Jurnal Pendidikan Sains Indonesia
(Indonesian Journal of Science Education)
https://jurnal.usk.ac.id/jpsi/index

12(4), p.867-884, (2024)
e-ISSN: 2615-840X p-ISSN: 2338-4379
https://dx.doi.org/10.24815/jpsi.v12i4.39893

Development of STEM-Based Science Educational Game Using Scratch to Train Computational Thinking Skill for Secondary School Students

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Article History:
Received date: July 6 2024
Received in revised from: September 21 2024
Accepted date: October 16 2024
Available online: October 23 2024

Citation:
Wulandari, T.D., Listiaji, P., Sulaiman, T., Jaafar, W.M.W., & Rahim, S.S.A. 2024. Development of A STEM-based scence educational game using scratch to train computational thinking skill for secondary school students. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, 12(4):867-884.

Abstract. Computational thinking skills (CTS) possessed by Indonesian students are not yet in the good category. These skills have not been integrated in learning. This is in accordance with the results of preliminary research at SMP Negeri 8 Semarang that CTS are a new concept for science teachers, including learning media used by teachers have not helped train students' CTS. Through preliminary research, it is known that science teachers give a positive response to the use of technology-based learning media that train students' CTS, one of which is a science educational game using scratch. The purpose of this study was to analyze the validity and determine the profile of students' CTS after using science educational games. The type of research used is development research with the ADDIE model. The instruments used are expert validation questionnaires, student readability sheets, and tests after using science education games. The results showed that the science education game was valid with a score of 0.89. The readability of science education games is very good with a score of 96.7. Through the test, it was found that the percentage of students with high computational thinking ability was 56.66%, medium 26.66%, and low 16.66%. Based on the research that has been done, it can be concluded that the science education game is valid and can train CTS of junior high school students.
Keywords: Science educational game, Computational thinking, STEM, Scratch

Introduction

The Programme for International Student Assessment (PISA), conducted by the Organisation for Economic Co-operation and development (OECD), is a study to evaluate education systems participated by over 70 countries around the world (Perez & Rodriguez, 2023). This study measured students' reading literacy, mathematics literacy, and science literacy skills (Volante & Mattei, 2024). The study involves 15-year-old school students randomly selected every three years. Indonesia has participated since 2000. However, throughout PISA's implementation, Indonesia has consistently ranked lower compared to other countries (Marifah, 2022). The low PISA scores among Indonesian students are attributed to several factors, including students' unfamiliarity with the question modeling and the lack of textbooks that emphasize real-world problem-solving as assessed by PISA. Minister of Education and Culture, Nadiem Makarim, has stated that he will use PISA results as one of the materials to evaluate the quality of education in Indonesia. The Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 104 of 2014 concerning assessment of learning outcomes by Educators in Elementary and Secondary Education states that the target of assessment by educators in thinking skills is the ability to remember, understand, apply, analyze, evaluate, and create (Minister of Education and Culture, 2014).

The Ministry of Education and Culture also plans to make CTS one of the skills that Indonesian students need to master, as it was included in the PISA study in 2022 (Yuliana, et al., 2021). Computational thinking is a way of thinking like a computer, enabling students to solve problems in the 21st century systematically and logically. Therefore, learning needs to be supported by learning media that can train students' CTS. Learning media is an important intermediary for transferring knowledge, increasing students' motivation to learn and curiosity, and achieving learning objectives. Based on literature, CTS are very important in science education (Hurt, et al., 2023). These skills can be trained in science subjects through technology-based learning media, one of which is educational games. The choice of game media is adjusted to the interests of Indonesian students who cannot be separated from technology.

According to a literature study by Nuvitalia, et al (2022) that examined CTS of secondary school students in Semarang through the Bebras problem-solving competition, the results showed that the CTS of secondary school students at Junior High School 8 Semarang were below average with a score of 46.25 out of an overall school average of 54.97. This is supported by the results of interviews conducted at Junior High School 8 Semarang with science teachers, which showed that CTS are a new concept for teachers. Furthermore, educational game learning media have not been used in science subjects. Science teachers at Junior High School 8 Semarang responded positively to the use of science educational game learning media because it is in line with students' interests and is a new innovation from the media used in learning. Moreover, this educational game can train students' CTS which have never been found in other learning media. Science educational game learning media can be developed using Scratch programming.

Scratch is a technology-based learning medium in the form of block programming like puzzles (Chasannudin, et al., 2022). The use of scratch as a learning medium continues to increase along with technological advancements every year (Wulandari, et al., 2023). Scratch learning media is currently being widely developed as a medium to realize active, interactive, and engaging learning (Piedade & Dorotea, 2022). Apart from that, the use of Scratch creates a technology-based teaching and learning process and makes learning more meaningfull (Sulaiman, et al., 2021). In fact, Scratch learning media has been proven to be able to improve measurable skills because it applies a logical mindset that can abstract problems by structuring simple concepts into complex ones. Through scratch, students have higher CTS (Martínez, et al., 2020; Asri & Jamaludin, 2022). The use of Scratch is also possible to make it easier for students to understand abstract science concepts into more concrete concepts. Science content in scratch-based science education games is getting easier to understand with the science, technology, engineering, and mathematics (STEM) approach.

