

Paper Airplane Toys: Interpreting Children's Thinking

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ABSTRACT

The article aimed to analyze the students' critical thinking and problem-solving skills in making paper airplane toys. It is phenomenology research that was conducted on elementary school students with a total of 15 students. The data collection techniques used documentation and interviews. Because of the form of the data obtained descriptive, the analysis was carried out qualitatively, namely by coding with the flow of data reduction, data presentation, and conclusion. The results showed that the students apply critical thinking and problem-solving concepts in making paper airplane toys. Several other factors were students planning and designing carefully, measuring in detail with mathematical concepts and estimating what allows paper airplanes to fly for a long time or even for a short time. This research contributed to creating learning that develops critical thinking skills and problem-solving through simple things close to children's lives (contextual).

Keywords: *STEM, Critical Thinking, Paper Airplane Toys*

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INTRODUCTION

Education must seek to develop children's thinking skills which must be integrated into the context of everyday life. Children must be accustomed to experience thinking without losing their nature to play. So what must be done is how to build a means of developing children's thinking through various activities that are close to children and have become a routine for them, and it must start from the simple. Children aged 5-12 years internalize many experiences through their social-emotional relationships with other individuals (Ogelman, Göktas, & Aytac, 2020), meaning that they do many things in the environment where they play with their friends. In addition, the experience of playing must also be internalized in the context of learning, because children prefer to learn while playing. Games and fun are positive educational elements that make learning and teaching activities more meaningful (Juhász, 2021). In games, they feel joy because of a physiological and natural tendency to try new things, explore, solve problems and have fun (Burdette & Whitaker, 2005). In addition, learning through games is highly recommended, and this will greatly function as a

stimulus for creating practice and a fun classroom atmosphere (Clark, 2019., & Sezgin, 2016).

Learning tools and thinking exercises are not only limited to memorizing concepts, but involve much higher thinking skills (Yaniawati, 2013). This ability can be done from simple things close to a child's life. The playing context must be adjusted to the background and condition of the child because this will provide many benefits to their development (Konuk & İlik, 2022). This thinking ability must be a part of what is done by children. Thinking will be able to form intuitive schemes that are useful for interpreting physical phenomena and emphasizes that physical intuition can help students think about heuristic ideas in terms of conceptual understanding (Clement, 2008). Intuition is defined as a process of discovery, characterizing intuitive thinking in the context of problem-solving by children (Park & Song, 2017). Teachers and parents must work together to develop children's thinking skills. In the context of school, the teacher plays a very important role, and when at home, parents can take over this responsibility.

In the context of the 21st century, 2 of the 4 skills that students must have are how to master thinking skills, where 2 are critical thinking, *problem-solving* and *creativity* (Ağaoğlu & Demir, 2020., & Turhan & Demirici, 2021). The skills suggested in the 21st century aim to develop children's cognitive abilities, so they can understand various things in solving simple problems (Amalia & Khoiriyati, 2018). Critical thinking is often described as a metacognitive process consisting of several high-level sub-skills of analysis, evaluation, and inference (Kennedy & Gruber, 2020). Critical thinking aims to make arguments, interpret things, or solve problems (Facione, 2011). It will produce logical conclusions to get the right solution to the problem at hand (Dwyer, Hogan, & Stewart, 2014). It can be said that critical thinking is closely related to the way of thinking for decision-making by accommodating and considering various existing options to find appropriate and soulful new ideas. According to Fahmi et al (2019) that a professional critical thinker will ask important and critical questions to explore possible solutions, gather concrete and abstract ideas from different sources, draw conclusions about reasonable and logical relationships between different opinions, and solve problems through systematic information gathering, all of these sets are skills in critical thinking. Davies (2014) has described the relationship between critical thinking skills and thinking levels, the description is explained in Table 1.

Table 1. Critical Thinking Skills

Lower-level thinking skills	Higher-level thinking skills	Complex thinking skills	thinking about thinking
Interpreting	Analyzing claims	Evaluating arguments	Metacognition
Identifying assumptions	Synthesizing claims	Reasoning verbally	Self-regulation
Asking questions for clarification	Predicting	Inference making Problem-solving	

When discussing the value of critical thinking, it will always be related to the focus of the thinking itself. In terms used by Dewey, the more problematic the problem, the more valuable critical thinking is in finding appropriate and effective solutions (Higgins, 2014). According to Pithers & Soden (2000), developing critical thinking skills in education has become very important as a means of adapting and

recognizing various changes (technology and information). Given the importance of critical thinking skills, this should become a habit because it is closely related to children's social experiences (Heyman, 2008), but this is also a major problem in education because of the lack of critical thinking skills (Purwanto et al, 2022) caused by seldom apply these skills. If students are given the context of questions that focus on critical thinking skills, the results show that students are at the novice thinking level (Everett, Anderson, Wright, & Fontana, 2018). According to Shukri & Mukundan (2015), critical thinking skills will help in various ways, including being more interactive, focusing on learning about certain parts, raising students' awareness to read a lot and reviewing various literature, and emphasizing aspects of students' critical thinking.

