool called Jigsaw Planet. In the field of engineering, it aims to support problem-solving, prototype creation and design creation skills. In the first stage of the activity, the children are seated in a circle technique by reading the book "Benek's Light". After the story, the children were given an insect matching page and asked to match similar insects. Then, the children were asked to share their ideas about what a magnifying glass is and information was given about the purpose of the magnifying glass. A president was chosen from each group and these presidents were given a magnifying glass and the insects in the garden were examined. When they returned to the classroom, the children were given narrow and wide papers and asked to create grasses, and various insect pictures were given and the children were allowed to paste them between the grasses. At the end of the activity, the groups presented their work to other groups and talked about the insects they observed in the garden. After talking about the habitats, body parts and features of insects, the students were provided with preliminary information and educational videos were shown for detailed information. Then, the students were guided to design their insect hotels and these hotels were placed in the garden. It was examined how many insects came by going to the garden at certain periods and the results were entered into the tables.

8. Week Crazy Robots STEM Activity Action: This activity application aims to develop the skills of students to pay attention to objects, situations or events by dealing with the subject of robotics in the field of science. It also includes counting objects and recognising geometric shapes in mathematics, aiming to support counting and recognising geometric shapes. In technology integration, it is envisaged to research using technology and benefit from videos related to problem situations. In the field of engineering, it aims to support problem-solving, drawing and design creation skills. In the first stage of the activity, the children were asked to make predictions about what the word "robot" could mean and draw these predictions. Then, an educational video giving information about the catapult was shown to the children. After the video, a robot-themed game was played with the children and they were given robot puzzles to complete. After having enough information about robots, the students were guided to design their imagined robots and groups were distributed materials to make their robots. After the products were completed, drama, symmetry and sudoku studies were done for evaluation. These studies helped students develop their creativity, aesthetic understanding and collaboration skills.

Analysis of Data

Within the scope of the research, descriptive statistics were used in the analysis of the data using a graded scale. The data obtained from the graded scale were converted into numbers and played an important role in gaining an idea about whether the students' science process skills developed or not (Taşpınar, 2017). In this context, the arithmetic mean was used to describe the data collected in the research. The arithmetic mean is the most frequently used central tendency measure obtained by dividing all values by the number of participants (Kilmen, 2020). During the research implementation, two separate scorers evaluated the students' studies within the scope of STEM activities. They observed how the students utilized their science process skills in these activities.

Validity and Reliability in Research

In qualitative research, the approach to evaluating validity and reliability differs from that in quantitative research. Here, validity and reliability are based on the criteria of credibility, transferability, consistency, and confirmability (Lincoln & Guba, 1985). For this research, the researcher interacted with participants over 8 weeks to enhance credibility, consulting faculty members who are scale-use experts for necessary adjustments. To boost transferability, an appropriate method from purposeful sampling methods was selected (Sığrı, 2018). Consistency requires the absence of personal judgments in data evaluation and interpretation. Thus, in this research, two observers, excluding the researcher, scored the scales (Turan & Özer Özkan, 2019). Confirmability necessitates a detailed explanation of the researcher's role, data collection process, and data analysis stages (Sığrı, 2018). Therefore, this research clearly stated the researcher's position and thoroughly explained the data collection and analysis processes.

Role of the Researcher

In participatory action research, the researcher plays a critical role. Researchers are actively involved at every stage, from designing activities to implementing them and analyzing the results. Firstly, a research problem regarding the use of STEM activities in science education was identified and the research's purpose was determined. Researchers considered the students' age and developmental levels while developing activity plans, with each activity designed to enhance students' science process skills. STEM activities were carefully chosen to support the predetermined learning objectives and gains of the science curriculum. Researchers ensured the activities were carried out smoothly and provided guidance and training to the teachers who observed and scored on a graded scale. During data collection, the researcher evaluated students' performance in the activities and how their science process skills developed. This involved careful monitoring and recording of students' participation and interaction. Finally, researchers analyzed and interpreted the data. The findings illuminated how STEM activities affect students' science process skills. Throughout this process, researchers adhered to the rigorous standards of scientific methods and ethical principles, ensuring the research's reliability and validity.

Ethics Committee Decision

Ethics committee decision was obtained from Süleyman Demirel University Social and Human Sciences Ethics Committee for the conduct of the research (Date: 22/12/2022, Number: E-87432956-050.99-413434)

FINDINGS

In this section, we present findings from an eight-week STEM activity program aimed at improving students' science process skills. The collected data is evaluated and interpreted weekly.