The STEM approach in science educational games makes students learn by solving a case. The learning process takes place by solving problems (Sugianto, et al., 2018). Through learning with the STEM approach, students are not only able to memorize science concepts but also to understand and implement science concepts in everyday life. This is also supported by their CTS. Through learning media that incorporates STEM elements with CTS, students become more focused in mastering science concepts and are able to find solutions to the problems they face according to 5 indicators, namely decomposition, abstraction, pattern recognition, algorithm construction, and generalization. (Eshnazarovna, 2021). The science material used is work, energy, and simple machines. The selection of this material is based on research by Rumiati, et al (2022) that students have difficulty understanding the material of work, energy, and simple machines because the discussion is quite dense with the characteristics of abstract material. Whereas the implementation of this material is very close to everyday life. Therefore, this study develops STEM-based science educational games using scratch to train CTS of junior high school students on the material of work, energy, and simple machines. The purpose of this research is to analyze the validity and determine the profile of CTS after using STEM-based science educational games using Scratch junior high school students on the material of work, energy, and simple machines.

Methods

The research used is development research with the ADDIE model which consists of 5 stages, namely 1) analysis, 2) design, 3) development, 4) implementation, and 5) evaluation (Branch, 2009). However, this research only reaches the stage of implementing the STEM-based science educational game product. This research was conducted at senior high school 8 Semarang on class VIII students.

1. Analysis

In the analysis stage, a literature study was conducted from national and international journals regarding the development of science educational games, STEM, Scratch, and CTS. In addition, interviews were conducted to analyze and identify problems at school related to science learning problems, media used in the science learning process, and the need for educational games in learning.

2. Design

Before developing the science educational game, a design was carried out by considering the elements of STEM; the relevance of the learning objectives of the work, energy, and simple machines chapters; and computational thinking indicators. At this stage, a flowchart was created which can be seen in Figure 1.