Critical thinking can be applied to various conditions and knowledge, so it involves students in the knowledge-construction process through reflection and thinking deeply about existing phenomena (Saleh, 2019). Implementing critical thinking will positively impact cognitive and mental, moral, social, and scientific knowledge (Darby & Rashid, 2017), so anyone must develop critical thinking skills. Fionce (2011) describes several indicators of critical thinking, including interpretation, analysis, evaluation, inference, explanation, and self-regulation. These indicators form the basis for measuring a person's level of critical thinking

Problem-solving skills are considered one of the most important thinking skills and must be possessed in 21st-century education (Demir, 2021), these skills are needed to solve all problems that arise (Riyadi, Syarifah, & Nikmaturrohman, 2021). Problem-solving skills are defined as cognitive organizing and effective behavioural processes towards certain goals, closely related to creativity (Ince, 2018). In cognitive theory, problem-solving is considered a very complex mental activity (Rahman, 2019), and the thinking stage is included in the highest stage (Mahanal et al, 2022) because these skills have very complex processes such as reading, processing, and solving mathematical problems (Demitra & Sarjoko, 2018). What must be emphasized in the context of problem-solving is the discovery process, not the emphasis on the final result of the answer (Saragih & Napitupulu, 2015). Problem-solving has many positive impacts on cognitive and affective aspects (Ozturk, Akkan, & Kaplan, 2020).

What must be considered in developing problem-solving skills is how to stimulate students by presenting appropriate problem contexts. The point is that the problems given must match real-life scenarios (Afacan & Kaya, 2022) so that it will provide opportunities for students to become problem solvers for themselves (Yu, Fan, & Lin, 2015). According to Heller & Heller (2010) that the steps that students must take in solving problems, namely 1) visualize the problem, 2) describe the problem, 3) plan solutions, 4) implement plans, and 5) examine and evaluate, steps Polya has also conveyed the steps above as an indicator of problem-solving skills. In addition, the problem-solving process is to understand the information provided, identify the important features and what are the relationships in a situation, build or apply one or more external representations, resolve the following questions and, finally, evaluate, justify and communicate the results as a means to understand better the situation (Novita, Zulkardi, & Hartono, 2012).

According to Alexander & Wine (2006), problem-solving has four main characteristics including 1) problem-solving is cognitive, which means that it occurs internally in the problem solver's cognitive system, and can only be inferred indirectly from the problem solver's behaviour, 2) problem solving is a process, which involves the representation and manipulation of knowledge in the problem solver's cognitive

system. 3) problem-solving is directed, namely, the problem solver's cognitive processes are guided by the problem solver's goals, and 4) problem-solving is personal, namely the individual knowledge and skills of the problem solver help determine the difficulties or conveniences that can overcome solution obstacles.

An approach that can be applied in an education and learning is science, technology, engineering and mathematics (STEM). STEM has developed and been promoted as an educational reform project on a national scale in various countries (Yata, Ohtani, & Isobe, 2020). The emergence of STEM has changed the perspective and paradigm of education (Razi & Zhou, 2022). STEM is an acronym created by the *National Science Foundation* in 1990 (Wilson et al, 2022) which includes and integrates four disciplines, namely *science, technology, engineering, and mathematics* (Watson, et al, 2020., & Bybee, 2013). STEM is a pedagogical methodology in which students learn the relationship between science and mathematics knowledge through certain technological engineering (Cinar, Pirasa, & Altun, 2022).