First Week

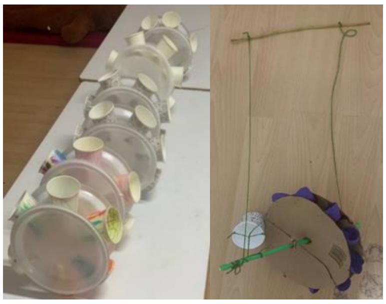
The raw scores and arithmetic mean that the students received from the graded scale related to their science process skills for the first week are presented in Table 3.

Table 3: Findings Related to the Raw Scores and Averages Given by the Evaluators for the First Week

Student	**1.Student**		**2.Student**		**3.Student**		**4.Student**		**5.Student**		**6.Student**		**7.Student**		**8.Student**	
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Total Score	24	25	20	19	21	21	22	23	17	18	17	17	26	24	25	23
Average Score	24,5		19,5		21		22,5		17,5		17		25		24	
Student	**9. Student**		**10. Student**		**11. Student**		**12. Student**		**13. Student**		**14. Student**		**15. Student**			
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**		
Total Score	17	18	18	18	20	21	28	26	25	26	22	24	20	19		
Average Score	17,5		18		20,5		27		25,5		23		19,5			
Overall Average	21,46															

When Table 3 is examined, the average score given by the evaluators for the first student is $\bar{X}$=24.5, the average score for the second student is $\bar{X}$=19.5, the average score for the third student is $\bar{X}$=21, the average score for the fourth student is $\bar{X}$=22.5, the average score for the fifth student is $\bar{X}$=17.5, the average score for the sixth student is $\bar{X}$=17, the average score for the seventh student is $\bar{X}$=25, the average score for the eighth student is

$\overline{X}$=24, the average score for the ninth student is $\overline{X}$=17.5, the average score for the tenth student is $\overline{X}$=18, the average score for the eleventh student is $\overline{X}$=20.5, the average score for the twelfth student is $\overline{X}$=27, the average score for the thirteenth student is $\overline{X}$=25.5, the average score for the fourteenth student is $\overline{X}$=23 and the average score for the fifteenth student is $\overline{X}$ =19.5. Also, it is observed that the overall average of all the studies done in the first week is $\overline{X}$=21.46. Based on these findings, it can be concluded that the student's level of science process skills is low. The work of some students is presented below.



Photos 2. Photos of the first week STEM activity implementation

Second Week

The raw scores and arithmetic means that the students received from the graded scale related to their science process skills for the second week are presented in Table 4.

Table 4: Findings Related to the Raw Scores and Averages Given by the Evaluators for the Second Week

Student	**1. Student**		**2. Student**		**3. Student**		**4. Student**		**5. Student**		**6. Student**		**7. Student**		**8. Student**	
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Total Score	26	26	21	20	23	25	25	24	18	20	20	18	27	26	25	26
Average Score	26		20,5		24		24,5		19		19		26,5		25,5	
Student	**9. Student**		**10. Student**		**11. Student**		**12. Student**		**13. Student**		**14. Student**		**15. Student**			
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**		
Total Score	20	19	21	20	24	23	28	28	28	29	25	25	22	23		
Average Score	19,5		20,5		23,5		28		28,5		25		22,5			
Overall Average	23,40															

When Table 4 is examined, it is seen that the average score given by the evaluators to the first student is $\overline{X}$=26, the average score for the second student is $\overline{X}$=20.5, the average score for the third student is $\overline{X}$=24, the average score for the fourth student is $\overline{X}$=24.5, the average score for the fifth student is $\overline{X}$=19, the average score for the sixth student is $\overline{X}$=19, the average score for the seventh student is $\overline{X}$=26.5, the average score for the eighth student is $\overline{X}$=25.5, the average score for the ninth student is $\overline{X}$=19.5, the average score for the tenth student is $\overline{X}$=20.5, the average score for the eleventh student is $\overline{X}$=23.5, the average score for the twelfth student is $\overline{X}$=28, the average score for the thirteenth student is $\bar{X}$=28.5, the average score for the fourteenth student is $\bar{X}$=25, and the average score for the fifteenth student is $\bar{X}$=22.5. Moreover, it is observed that the overall average of all work done in the second week is $\bar{X}$=23.40. Based on these findings, it can be concluded that the student's level of science process skills is low. Some of the student's work is presented below.