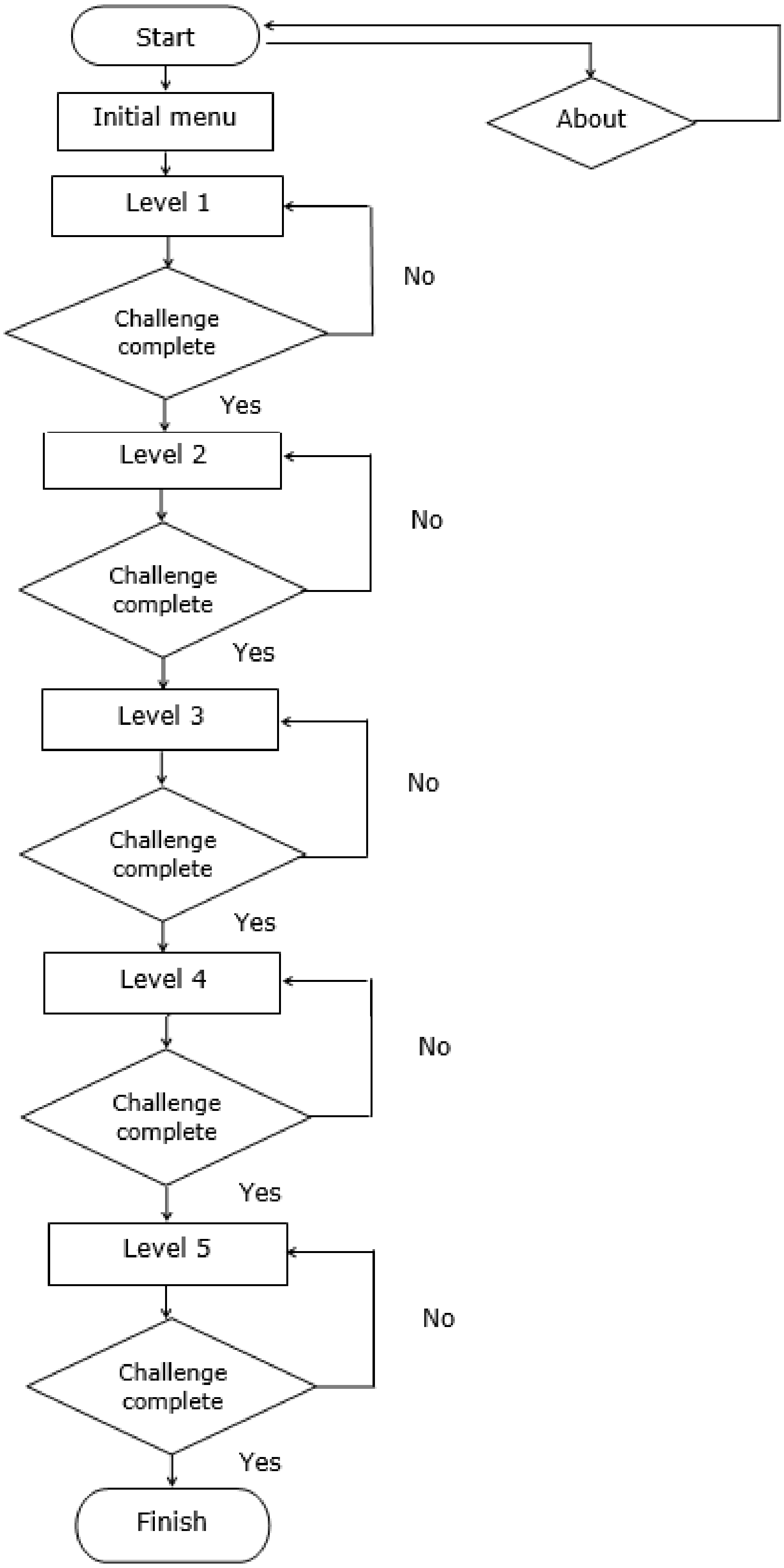

Figure 1. Flowchart a STEM-based science educational game

3. Development

The development stage in this research is to develop a science educational game using Scratch 3.0 programming according to the scenario that has been prepared. The initial step in creating a STEM-based science educational game is to create programming by compiling block codes according to the design that has been made with an interesting arrangement of elements and designs. After that, validation of the game media and material as well as test questions was carried out to 5 experts consisting of 2 lecturers and 3 science teachers using an answer sheet. In addition, a pilot test was conducted to assess the readability of the product to class IX students. Analysis of the content validity of test questions and science educational games using Aiken V with the following formula.

$$V = \frac{\Sigma s}{[n(c-1)]} \qquad (1)$$

(Source: Aiken, 1985)
s = r - lo
lo = the lowest validity assessment score
c = the highest validity assessment score
r = the number given by an expert

The analysis of the readability of the media by students is carried out through a questionnaire using a four-category Likert scale. The criteria for the readability level of STEM-based science educational games are as follows in Table 1.

Table 1. Criteria for the readability level of stem-based science educational games

Readability (%)	Classification
81.25 < score < 100	Very good
62.50 < score < 81.25	Good
43.75 < score < 62.50	Quite good
25.00 < score < 43.75	Not so good

4. Implementation

The final stage of this research is implementation. The STEM-based science educational game will be implemented in science learning. The research subjects are one class of eighth-grade students at junior high school. After the learning activities take place, the students' CTS are measured by working on multiple-choice test questions. Then an analysis of the profile of students' CTS is carried out. The results of the test scores obtained are then categorized into high, medium, and low. The category of the profile of students' CTS can be seen in Table 2.

Table 2. Categories of CTS

Computational Thinking	Criteria
71 < CT ≤ 100	High
41 < CT ≤ 70	Medium
10 < CT ≤ 40	Low

(Source: Muhammad, et al., 1985)

Results and Discussion

The content validity of the STEM-based science education game was obtained from experts consisting of 2 lecturers and 3 teachers. The content validity test aims to determine the suitability of STEM-based science educational games, both from media and material aspects before being used for trials. Aspects contained in the validity test questionnaire include general appearance, game presentation, STEM aspects, and computational thinking aspects. STEM-based science educational games are said to be valid if the validity value is > 0.87 with an error scale of 5% or $P < 0.05$. The validity obtained from experts is 0.98 with valid criteria for use in the learning process. The assessment results for the validity aspect of STEM-based science educational games are presented in Figure 2.