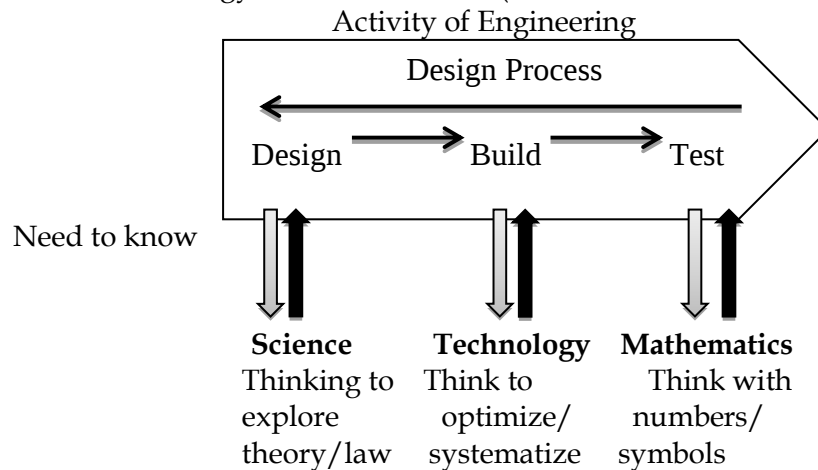
STEM is motivated by the rapid progress of innovation and technology that encourages 21st-century skills (Roehrig, Dare, Ring-Whalen, & Wieselmann, 2021) and mastery of components in STEM (Granovskiy, 2018) coupled with very complex problems in real life that demand solutions through the relationship of science, technology, engineering, and mathematics (Hall, 2021., & Kartal & Tasdemir, 2021). According to America After 3PM (2021), STEM impacts future job prospects, even people who work in STEM are paid twice as much as non-STEM. In America, the demand to master STEM is logical because it is a top priority that has an impact on economic growth for both its citizens and the State (Waters & Orange, 2022), and schools have been established that focus on STEM development (Wieselmann, Roehrig, Ring-Whalen, & Meagher, 2021). STEM is considered learning that positively impacts everyone's life (Hill-Cunningham, Mott, & Hunt, 2018), especially in children's learning (Salvatierra & Cabello, 2012). All learning conditions in the 21st century require STEM, especially basic skills that help students' academic development (Wang, Moore, Roehrig, & Park, 2011). According to Bybee (2010), STEM is needed to develop problem-solving skills and foster literacy in each STEM subject.

STEM involves various formal and informal aspects, it can be understood that education must cover the whole society (Chrispeels, 1996) so that it can be implemented in any condition. According to The National Research Council (2012), STEM includes the relationship of various disciplines (scientific investigation, computational thinking, data processing or mathematical modelling, and engineering design processes). STEM is considered a very important scientific discipline in the process of scientific inquiry (So, Zhan, Chow, & Leung, 2017). According to The West Virginia Department of Education (2021) that in implementing STEM, several things must be considered, including 1) increasing the capacity of educators to understand STEM, 2) student involvement, 3) preparation, and 4) achieving competence in STEM.

In STEM approach, the engineering used is the design process (EDP). According to Hafiz & Ayop (2019), EDP is one of the available strategies for implementing STEM education. EDP has developed as a highly systematic and iterative problem-solving strategy used by engineers to identify and solve various problems encountered (Pleasants & Olson, 2019). According to Lucat et al (2014), EDP is iterative because engineers build various design prototypes, test them and optimize their solutions, analyze and interpret data, learn from failures, and make decisions based on evidence to improve solution quality and get the best results. According to English & King (2015) that the steps taken in EDP can significantly improve students' ability to apply

science and mathematics concepts so that they can solve problems in the real world. The Scheme of the Design Process and its relationship with science, technology, and mathematics is as follows.

Figure 1. Relationships between the Engineering Design Process and Science, Technology, and Mathematics (Yata, Ohtani, & Isobe, 2020)



The skills described above are very important skills for children to have, and this can be realized from simple habits and activities that exist in the child's environment. One of them can be seen in the way children play with simple paper airplanes toys. Simple things that are close to children's lives should be the main focus in efforts to develop various children's skills, and if this continues to become a habit, then children have been trained in various skills that will be useful for themselves in the future. In this study, the challenge for children to develop critical thinking skills and problem-solving is how to make a simple paper airplane toys that can fly in the air for a long time. Even though it is simple, this makes children challenged to design and make the best version of their airplane, whose goal is to fly for a long time. Children very often play this game, but research is rarely found that discusses this matter, the most recent is research from Santoso (2022), which explains that paper airplanes can generate motivation to learn in Indonesian language lessons. This is different from the context of this study, where the aim is to reveal in detail how the construction of meaning is built in making paper airplanes toys, especially to reveal how critical thinking skills and problem-solving are in children. Making the airplane involves a learning approach that will direct students in designing, making and even revising the paper plane. The approach used is *Science, Technology, Engineering, and Mathematics* (STEM). This approach is very appropriate because it contains aspects that exist in STEM in making paper airplanes.

METHODS

This study uses the phenomenological method. According to Qutoshi (2018), that phenomenology as a method of inquiry is not limited to an approach to knowing something, it is more an intellectual involvement in interpretation and making meaning that is used to understand the world of humans who live at the level of consciousness. It is very relevant to the intent and purpose of this study to reveal the phenomenon of the meaning of children's thinking in making paper airplane toys.