Photos 3. Photos of the second week of STEM activity implementation

Third Week

The raw scores and arithmetic means that the students received from the graded scale related to the science process skills for the third week are presented in Table 5.

Table 5: Findings Related to the Raw Scores and Averages Given by the Evaluators for the Third Week

Student	**1. Student**		**2. Student**		**3. Student**		**4. Student**		**5. Student**		**6. Student**		**7. Student**		**8. Student**	
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Total Score	28	26	21	23	24	25	25	25	21	22	22	22	29	28	28	29
Average Score	27		22		24,5		25		21,5		22		28,5		28,5	
Student	**9. Student**		**10. Student**		**11. Student**		**12. Student**		**13. Student**		**14. Student**		**15. Student**			
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**		
Total Score	22	23	24	23	26	25	33	32	32	30	28	28	25	24		
Average Score	22,5		23,5		25,5		32,5		31		28		24,5			
Overall Average	25,83															

When Table 5 is examined, according to the scores given by the evaluators, the average score $\bar{X}$=27 for the first student's work, the average score $\bar{X}$=22 for the second student's work, the average score $\bar{X}$=24.5 for the third student's work, the average score $\bar{X}$=25 for the fourth student's work, the average score $\bar{X}$=21.5 for the fifth student's work, the average score $\bar{X}$=22 for the sixth student's work, the average score $\bar{X}$=28.5 for the seventh student's work, the average score $\bar{X}$=28.5 for the eighth student's work, the average score $\bar{X}$=22.5 for the ninth student's work, the average score $\bar{X}$=23.5 for the tenth student's work, the average score $\bar{X}$=25.5 for the eleventh student's work, the average score $\bar{X}$=32.5 for the twelfth student's work, the average score $\bar{X}$=31 for the thirteenth student's work, the average score $\bar{X}$=28 for the fourteenth student's work, and the average score $\bar{X}$ =24.5 for the fifteenth student's work were determined. In addition, the overall average of all the works done in the third week was calculated as $\overline{X}$=25.83. Based on these findings, it can be concluded that the level of science process skills of the students is low. Below are the works of some students:

Photos 4. Photos of the third week STEM activity implementation

Fourth Week

The raw scores and arithmetic mean that the students obtained from the graded scale related to the science process skills for the fourth week are presented in Table 6.

Table 6: Findings Related to the Raw Scores and Averages Given by the Evaluators for the Fourth Week

Student	**1. Student**		**2. Student**		**3. Student**		**4. Student**		**5. Student**		**6. Student**		**7. Student**		**8. Student**	
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Total Score	29	30	23	24	26	27	27	27	23	23	25	23	31	32	30	32
Average Score	29,5		23,5		26,5		27		23		24		31,5		31	
Student	**9. Student**		**10. Student**		**11. Student**		**12. Student**		**13. Student**		**14. Student**		**15. Student**			
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**		
Total Score	25	26	27	25	29	27	32	34	34	33	27	31	28	26		
Average Score	25,5		26		28		33		33,5		29		27			
Overall Average	27,86															

When Table 6 is examined, according to the scores given by the evaluators, the average score for the first student's work is $\overline{X}$=29.5, for the second student's work the average score is $\overline{X}$=23.5, for the third student's work the average score is $\overline{X}$=26.5, for the fourth student's work the average score is $\overline{X}$=27, for the fifth student's work the average score is $\overline{X}$=23, for the sixth student's work the average score is $\overline{X}$=24, for the seventh student's work the average score is $\overline{X}$=31.5, for the eighth student's work the average score is $\overline{X}$=31, for the ninth student's work the average score is $\overline{X}$=25.5, for the tenth student's work the average score is $\overline{X}$=26, for the eleventh student's work the average score is $\overline{X}$=28, for the twelfth student's work the average score is $\overline{X}$=33, for the thirteenth student's work the average score is $\overline{X}$=33.5, for the fourteenth student's work the average score is $\overline{X}$=29, and for the fifteenth student's work the average score is $\overline{X}$=27. In addition, the general average of all the studies conducted in the fourth week was calculated as $\bar{X}$=27.86. Based on these findings, it can be concluded that the students' scientific process skill level is low. Below, the works of some students are presented:

Photos 5. Photos of the fourth week of STEM activity implementation

Fifth Week

The raw scores and arithmetic means obtained from the graded scale towards the science process skills of the students related to the fifth week are presented in Table 7.