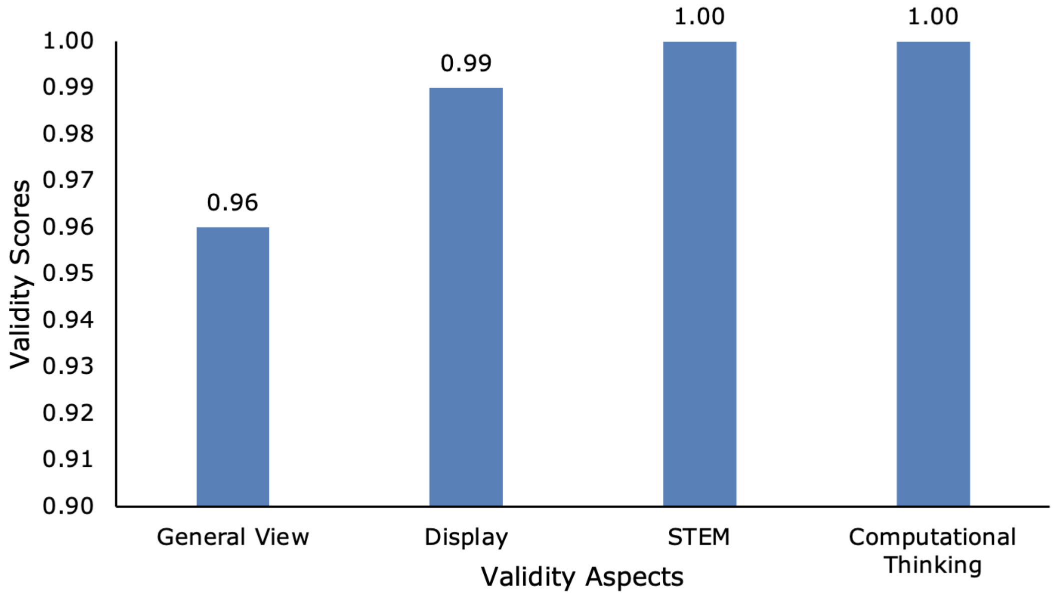

Figure 2. Graph of validity test results of stem-based science education games

STEM-based science educational games then tested by testing media readability using a questionnaire. The readability test of STEM-based science educational games was carried out in class IX D of Junior High School 8 Semarang with 30 students. The readability test of STEM-based science educational games was given to class IX students who had previously received material about work, energy and simple machines. The purpose of the readability test is to get input, criticism and suggestions from students. The readability data of this educational game is also used as consideration for the feasibility of a STEM-based science educational game before implementation. The readability questionnaire contains media and material aspects. The results of the readability questionnaire received a score of 96.7 with very adequate criteria.

The material aspect obtained a readability score of 94.88 with very good criteria. STEM-based science educational games contain all sub-materials which include sub-chapters for work, energy and simple machines in accordance with learning objectives. The challenges in science educational games present the relationship between the concepts of work, energy and simple machines. The STEM component in science education games is implemented by presenting examples of problems in everyday life. After playing STEM-based science educational games, students are motivated to work on science questions on work, energy and simple machines in a coherent and systematic manner. Apart from the material aspect, there is a media aspect which received a readability score of 97.63 with very good criteria. The appearance, type and layout of animation, color selection, and type of letters used increase students' interest in STEM-based science educational games. The existence of navigation buttons and instructions in educational games makes it easier for students to play. The use of communicative sentences also makes students understand the flow of STEM-based science education games well.

A STEM-based science educational game was developed using Scratch programming on the topic of work, energy, and simple machines. Validity testing obtained valid criteria indicating that the STEM-based science educational game is feasible for use as a learning medium. This validity test was strengthened by the readability test of the STEM-based science educational game on students, with the result being very good. The STEM-based science educational game contains all sub-chapters of the topic of work, energy, and simple machines, which are adapted to the learning objectives. The alignment of learning objectives was carefully considered in the creation of the STEM-based science educational game. According to Wahyuning (2022), the creation of educational games as a learning medium for students should be in accordance with their learning objectives.

In addition, the STEM-based science educational game was developed with consideration of several media aspects. The appearance, type and layout of animations, color selection, and font type used increased students' interest in the STEM-based science educational game, as evidenced by the validity test with the criteria of valid. This is in line with the opinion of Panjaitan, et al (2020) that the proportional placement of animations and the arrangement of text in the game can attract students' interest in using the learning media. The colors used in the STEM-based science educational game are bright to attract students' interest in learning. According to Gea, et al (2023), good color selection is one way for students to easily capture and store information in the brain because color can stimulate information related to the learning material. The presence of navigation buttons and instructions in the educational game makes it easier for students to play. Erfan, et al (2020) an educational game needs to be equipped with navigation because it has benefits and makes game operation effective. The use of communicative sentences also makes it easy for students to understand the storyline of the STEM-based science educational game. The appearance of the developed STEM-based science educational game is as follows.