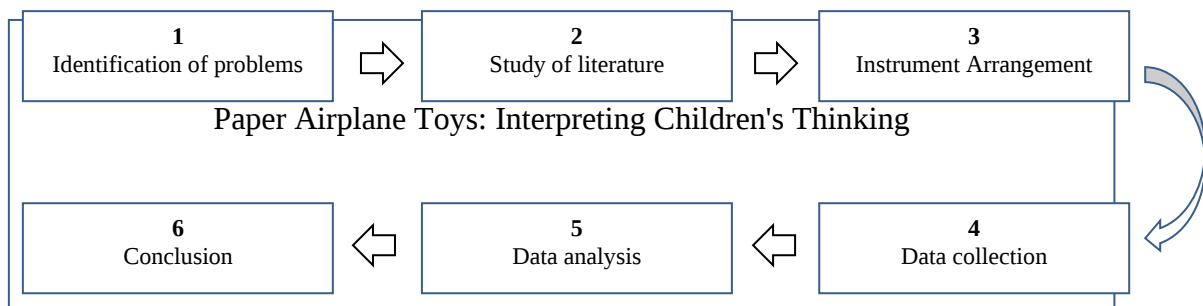
This research was conducted on 15 elementary school students in Bandung by providing a challenge to make a paper airplane toy that can fly for a long time in the

air, this involves aspects of the STEM approach as an effort to make airplane toys that are effective and as expected, and including 2 skills seen from the creation of the toy plane, namely critical thinking and problem-solving.

Data collection in this study used qualitative methods, namely documentation study techniques and interviews. Documentation studies are used to look at various data that support seeing phenomena of children's thinking in terms of approaches (STEM) and skills (critical thinking and problem solving). Interview techniques are used to determine the meaning seen from the documentation study or not seen directly (thoughts) so that this data will strengthen the conclusions drawn in this study. The analysis technique used is coding, with the plot being data reduction, data presentation, and drawing conclusions

The flow of this research is explained as follows.

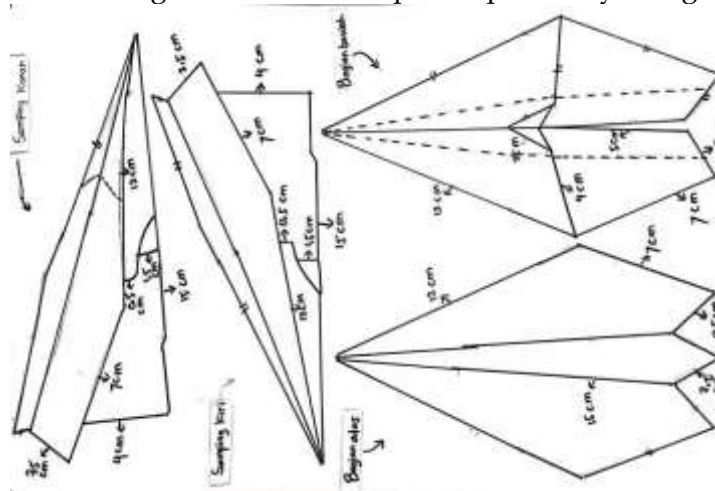
Figure 2. Research Flow



RESULT AND DISCUSSION

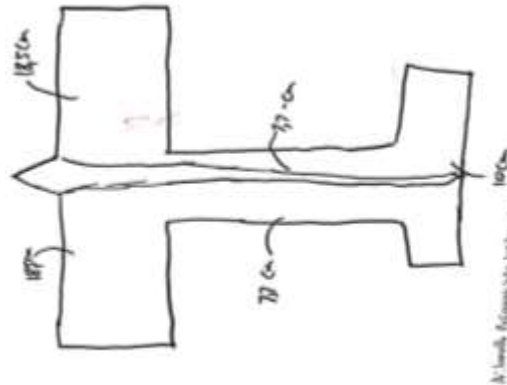
Making paper airplane toys is carried out using the principles of the engineering design process (EDP), which are then integrated with the dimensions of science, technology, and mathematics (STEM). It is also associated with 2 skills, namely critical thinking and problem-solving. In making paper airplane toys, this is not just making and then flying them but children need to design, measure, try out, and analyze, including identifying the weaknesses of the airplane toys they make. In addition, there are several designs made by children, this is the child's creativity in making airplane designs that they want to try.