Table 7: Findings Related to the Raw Scores and Averages Given by the Evaluators for the Fifth Week

Student	1. Student		2. Student		3. Student		4. Student		5. Student		6. Student		7. Student		8. Student	
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Total Score	33	31	27	26	28	29	30	28	25	26	28	25	33	36	31	34
Average Score	32		26,5		28,5		29		25,5		26,5		34,5		32,5	
Student	**9. Student**		**10. Student**		**11. Student**		**12. Student**		**13. Student**		**14. Student**		**15. Student**			
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**		
Total Score	28	27	29	26	31	30	36	35	34	36	29	34	29	29		
Average Score	27,5		27,5		30,5		35,5		35		31,5		29			
Overall Average	30,1															

When Table 7 is examined, according to the scores given by the evaluators, the average score for the first student's work is $\bar{X}$=32, the average score for the second student's work is $\bar{X}$=26.5, the average score for the third student's work is $\bar{X}$=28.5, the average score for the fourth student's work is $\bar{X}$=29, the average score for the fifth student's work is $\bar{X}$=25.5, the average score for the sixth student's work is $\bar{X}$=26.5, the average score for the seventh student's work is $\bar{X}$=34.5, the average score for the eighth student's work is $\bar{X}$=32.5, the average score for the ninth student's work is $\bar{X}$=27.5, the average score for the tenth student's work is $\bar{X}$=27.5, the average score for the eleventh student's work is $\bar{X}$=30.5, the average score for the twelfth student's work is $\bar{X}$=35.5, the average score for the thirteenth student's work is $\bar{X}$=35, the average score for the fourteenth student's work is $\bar{X}$=31.5 and the average score for the fifteenth student's work is $\bar{X}$=29. In addition, the overall average of all the work done in the fifth week has been calculated as $\bar{X}$=30.1. Based on these findings, it can be concluded that the student's level of science process skills is moderate. Below are some of the students' works:

Photos 6. Photos of the fifth-week STEM activity application

Sixth Week

The raw scores and arithmetic averages obtained from the graded scale related to the science process skills of the students for the sixth week are presented in Table 8.

Table 3: Findings Related to the Raw Scores and Averages Given by the Evaluators for the Sixth Week

Student	1. Student		2. Student		3. Student		4. Student		5. Student		6. Student		7. Student		8. Student	
Evaluator	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Total Score	35	34	29	30	32	31	33	32	29	33	31	32	35	38	34	36
Average Score	34,5		29,5		31,5		32,5		31		31,5		36,5		35	
Student	9. Student		10. Student		11. Student		12. Student		13. Student		14. Student		15. Student			
Evaluator	1	2	1	2	1	2	1	2	1	2	1	2	1	2		
Total Score	30	31	33	29	35	35	38	39	38	40	34	38	33	31		
Average Score	30,5		31		35		38,5		39		36		32			
Overall Average	33,6															

When Table 8 is examined, according to the scores given by the evaluators, the average score for the first student's work is $\bar{X}$= 34.5, the average score for the second student's work is $\bar{X}$=29.5, the average score for the third student's work is $\bar{X}$=31.5, the average score for the fourth student's work is $\bar{X}$=32.5, the average score for the fifth student's work is $\bar{X}$=31, the average score for the sixth student's work is $\bar{X}$=31.5, the average score for the seventh student's work is $\bar{X}$=36.5, the average score for the eighth student's work is $\bar{X}$=35, the average score for the ninth student's work is $\bar{X}$=30.5, the average score for the tenth student's work is $\bar{X}$=31, the average score for the eleventh student's work is $\bar{X}$=35, the average score for the twelfth student's work is $\bar{X}$=38.5, the average score for the thirteenth student's work is $\bar{X}$=39, the average score for the fourteenth student's work is $\bar{X}$=36 and the average score for the fifteenth student's work is ¯X=32. In addition, the overall average of all work done in the sixth week was calculated as $\overline{X}$=33.6. Based on these findings, it can be concluded that the level of science process skills of the students is medium. Below, some students' works are presented:

Photos 7. Photos of the STEM activity implementation in the sixth week

Seventh Week

The raw scores and arithmetic means obtained from the graded scale for the students' science process skills related to the seventh week are presented in Table 9.