Figure 3. Initial appearance of STEM-based science education game

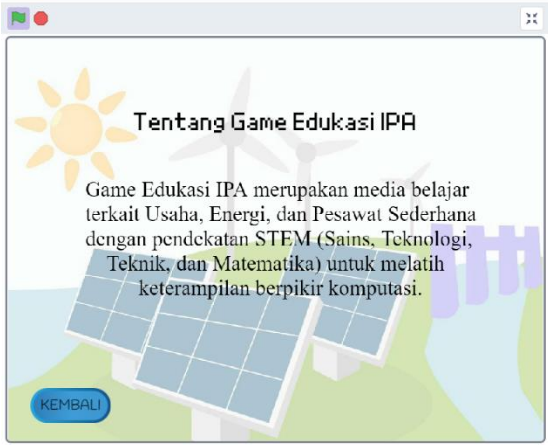

Figure 4. Display of STEM-based science education game instructions

The development of STEM-based science educational games encompasses four characteristics of educational games. According to Zakyanto & Wintarti (2022), the characteristics of educational games include challenge, curiosity, control, and fantasy. Moreover, STEM-based science educational games have their own unique characteristics, namely being STEM-based and training students' CTS. Each level of the STEM-based science educational game has different challenges by presenting problems related to the material of work, energy, and simple machines in everyday life. Nuraeni, et al (2020) state that the use of games for learning needs to present a challenge so that students are motivated to face difficulties in overcoming them and understand the science material contained in the game. Various challenges related to science material that contain STEM elements and computational thinking indicators in the educational game trigger students' curiosity. The attractive visual appearance of the game, supported by the addition of background music and sound effects, also stimulates students' curiosity to use the STEM-based science educational game as a learning medium. Klimmt, et al (2019) research mentions that the presence of music in a game will create appeal and a gaming experience. The gameplay that is arranged by presenting problems in everyday life forms students' imagination as if they are playing in the real world. This is supported by students' freedom to control when playing the STEM-based science educational game.

Figure 5. Level 1 display of STEM-based science education game

Each level of the science education game contains different STEM elements and indicators of CTS. The elements of Science, Technology and Engineering are found at level

1. The Science element is related to issues regarding science material on energy sources. The Technology element presents examples of technology-based renewable energy sources that can be applied, namely waterwheels and windmills. The engineering element is found in the activity of assembling the wheel correctly. These three STEM elements are integrated with computational thinking indicators, namely decomposition. Decomposition is the basis of computational thinking which trains skills in breaking down complex problems into several parts so they can be easily solved (Jamalluddin, et al., 2022). Decomposition indicators can be trained with activities in the form of identifying and compiling the components needed to apply environmentally friendly technology in the energy sector (Novianti & Dewi, 2023).

The existence of gaming activities with educational content makes students understand and able to practice their skills to find solutions to these problems. The material on work, energy and simple machines is included in science material which is complex and interrelated but there are still many students who do not understand it so that student learning outcomes are far from learning objectives (Alamsyah, et al., 2019). This can be overcome with learning media in the form of STEM-based science education games because they utilize audio and visuals, making it easier for students to get learning outcomes according to the expected learning objectives. According to Aditia & Hamka (2021), learning by utilizing the five human senses will make it easier for students to understand information related to the material being studied, train students' skills while playing, make learning more impressive and meaningful, and provide a broader learning experience.

Figure 6. Level 2 display of STEM-based science education games

At level 2, the Science element regarding examples of objects that include levers in everyday life is associated with indicators of computational thinking, namely abstraction and generalization. Abstraction thinking allows students to focus on information related to problem solving and then draw conclusions as a solution to the problem or what is usually called generalization (Maharani, et al., 2020). The level 2 challenge in science educational games is related to material on types of levers. Abstraction indicators in CTS train students to focus on things that are important to achieve goals and ignore things that are less important so that students can easily conclude (generalize) with a decision (Ngandoh, 2022). The challenges presented at level 2 are closely related to objects including levers in the surrounding environment. This challenge was chosen because objects including levers are often used in everyday life to make work easier. However, most students still cannot differentiate between objects that are levers and that are not (Fadli, et al., 2022).

The level 2 challenge in STEM-based science educational games aims to hone students' scientific understanding of levers and is also used to train abstraction and generalization CTS. Students are trained to focus on objects that include levers and ignore objects that do not include levers in a room. The activity of playing science education games at level 2 trains abstraction thinking skills so the students can easily make conclusions to determine the answer to the level 2 challenge quickly and precisely. This is also in accordance with the opinion of Novianti & Dewi (2023) that the way to train abstraction and generalization CTS is to provide problems related to investigative activities by identifying and determining an object based on an image.

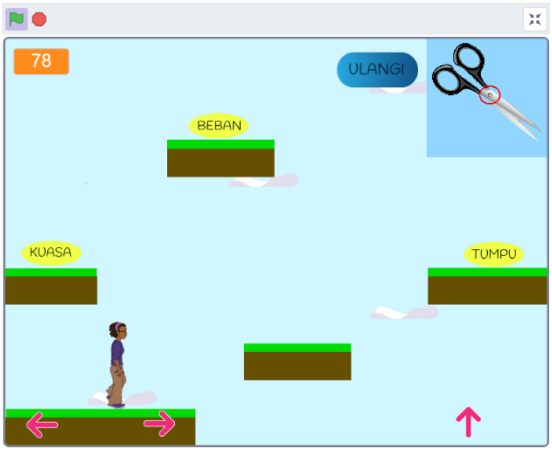

Figure 7. Display of levels 3 and 4 of STEM-based science education games

The challenges at levels 3 and 4 of science educational games are related to the STEM science component regarding lever parts, while the CTS that is trained at this level is pattern recognition. Pattern recognition is closely related to students' skills in identifying regularities and being able to conclude them (Barcelos, et al., 2018). This indicator is also related to similarities or patterns in a problem that are used as a way out for effective problem solving (Azizah, et al., 2023). Pattern recognition indicators in science educational games are trained through games with challenges in the form of determining the parts of a lever. Each type of lever has a different location of the fulcrum, power point and load. Objects that are levers of the same type have lever parts with the same layout pattern.