Figure 3. Model 1 Paper Airplane Toy Design



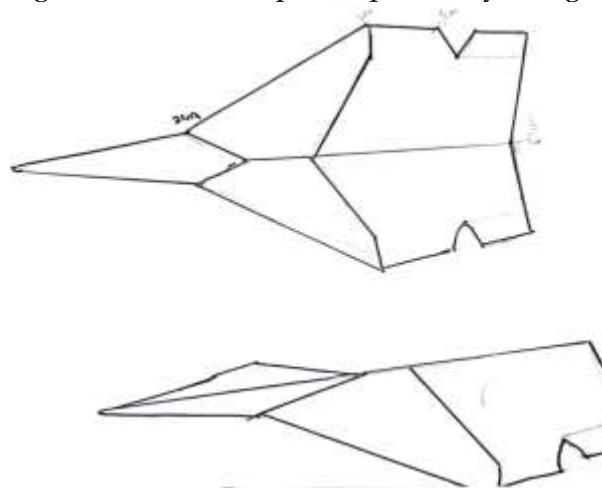
This model is very similar and is often made by children when playing with paper airplanes. It can be seen in the picture above that the child visualizes the airplane toy that has been made into an image object from various sides. In this context, the children independently designed a paper airplane toy in detail, they also described the parts of the airplane consisting of the fuselage and wings. On the other hand, they also consider various elements in making paper airplane toys, such as measuring each part of the airplane, paying attention to the weight and measuring the balance of each fuselage. In the mathematical context, this is referred to as similarity and congruent.

Figure 4. Model 2 paper airplane toy design



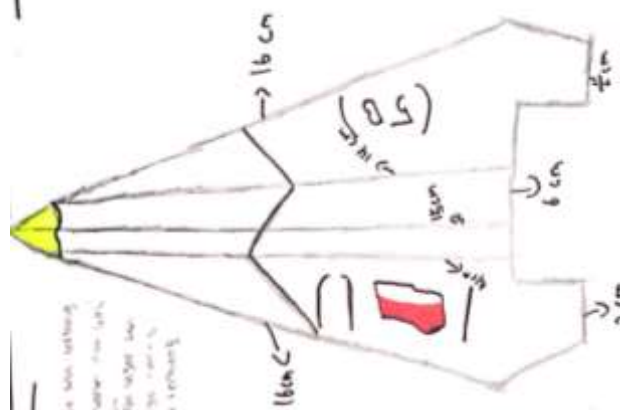
Based on the picture above, old airplane models inspire students, this model airplane is a type of plane with 2 wings, namely in front and behind, this plane also has a head and fuselage. This airplane model is the same as the type of airplane, The Bleriot XI, which originates from France. This child thinks that the plane's flight is caused by a balance between the wings of the plane, if the wings are not balanced, then the plane's flight will not be good. It can be proven from the size of each part of the airplane that is made, which has the same size.

Figure 5. Model 3 Paper Airplane Toy Design



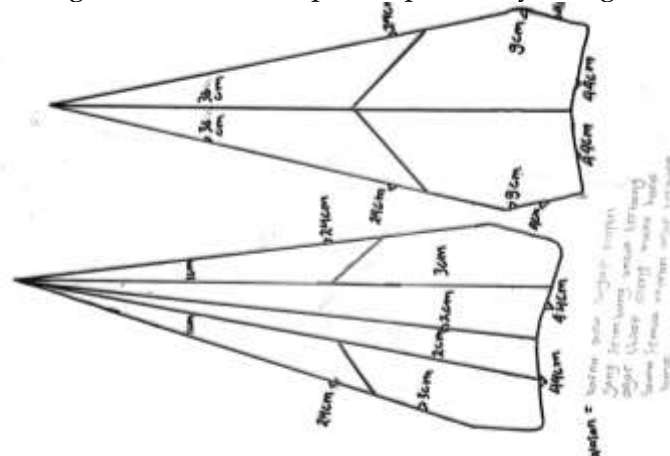
From the picture above, the child is inspired by today's fighter jets, this type of plane has a head, body and wings. Children know jet planes that have high speeds and can fly high in the air, so this is why they make airplane toys of this type, but when making the design, the child does not measure every part of the airplane in detail.

Figure 6. Model 4 Paper Airplane Toy Design



This airplane was inspired by a fighter plane, if we look at this type of airplane, it is almost the same as the B-2 Stealth Bomber, a military airplane owned by the United States Air Force. This child measures every part of the fuselage in detail from the picture above. This child thinks that the flying plane is grounded because of the air pressure from the wind, including the balance of the wings, which will greatly affect the plane's flight.