Table 9: Findings Related to the Raw Scores and Averages Given by the Evaluators for the Seventh Week

Student	**1. Student**		**2. Student**		**3. Student**		**4. Student**		**5. Student**		**6. Student**		**7. Student**		**8. Student**	
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Total Score	38	40	33	35	35	37	35	35	32	36	33	34	39	40	36	39
Average Score	39		34		36		35		34		33,5		39,5		37,5	
Student	**9. Student**		**10. Student**		**11. Student**		**12. Student**		**13. Student**		**14. Student**		**15. Student**			
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**		
Total Score	35	39	35	36	40	38	42	41	42	40	36	39	38	37		
Average Score	37,5		35,5		39		41,5		41		37,5		37,5			
Overall Average	37,03															

When Table 9 is examined, according to the scores given by the evaluators, the average score for the first student's work is $\overline{X}$=39, the average score for the second student's work is $\overline{X}$=34, the average score for the third student's work is $\overline{X}$=36, the average score for the fourth student's work is $\overline{X}$=35, the average score for the fifth student's work is $\overline{X}$=34, the average score for the sixth student's work is $\overline{X}$=33.5, the average score for the seventh student's work is $\overline{X}$=39.5, the average score for the eighth student's work is $\overline{X}$=37.5, the average score for the ninth student's work is $\overline{X}$=37.5, the average score for the tenth student's work is $\overline{X}$=35.5, the average score for the eleventh student's work is $\overline{X}$=39, the average score for the twelfth student's work is $\overline{X}$=41.5, the average score for the thirteenth student's work is $\overline{X}$=41, the average score for the fourteenth student's work is $\overline{X}$=37.5, and the average score for the fifteenth student's work is $\overline{X}$=37.5. Additionally, the overall average of all the work done in the seventh week has been calculated as $\overline{X}$=37.03. Based on these findings, it can be concluded that the students' scientific process skill level is average. Below, some students' works are presented:

Photos 8. Photos of the seventh-week STEM activity implementation

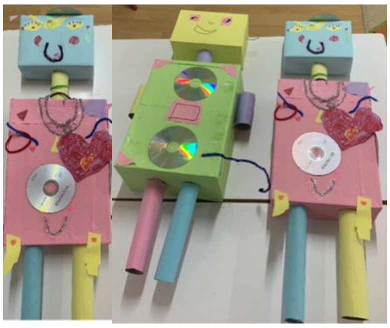
Eighth Week

The raw scores and arithmetic averages obtained from the graded scale related to the science process skills of the students for the eighth week are presented in Table 10.

Table 10: Findings Related to the Raw Scores and Averages Given by the Evaluators for the Eighth Week

Student	1. Student		2. Student		3. Student		4. Student		5. Student		6. Student		7. Student		8. Student	
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
Total Score	44	42	38	41	38	39	36	38	40	42	38	40	50	48	40	45
Average Score	43		39,5		38,5		37		41		39		49		42,5	
Student	**9. Student**		**10. Student**		**11. Student**		**12. Student**		**13. Student**		**14. Student**		**15. Student**			
Evaluator	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**		
Total Score	39	44	40	42	44	43	51	51	51	50	40	44	44	46		
Average Score	41,5		41		43,5		51		50,5		42		45			
Overall Average	42,9															

When Table 10 is examined, according to the scores given by the evaluators, the average score for the first student's work is $\bar{X}$=43, the average score for the second student's work is $\bar{X}$=39.5, the average score for the third student's work is $\bar{X}$=38.5, the average score for the fourth student's work is $\bar{X}$=37, the average score for the fifth student's work is $\bar{X}$=41, the average score for the sixth student's work is $\bar{X}$=39, the average score for the seventh student's work is $\bar{X}$=49, the average score for the eighth student's work is $\bar{X}$=42.5, the average score for the ninth student's work is $\bar{X}$=41.5, the average score for the tenth student's work is $\bar{X}$=41, the average score for the eleventh student's work is $\bar{X}$=43.5, the average score for the twelfth student's work is ¯X=51, the average score for the thirteenth student's work is $\bar{X}$=50.5, the average score for the fourteenth student's work is $\bar{X}$=42 and the average score for the fifteenth student's work is $\bar{X}$=37.5. In addition, the overall average of all work done in the eighth week has been calculated as $\bar{X}$=42.9. Based on this result, it can be said that the students' science process skills are high. Some students' works are presented below.