The challenge at level 3 and level 4 is to determine the part of the lever in question in the picture. This is in accordance with the opinion of Azizah, et al (2023) that the foundation of computational thinking on pattern recognition indicators can be integrated with learning activities to analyze equations in images. When playing the game, students will look for similar patterns of the parts asked about in the picture according to the type of lever. Through this game, students not only know examples of objects that include levers, but also their parts. Pattern recognition skills make it easier for students to face problems in their lives. This pattern recognition indicator can also be used to solve other problems encountered (Ansori, 2020).

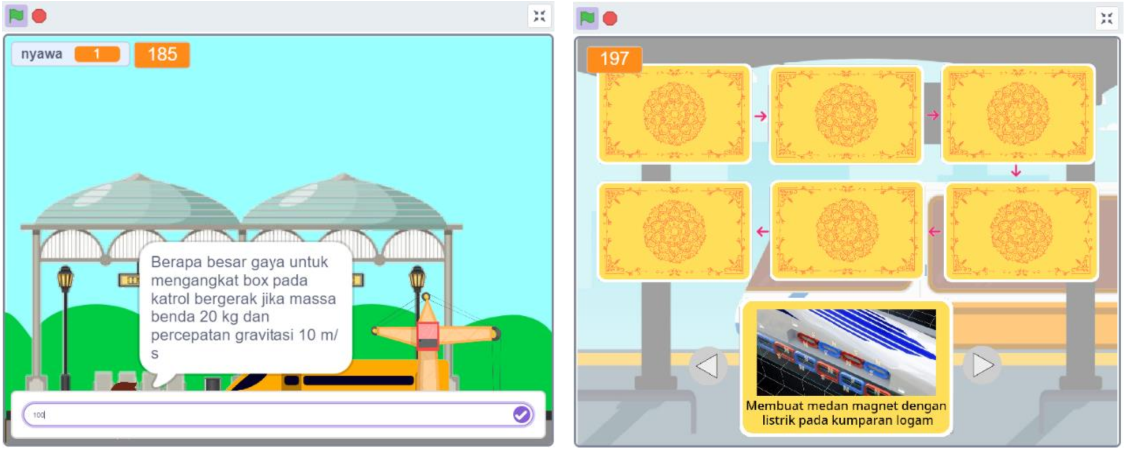

Figure 8. Display of level 5 STEM-based science education games

The level 5 science educational game is the final challenge which contains 3 STEM elements, namely Science, Technology and Mathematics. The science element is related to work, energy, and pulleys. The technology element at level 5 is the application of environmentally friendly energy in life. The mathematical elements are combined with science elements in a challenge. Mathematics is one of the constituent components of STEM where activities include analyzing, determining problems, formulating solutions, and communicating them effectively for mathematical problems that can be applied in various different situations (Alifa, et al., 2018). Mathematical elements in STEM-based science education games are presented at level 5 in the form of challenges related to the concept of work and pulleys. These challenges relate to working materials and pulleys which require calculations to obtain answers. This is in accordance with the opinion of Izzati, et al (2019) that the STEM mathematics component is used in activities when carrying out data analysis calculations such as applied mathematical concepts, theorems or formulas required in science learning.

At level 5 of the science education game, the science STEM component is also integrated with technology elements to train algorithmic thinking skills in the form of challenges. Algorithmic thinking is an indicator of computational thinking where students can state the steps to solve problems in a coherent manner (Ngandoh, 2022). Technology covers a variety of fields that involve the application of knowledge, skills and computational thinking to expand human capabilities and help fulfill human needs and desires (Davidi, et al., 2021). The choice of material in the STEM technology component is related to the application as an environmentally friendly energy source in life due to the very complex problem of environmental damage in Indonesia (Meni, 2023). The activity in this challenge is to develop stages for implementing environmentally friendly technology as a means of transportation. Through activities in the process of solving challenges, students will practice their algorithmic thinking skills by analyzing and determining the sequence of steps systematically. This is in line with the opinion of Novianti & Dewi (2023) that algorithmic thinking skills can be trained by developing problem-solving steps such as creating environmentally friendly technology design stages in the energy sector in the form of flowcharts.