Figure 7. Model 5 Paper Airplane Toy Design

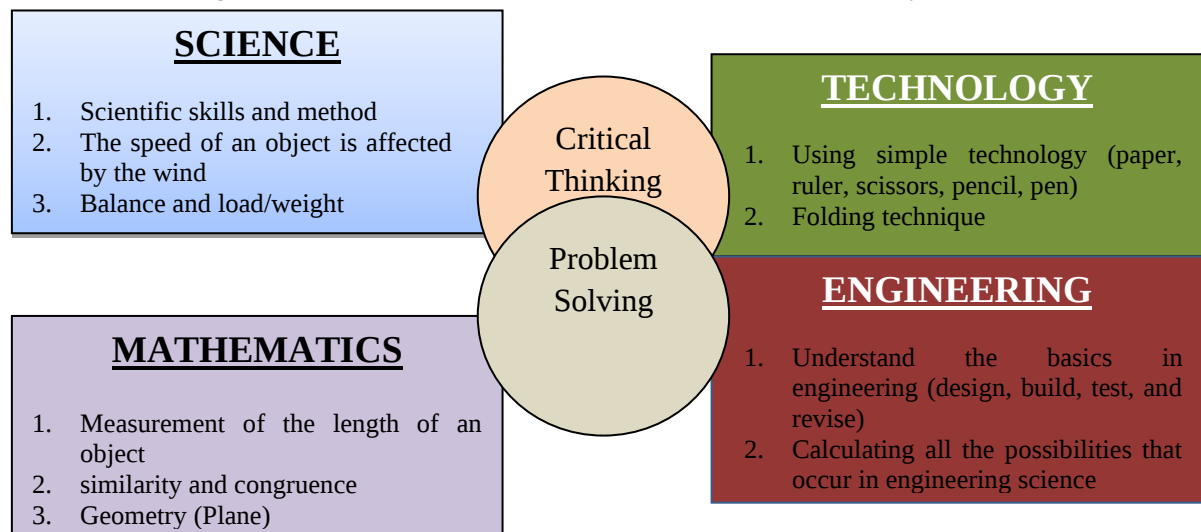


From the picture above, it can be seen that this model is also often found in children. This aeroplane's design is considered an airplane that can fly at high speed. Children think that this is because it is pointed forward. If it is seen that the design of this airplane has detailed dimensions, with each size being similarity and congruent, this is what makes the students reason that airplanes can fly because they have the same body size, the balance of the wings is also considered something that can make the airplane fly long and not sway.

STEM Integration in Paper Airplane Toys

A simple description of the achievements and skills, including the STEM approach, which is packaged in a paper airplane toy, is described in Figure 3 below.

Figure 8. Skills and Achievements in Paper Airplane Toys



Based on the picture above, in making paper airplane toys, there are several elements of skills and achievements from each STEM dimension. These are integrated into hands-on learning, where students learn the concepts of science, technology, engineering and mathematics.

In the science dimension, there are 3 things that children learn 1) skills and scientific methods, 2) wind speed, and 3) balance and weight. Making paper airplane toys not only trains children in cognitive aspects but also trains other aspects of skills. In this context, children are required to have a scientific attitude, where children must carry out a process of investigation and effort to solve a given problem, identify problems and find solutions through systematic observation, prediction of information, and analysis of results. The process goes through various stages, such as repeated questions, testing ideas, decision-making, and explanation and justification of how to build a causal theory (Hajian, et al., 2021). Science learning must be directed at the process of inquiry, students investigate, explain, and predict phenomena that aim to introduce cognitive processes (Balim, 2009), these skills and scientific methods are not only useful for improving the quality of life but also help to learn in an uncertain world of life (Prachagool & Nuangchalerm, 2021), through this scientific method children also learning related to the conceptual knowledge that the flight of a paper airplane toy is influenced by a thrust and wind, including balance and weight so that it will produce a speed.

In the technology dimension, there are 2 things that children learn, including 1) introducing simple technological concepts to children and 2) folding techniques. Both are parts of simple technology that are very close to children's lives because simple technology is a tool or technology that can facilitate human work. In the Engineering dimension, there are 2 things that children learn, including 1) learning the basics of engineering and 2) learning all the possibilities that occur as a result of the thoughts they have done. In making paper airplane toys, children are required to master engineering concepts. This becomes the basis and beginning for children to recognize an engineer because in EDP, what is very important is positioning children as

engineers (Hynes, et al., 2011), and this will also introduce children to the career of an engineers' which is needed in the future.

In the mathematics dimension, there are 3 things that children learn, including 1) measuring a length, 2) similarity and congruence, and 3) Geometry (plane). In making paper airplane toys, the 3 things above are activities that children cannot separate from and carry out. These three things are included in the material taught in learning mathematics. According to The National Council of Teacher Mathematics (2003), the material standards taught in mathematics learning are numbers, geometry and measurement, and statistics. And in the activity above, at least the child learns 2 materials, namely numbers and geometry and measurement. In addition, learning in the context of mathematics in making paper airplane toys is close to children's lives (contextual), meaning that children already have prior knowledge, making it easier for them to understand learning mathematics. According to Fauzi et al (2021), contextual problems close to children's lives can stimulate children to be actively involved in the learning process. It will also create meaningful learning where children construct their previous knowledge into new situations and knowledge.