Photos 9. Photos of the eighth-week STEM activity implementation

General Evaluation of All Weeks

According to the scores given by the evaluators, the general average of the studies in the first week is $\overline{X}$=21.46, the general average of the studies in the second week is $\overline{X}$=23.40, the general average of the studies in the third week is $\overline{X}$=25.83, the general average of the studies in the fourth week is $\overline{X}$=27.86, the general average of the studies in the fifth week is $\overline{X}$=30.01, the general average of the studies in the sixth week is $\overline{X}$=33.06, the general average of the studies in the seventh week is $\overline{X}$=37.03 and the general average of the studies in the eighth week is $\overline{X}$=42.09. According to these results, the general average of science process skills is increasing regularly every week.

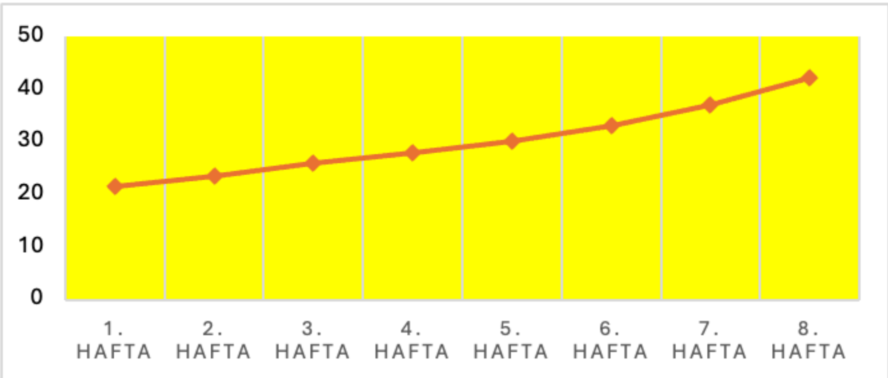


Figure 1. Line graph of the average of all weeks

As seen in Figure 1, it is observed that the students' science process skills have improved as a result of the actions applied within the scope of the research.

CONCLUSION and DISCUSSION

According to the research results, the impact of STEM activities on children's science process skills has been examined. This study delves into developing and enhancing science process skills, namely observation, sequencing, classification, measurement, inference, and prediction. These skills are fundamentally developed during early childhood. A key focal point of this research is the impact and influence of these skills on the development of a child's observational abilities. Active participation in the science process and using concrete materials for observation play a pivotal role in the growth and development of science process skills. This is backed by the work of esteemed researchers in the field, such as Chittleborough et al. (2005), and Ekasari and Maulidinah (2023). Their studies help emphasize the importance of practical, hands-on learning in science education, especially in early childhood. Observation, as a science skill, is not just important but also fundamental to the science process. It holds a position of critical importance as it enables students to not only understand but also explore various science topics. This view is further endorsed by İşıker and Emre (2020), and Sejati, Saputro and Indriyanti (2020), who highlighted the crucial role of observation in the science process. The development and refinement of this observational skill through STEM (Science, Technology, Engineering, and Mathematics) activities prove to be an effective method. It enables students to scrutinize their environment more closely, collect invaluable data, and draw logical inferences from this data. This hands-on approach to learning helps in the overall development of a student's science temperament. There are several educational benefits associated with the development of observational skills through STEM activities. One of the foremost benefits is the kindling of science curiosity and the fostering of inquiry abilities among students. As students become more adept at observing their environment, they start to understand the world around them more deeply. This, in turn, fuels their curiosity and encourages them to ask questions and investigate, as noted by Jirout and Zimmerman (2015). In addition, the development of observational skills also has the potential to strengthen students' analytical thinking and problem-solving abilities. As students learn to analyze the data obtained during the observation process and draw conclusions from this data, they start thinking scientifically. This process of analysis and conclusion not only strengthens their scientific thinking processes but also enhances their critical thinking skills. Finally, the development of students' observational skills through STEM activities could serve as a compass, guiding them towards their career and interest areas in the science field. As students start understanding and exploring science processes more comprehensively, they might unearth latent interests and abilities that propel them towards careers in science and engineering fields. This alignment of interests and careers can have long-lasting effects on their professional journey and personal fulfilment.