The profile of CTS after using STEM-based science educational games was analyzed through tests. The preparation of test question types is adjusted to Bebras questions for junior high school students. According to Babo, et al (2023), one way to find out students' concepts of computational thinking is by working on Bebras questions which have been held since 2016 and can be taken by elementary school, junior high school and high school students. Each question contains the concept of computational thinking indicators consisting of decomposition, abstraction, pattern recognition, algorithmic thinking, or generalization by including work, energy and simple machines. Based on the test results, it is known that students' ability to answer each question correctly in each category varies. The average score obtained by students was 73.6. The scores for each student's test questions are different, which determines their category. The score results will be categorized into three, namely the high category, medium category and low category. The percentage profile of CTS is in Table 3.

Table 3. Percentage of CTS profile

No	Number of Students	Category	CTS profile (%)
1	17 students	High	56.66
2	8 students	Medium	26.66
3	5 students	Low	16.66

Based on the test results, the percentage of students in the high category dominates compared to the percentage in the medium and low categories. This shows that STEM-based science educational games can train students' CTS. All challenges can encourage interest and provide playing experience for students when using science educational games. The characteristics of science material related to work, energy and complex simple machines can be conveyed well. STEM elements that are integrated with computational thinking indicators are able to train decomposition skills, abstraction thinking, pattern recognition, algorithmic thinking, and generalization. If analyzed for each indicator, the number of students in each indicator is in Figure 9.

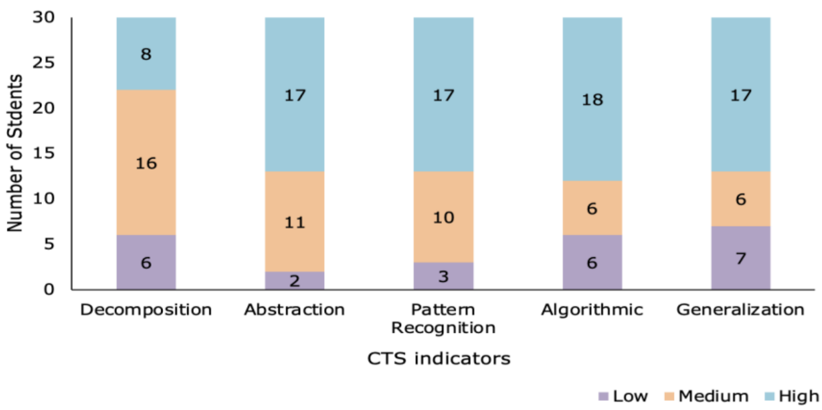

Figure 9. Profile of Students' CTS

Computational thinking consists of 5 indicators, namely decomposition, abstraction, pattern recognition, algorithmic thinking, and generalization (Litia et al., 2023). Students who are able to answer test questions correctly have applied indicators of CTS as a basis for selecting answers. In questions with decomposition indicators, students succeed in analyzing the complex problem being asked into smaller, more manageable parts. STEM-based science educational games train decomposition indicators at level 1 where students arrange waterwheels and windmills. Students are trained to be able to analyze the problems presented when playing science education games, namely the command to arrange a pinwheel. Then students analyze and divide the complex problem into smaller parts, namely by analyzing the parts of waterwheels and windmills. Students will also be trained to know the relationships between the parts of a waterwheel so they can arrange or assemble waterwheels and windmills correctly. This is in accordance with the opinion of Megawati, et al (2023) that students who have problem decomposition skills will be able to examine images and describe them as a step in solving the problem. Decomposition is one of the basic techniques in CTS to solve problems. Rich, et al (2019) also said that applying decomposition techniques to a problem includes analyzing the main problem, breaking down and labeling each part, analyzing the relationships between parts, and solving the problem. Ansori (2020) also believes that decomposition skills are very necessary to break down complex problems found in everyday life so that they can be easily resolved.

The profile of CTS on indicators of abstraction and generalization thinking possessed by students is trained using STEM-based science educational game learning media. This allows students to solve test questions correctly. STEM-based science education games train abstraction and generalization indicators at level 2 where students analyze objects that include levers, both type 1, type 2, and type 3. Abstraction indicators are trained by analyzing objects found in a room in science education games. Then students focus on objects that include levers and ignore other objects. When students can separate appropriate information from information that is not appropriate to the problem, students can generalize or draw conclusions correctly. Meanwhile, when working on questions, students succeeded in carrying out abstraction and generalization thinking steps. Maharani, et al (2020) said that in computational thinking, someone who has abstraction skills can find ways to work with different parts efficiently and accurately. The questions are presented regarding statements based on certain situations.