From the simple ones, students can learn many things in the dimensions of science, technology, engineering and mathematics. In fact, if these subjects are taught classically and separately from each other, many students experience difficulties and many even avoid them (Simpkins et al, 2006). This is also explained by Corredor et al (2014) that studying disciplines in STEM is considered to have various difficulties and challenges because it has characteristics that are complex, abstract, and multidimensional in nature. The STEM approach which is integrated in the context of learning and playing makes it very easy for students to understand many things related to dimensions in STEM. and this makes learning more meaningful. It is this playing role that makes children more free to try various things and this is believed to influence various learning outcomes (Arztmann et al, 2023). According to Plas et al (2015) describes four different theoretical perspectives for game-based learning research that refer to game design as well as the outcomes targeted by games: a cognitive perspective, a motivational perspective, an affective perspective, and a sociocultural perspective.

Critical Thinking-Problem Solving in Paper Airplane Toys

In addition to the STEM dimension, 2 skills are seen in making paper airplane toys: critical thinking and problem-solving. Students' critical thinking skills arise when students are given a stimulus in the form of giving a problem, the problem is how to make the concept of a paper airplane toy that can fly for a long time. In simple terms, of all the circuits they have done (designed, made, tested, and revised), there are several things that students also do related to critical thinking, both metacognition and self-regulation. Critical thinking is related to how to make a decision which involves specific standards for making judgments that meet the criteria of rationality and realism (Nosich, 2012). So, many activities go through stages such as analyzing facts, making comparisons, generating and organizing thoughts, and defending opinions. , evaluate arguments and solve problems (Halpern, 2003). These activities are certainly carried out when students make these paper airplane toys.

In solving the problem, students are faced with the challenge of how long the plane can fly. This challenge is a type of problem that is very close to a child's life. In addition to playing, children are also required to solve the problems given. According to Sari et al (2021), problem-solving skills can be obtained through learning steps that

direct students to think and find solutions to a problem. From the problems given, students then do the things Polya described: visualizing problems, describing problems, planning solutions, implementing plans, and checking and evaluating. Of all the series of problem-solving activities, students found several solutions why the paper airplane toys could fly.

Figure 9. Problem-Solving 1, Why Paper Airplane Toys can Fly for a Long Time

Cara Pesawat kertas dapat terbang :
Dengan adanya tekanan udara di sisi atas sedikit lebih rendah dari pada di sisi bawah sayap sehingga pesawat mendapat gaya angkat dan dengan sayap pesawat kertas dan bentuk yang seimbang sehingga dapat terbang dengan jauh

A student gave an argument why the paper airplane they made could fly for a long time.

"With the air pressure on the top side slightly lower than the underside of the wing, so the plane gets lift and with paper airplane wings, and a balanced shape will result in the plane being able to fly for a long time".

This indicates that students have been able to identify and evaluate, and at least students have also been able to describe their findings on the problems given, that paper airplanes can fly due to 1) air pressure, 2) lift on the plane, 3) wings with the same size will provide balance to the plane.

Figure 10. Problem-solving 2, Why Paper Airplane Toys can Fly for a Long Time

Sayap pada pesawat berguna untuk menyeimbangkan pesawat.
Ekor pada pesawat berguna untuk agar pesawat tidak jatuh ke belakang

A student gave an argument why the paper airplane they made could fly for a long time.

"The wings on the plane are used to balance the plane, and the tail of the plane is used to keep the plane from falling backwards".

From the arguments presented, there are 2 important points: 1) students analyze the reasons why airplanes can fly for a long time, and 2) students also tend to highlight the benefits and uses of the airframe (wings and tail), this indicates that these students are also able to analyze the reasons and the use of airframes based on the perspective they are built from.

Figure 11. Problem-solving 3, Why Paper Airplane Toys can Fly for a Long Time

Alasan kenapa pesawat bisa terbang:
karena pesawat memiliki keseimbangan dan di bantu arah angin

A student gave an argument why the paper airplane they made could fly for a long time.

"Because the plane has a balance, and is also assisted by the wind direction".

Actually the reason why the plane can fly because of balance has also been conveyed by another child, but this child also thinks that the presence of wind will increase the speed of the plane and affect the plane's ability to fly for a long time.

Figure 11. Problem-solving 3, Why Paper Airplane Toys can Fly for a Long Time

alasannya = karna ada sayap kapal
yang seimbang untuk terbang
agar tidak oleng maka harus
sama semua ukuran agar terbang
lama

A student gave an argument why the paper airplane they made could fly for a long time.

Because there is a balanced airplane wing, so that the plane can fly for a long time and not roll, all the dimensions of the fuselage must be the same".

From the arguments presented, that children consciously share how airplanes can fly for a long time, this method is the result of evaluations and findings from the paper airplane toys they have made. Students think that by having the same size for each fuselage, it will affect the balance and flight of the plane.