According to the research results, it has been observed that the prediction sub-dimension of children's science process skills has improved with STEM activities. In their study, Alabay and Özdoğan (2018) concluded that children's science process skills can be improved through various applications and contemporary method techniques. Similarly, Hanauer (2018) suggests that skills such as creating graphics and drawing prototypes within STEM applications can enhance students' prediction abilities, enabling them to establish simple cause-and-effect relationships. These results show similarity with the findings of the study we conducted. Predictive skill refers to the ability of students to establish hypotheses in the science process and predict the results in advance (Jirout & Zimmerman, 2015). The development of this skill through STEM activities can enable students to better understand science topics and gain experience. Students actively participate in the processes of conducting experiments and collecting data thanks to STEM activities. These processes offer students the opportunity to test their hypotheses and predict the results. Students, by conducting experiments based on real-world examples, enable them to better understand science topics. Based on these results, it can be said that STEM activities improve children's prediction skills. It can be stated that the curiosity of children, who develop prediction skills, towards the situations occurring in their environment will increase and they will be able to analyze these situations better. In addition, it can be said that the development of prediction skills will support the development of analysis and reasoning skills in children by establishing a relationship between the data. The implementation of engineering-based STEM activity plans during the application process, the preliminary drawing of how the designs will be, and the comparison after the products are produced may have contributed to the development of this skill. It is also thought that comparison and prediction skills have improved through games played with Web 2.0 tools used in STEM activities. Indeed, some applications support students in making predictions and comparisons within these activities. In this regard, it can be stated that the Web 2.0 tools used within STEM activities positively affect the development of these skills.

According to the research results, it was observed that the classification and ordering sub-dimension skills of children's science process skills developed with STEM activities. These results show that STEM activities support children's science thinking skills and help them understand science topics better. Classification and sequencing skills express children's abilities to organize, classify, and relate concepts in science (Dökme et al., 2021). STEM activities offer children the opportunity to conduct experiments, collect data, and analyze. These processes enable children to organize and categorize their knowledge of science topics. For example, analyzing the data obtained as a result of an experiment and classifying the results develop children's classification and sequencing skills. In this respect, it can be stated that the math activities included in the implemented STEM activities improve students' sequencing and classification skills. It is thought that the development of children's classification and sorting skills will support them to analyze the similar and different aspects of the events they encounter in their social environment and professional lives in the future. In addition, it can be stated that the development of classification and sorting skills will contribute to the formation of mathematical competence in children.

According to the research results, it has been observed that the measurement skill, which is one of the science process skills of children, has also developed with STEM activities. Ünal (2019), in his study, concluded that the measurement dimension of science process skills was developed with activity-based STEM education applied to children. Aykut (2006), found that preschool teachers gave less place to the measurement sub-dimension among science process skills than other dimensions. Çilengir Gültekin (2019), in his study, stated that children were successful in calculations on length, surface, area, and volume with STEM studies. STEM activities offer children the opportunity to actively participate in measurement and evaluation processes. For example, when conducting experiments and collecting data, children have to make measurements. These processes enable children to learn to use correct measurement techniques and analyze data. Measurement skill expresses children's ability to understand quantities, dimensions, and relationships in science topics (Dökme, 2021). STEM activities assist children in developing this skill. By learning skills such as using measurement tools, collecting data, converting data to graphs, and interpreting results, children better understand science topics. It can be said that the math-centred STEM activities implemented within the scope of the research also contributed to the development of this skill. Calculations, creating graphs, patterns, symmetry, measurements, etc., were included in the implemented plans. Based on these activities, it is thought that students' measurement skills have improved. Based on this result, it can be said that the implemented activities are effective on students' measurement skills. The basis of reasoning and research inquiry skills, which are emphasized in 21st-century skills, is the measurement skill. It is thought that reasoning and inquiry skills will develop thanks to this skill supported by STEM activities in children. Also, the measurement skill is one of the skills we use in all of our lives. It can also be stated that awareness has been raised in children about this skill thanks to these activities.