Students' abstraction ability is measured according to their success in eliminating or crossing out statements that do not fit or relate to a complex problem to reduce it to its most important components. Students who have abstraction skills are able to simplify or break down problems to make them easier to solve. This is in accordance with the opinion of Bhagat & Dasgupta (2021) that the abstraction process occurs through filtering irrelevant information and identifying what is most important. Generalization indicator skills are used by students to answer similar problems in STEM-based science educational games. This is because the skill of abstracting problems will make it easier for students to make conclusions from problems which are called generalizations. Generalization is used to determine solutions to problem solving. According to Maharani, et al (2020) generalization is the process of drawing conclusions from a problem.

The generalization process when solving problems in science educational games and test questions occurs after students have reduced statements that do not match what was asked in the question, then students can connect each statement to obtain a complete solution. In this way, students are able to make decisions to conclude the correct answer to the question. Indicators of CTS abstraction and generalization are related, abstraction includes the activity of separating relevant information from other information. Meanwhile, generalization allows students to conclude patterns that have been found and formulate a particular pattern in general in order to solve problems (Mubarokah, et al., 2023). Students who are trained in generalization skills can solve problems in everyday life easily, especially similar problems. This is because students who are often faced with problems are used to solving more quickly. Generalized CTS enable students to solve problems quickly based on previous solutions to similar problems (Nuvitalia, et al., 2022).

The profile of students' CTS on pattern recognition indicators is trained using STEM-based science educational game learning media. This allows students to solve test questions correctly. STEM-based science educational games train pattern recognition at level 3 and level 4 where students analyze parts of objects including levers. Pattern recognition indicators are trained by determining the part in question of the object which includes levers, including the fulcrum point, force point and load. During the game, students are trained to be able to understand the pattern of parts of objects, both on type 1 levers, type 2 levers, and type 3 levers. Meanwhile, when working on the problem, students successfully performed the step of recognizing patterns by observing and paying attention to their characteristics. Images presented, looking for similarities and differences between images, looking for regularities and patterns in each image, analyzing and interpreting patterns to solve the problems asked in the question, and applying patterns to solve problems.

Pattern recognition is part of computational thinking where there is a process of identifying patterns in data sets to categorize, process, and complete information more effectively (Maharani et al., 2020). Patterns are pieces or series of data that have one or more things in common. Pattern recognition is an important tool in computational thinking because it helps simplify problems and improve understanding of their intricacies (Helsa, et al., 2023). Pattern recognition in computational thinking uses the identification of similarities in a particular set or sequence of data to simplify understanding and solving a problem. Pattern recognition skills are needed when solving problems in everyday life (Ansori, 2020). This skill can increase student effectiveness when carrying out the problem solving process by creating solutions that can be repeated to solve similar problems or goals. While computational solutions cannot be repeated in their entirety for different problems or purposes, pattern recognition skills can help identify different parts that can be solved using other solutions.

The profile of computing skills on algorithmic thinking indicators possessed by students is trained using STEM-based science educational game learning media. This allows students to solve test questions correctly. STEM-based science educational games train algorithmic thinking at level 5 where students create the stages of operating a maglev train. Pattern recognition indicators are trained by systematically or sequentially arranging steps related to the steps for running a maglev train. When determining this sequence, students cannot miss a single step so as to form complete order. Meanwhile, when working on questions, students succeed in applying algorithmic thinking skills to a problem sequentially and logically like a computer algorithm. When working on test questions, students' algorithmic thinking skills make it easier for students to understand each step or stage presented, then arrange these steps systematically without missing a single step until they get the answer to the question. This is in accordance with the opinion of Maharani, et al (2020) that algorithmic thinking includes a process of making systematic steps to solve a problem.

The steps arranged based on algorithmic thinking skills must be orderly, sequenced and complete (no steps are left behind) because if these steps are not carried out systematically then the right solution will not be formed. There are three things needed for algorithmic thinking, including 1) problem, namely a problem that you want to solve; 2) input, namely arranging steps to find a way out of a problem; and 3) output, namely the final form of the data or state after the algorithm is implemented into the input. Output is the desired ideal result and is considered to have solved the problem or found the right solution. If students always use algorithmic thinking skills to solve a problem, students will get used to dealing with bigger, more difficult and more complex problems (Palts & Pedaste, 2020). Students can also easily detail the problem and then solve it in the form of steps in sequence. This was also conveyed by Ansori (2020) that algorithmic thinking skills are very necessary in the surrounding environment. Students who are used to being trained in algorithmic thinking skills can easily face problems in everyday life.

Conclusion

STEM-based science educational games can be used as a learning medium that trains CTS on materials such as work, energy, and simple machines. The profile of students' CTS after using STEM-based science educational games was measured using a multiple choice test. The test results are then used to categorize students into high, medium, and low categories. A total of 17 students or 56.66% were in the high category, 8 students or 26.66% were in the medium category, and 5 students or 16.66% were in the low category.

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