From the description above, at least some of the reasons given by the children for their findings about why the paper airplane toys they made can fly for a long time are summarized in the table below.

Table 2. Reasons Why Paper Airplane Toys can Fly for a Long Time

Problem	Solution
Why do planes fly so long?	There is a balance between the fuselage
	There are airplane wings
	Air pressure affects the speed of the plane
	The dimensions of each fuselage are similarity and congruent
	There is a push-and-lift force
	The tail of the plane is useful so that the plane does not fall backwards

There are many actual things related to children's lives, which contain a lot of meaning and problems that require solutions, if this is given to children and then developed, it will be very useful in developing problem-solving skills because the essence of problem-solving is to participate in tasks that are the completion is not known beforehand The National Council of Teacher Mathematics (2003), problem-solving activities will also be very useful in training children's cognitive development, because in it involves more creative activities that involve testing, modifying, and refining various solutions from the hypotheses that are thought of, and ultimately can build a formal proof of a set of theory activities (Tall, 2002).

In addition, Snyder & Snyder (2008) revealed that critical thinking is a learned skill that requires teaching and practice, so that activities such as making paper airplane toys are one of the training steps that students can do. In making paper airplane toys, this cannot be separated from the STEM context, according to Bicer et al (2013) who conducted research by integrating mathematics teaching with STEM, the result is that students tend to produce and apply better problem-solving skills, because STEM is closely related to aspects of real life. Then, Szabo et al (2020) revealed that several things could help teachers improve students' ability to solve problems which consist of several steps, namely Understanding the Problem; Making a Plan; Executing the Plan; and Feedback; this was also proven when the researcher applied the same thing in the project of making paper airplane toys by students. Furthermore, making paper airplane toys is felt to be very capable of improving students' critical thinking

skills; this is because this activity requires students to find out things that can make paper airplanes fly longer by utilizing innovative pedagogy to support teaching and learning goals, students will be more likely to achieve their full potential and have their voices heard (Živković, 2016). Furthermore, the STEM concept used is felt to be able to facilitate students' critical thinking skills and problem-solving; this is in line with research conducted by Asigigin & Samur (2021), which revealed that using gamified STEM activities on 3rd and 4th-grade students' Although it is not significant, the results showed that an increase was found in students' perception of problem-solving skills. Besides, students' intrinsic motivation levels were found to be high, and they stated that "gamified STEM" activities helped them learn and practice the content and found the activities enjoyable, competitive, and exciting.

The existence of this research has an impact on several things, namely 1) integration of STEM in learning will make it easier for children to understand various STEM dimensions which children find difficult, 2) learning that is integrated with play will build a much more pleasant atmosphere and this makes it easier for children to understand the various material concepts and skills being taught, and 3) critical thinking skills-problem solving is a skill needed in the 21st century and it must be taught to children in their daily lives and starting from simple things, one of which is by playing paper airplanes .

This research also certainly has limitations which certainly need to be improved in the future, these limitations include 1) the scope of the research is simple, namely only analyzing phenomena related to paper airplane toys made by children, 2) participants in this study are also limited to a few people, and 3) the data collection technique only uses documentation and interviews.

This research can be developed and studied in more depth, and this can also be a follow-up study for other researchers, including 1) how to study the development of students' creative thinking through very simple activities, one of which is in paper airplane toys, and 2) Effects of games in STEM education that can influence the understanding of STEM dimensions and various other student skills.

CONCLUSION

The nature of a child is to play, because in essence, the concept of play cannot be separated from the child's life, but this game must be able to encourage children to think so that situations of learning while playing are created. In every activity children play, there are many phenomena of thinking that are unique to be examined, and there are many meanings contained in what they do, a very simple thing is when children play flying paper airplanes, what they fly goes through many processes. Thinking without realizing it is also related to the dimensions of *science, technology, engineering, and mathematics* (STEM). In addition, activities in playing with paper airplanes can foster various skills, including critical thinking and problem-solving. All stages in critical thinking skills (interpretation, analysis, evaluation, inference, explanation, and self-regulation) and problem-solving skills (visualize the problem, describe the problem, plan solutions, implement plans, examine and evaluate) has been done by children when making paper airplane toys, this indicates that from things that are simple and close to children's lives, they can develop various skills including paper airplane toys which can train critical thinking and problem-solving skills. So what must be done in the future is to facilitate children's play activities by not forgetting to link them with thinking/learning activities. This research is expected to impact

education to facilitate children to develop various skills through learning while playing.

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AUTHOR CONTRIBUTION STATEMENT

This is a collaborative research which essentially discusses the interpreting of children's thingking through paper airplane toys. IF, JC, MK and SIF jointly designed the research, collected data, analyzed the data obtained, and compiled a research report

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