According to research results, it has been observed that the inference skills of children's science process skills have improved through STEM activities. The term 'inferencing skills' delineates the capacity of children to deduce logical conclusions grounded on the data they have amassed (Dökme, 2021). STEM activities furnish children with the avenue to partake in the processes of data collection, analysis, and conclusion formulation. These processes serve to cultivate children's acumen in data appraisal, correlation establishment, and inference derivation premised on resultant data. STEM activities imbue children with the capacity to approach predicaments analytically and amalgamate diverse datasets. For instance, by scrutinizing the data gleaned from an experimental endeavour and contextualizing it within the realm of science subjects, children are adept at reaching reasoned conclusions. Concomitantly, Abanoz (2020) discerned, through his doctoral inquiry, a pronounced influence of the STEM activities he administered on children, notably augmenting their prowess in inferential reasoning. It has been found that the brain-based learning science program implemented by Özkan (2015) significantly and positively affected children's inferencing skills. Based on these results, it can be stated that student-centred activities affect students' inference skills. These research results support this research result conducted in a student-centred manner. It can be stated that if inference skills are developed, children's abilities to establish cause-and-effect relationships, analyze, understand and interpret can also be supported. At the same time, with the development of this skill, children can produce deeper solutions by thinking like scientists in the face of the problems they encounter.

When the general result of the research is examined, it has been observed that children's science process skills have improved with STEM activities. In the experimental study conducted by Abanoz (2020), a significant difference was found between the pre-test and post-test scores among children who applied STEM activities, and it was determined that children's science process skills improved. Kavak (2020) stated in his doctoral study that STEM activities contributed positively to all sub-dimensions of children's science process skills. Öcal (2018) implemented a 10-week STEM program in his study and concluded that this program positively affected students' science process skills. Kunt, Kunt and Özel (2015) found in their study that students' classification, observation and space skills were positively affected; It has been stated that prediction, conclusion drawing, and measuring skills have increased, but still, they have not shown sufficient development compared to classification and observation skills. This research result does not exactly match the result of this research. The reason for this can be shown that this research was conducted in a different country and within the framework of different STEM activities. Ayvacı (2010) examined children's proficiency in using science process skills with STEM activities in his study, and as a result of the tests and observations, it was concluded that children's proficiency in using science process skills was good. Özgök (2019) stated in his research that preschool children contributed to learning problem-solving steps and the development of science process skills with planned STEM activities.

According to the results of the research, children gain basic science process skills at an early age through STEM activities. The development of skills such as observation, prediction, classification, measurement, and inference can contribute to the acquisition of metacognitive-level skills in the future. In addition, it has been observed that children's awareness of these skills has increased and their ability to transfer and use them in daily life has improved. It can be said that children have also gained skills such as noticing information, sharing, and collaboration thanks to STEM activities. In this respect, it can be stated that STEM activities develop children's daily life skills. Also, since STEM activities include mathematics and science disciplines, it is thought that children will develop a positive attitude towards these fields at an early age. The fact that children look forward to STEM activities during the research process and ask questions about the activities may influence their future career choices and increase their interest in engineering skills. Despite the difficulties of children at the beginning of STEM activities, it has been observed that they presented creative designs as the process progressed and completed the activities without assistance. Therefore, it can be stated that the activities developed not only children's science process skills but also indirectly their critical thinking and creative thinking skills.

Research indicates that STEM activities in early childhood science education enhance students' science process skills. According to the findings, these activities improve students' observation skills by teaching them to collect data through careful observation of their surroundings. Furthermore, STEM activities support the development of prediction skills. Students learn to anticipate outcomes through experiments and applications, leading to improved prediction skills. These activities also boost students' classification and ordering skills. By identifying and classifying objects with different properties, students improve their grouping skills. Lastly, STEM activities encourage the development of measurement and inference skills. In essence, incorporating STEM activities in preschool contributes to the development of vital science process skills. These activities reinforce basic skills such as observation, prediction, classification, ordering, measurement, and inference, making students more competent in the field of science. The findings highlight the importance of STEM-focused approaches in early childhood curricula. They suggest that STEM education should be prioritized in preschool education to cultivate individuals with 21st-century skills, thereby contributing to the scientific and economic development of countries.

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CONTRIBUTION RATE	CONTRIBUTORS
Idea or Notion	Vesile UYULAN – Serkan ASLAN
Literature Review	Vesile UYULAN – Serkan ASLAN
Method	Vesile UYULAN – Serkan ASLAN
Data Collecting	Vesile UYULAN – Serkan ASLAN
Data Analysis	Vesile UYULAN – Serkan ASLAN
Findings	Vesile UYULAN – Serkan ASLAN
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