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Potential Scratch Games in Developing Students' Thinking Skills

Anis Syahmi Mohd Asri[1*], Khairul Azhar Jamaludin[2]

[1]Faculty of Education, National University of Malaysia, 43600 Bangi, Selangor, Malaysia.
Email: p112116@siswa.ukm.edu.my
[2]Faculty of Education, National University of Malaysia, 43600 Bangi, Selangor, Malaysia.
Email: khairuljamaludin@ukm.edu.my

CORRESPONDING AUTHOR (*):
Anis Syahmi Mohd Asri
(p112116@siswa.ukm.edu.my)

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ABSTRACT

Previous research has indicated that several factors contribute to Malaysian students' minimal level of thinking skill achievement when compared to students in other countries. This is a result of the implementation of teaching techniques that are uninteresting to students and contribute to their understanding of the topic being limited to the basics. In addition, it become challenging to comprehend a subject in greater depth, Malaysian students are less exposed to the advancement of information technology (IT). It is true that students are more likely to effectively use technology than to construct it, especially when learning in schools. This study aims to review the potential scratch games in students thinking skills. Students required to learn using modern method such as Scratch games in learning to enhance thinking skills. However, although problem solving is essential for programming but how it is being used to develop students thinking, computational thinking and mathematical ideas and how this Scratch games teaching method can enhance students' interest in learning. This study identified that scratch games development can be used to develop mathematical ideas, computational thinking, build an interactive learning between teacher and students and develop students thinking skills.

Contribution/Originality: The paper's primary contribution is finding that implementation of Scratch application can help students to improve their high order thinking skills (HOTS) in learning. Thus, this method can be proposed to the Ministry of Education and enhance teachers to use this method in their teaching for particular subject.

1. Introduction

According to Bernard and Setiawan (2020) they stated that teachers still use traditional teaching strategies and have not been able to develop interactive learning materials, which means that the focus of the learning process is still on the teacher and that students are not actively participating in it because there is only room for question and answer exchanges. For example, teachers still use 'chalk and talk' method by using PowerPoint as

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teaching aid in their mathematics class. This method of teaching quite boring and not engaging because there are no interactions between students and teaching aid.

Our education system nowadays has witnessed a rapid change in development especially in technology innovation in learning processes. This innovation and improvement of technology in education widely applied into the education system as well as to enhance more quality students in future. These changes of learning method become great challenges because the educators need to adopt with new learning method in order that meets 21st century skills. Teachers with prior knowledge in computer programming and computational skills will contribute and help the institution to develop this learning method with appropriate learning skills that can help students to enhance their thinking skills. As a result, learning media utilizing the Scratch programme started to be produced in tandem with technical advancements, and the scratch application was used to teach math.

Scratch is a visual programming language application for teaching and learning environments (PdP) that enables novices (students, teachers, students, or adults) to learn to code without worrying about syntax issues. Scratch games is a free visual-based programming language that can be used to create various kinds of works such as stories, games, animations, music, art, and presentations. Just by drag and drop a block of color on the module, Scratch can be run easily without having to master complicated programming languages. Scratch can be used by all ages even though this application is intended for children aged eight to sixteen years.

Students are intended to become more motivated, creative, and able to work in groups. The scratch programme help students comprehend the topic in a comprehensive and relevant way. Students will learn to think creatively, collaborate in groups, and become more engaged and active learners in this scratch application software. The Scratch program can produce learning media equivalent to the quality of Flash programs, but the process of making the media is equivalent to making media using a PowerPoint program. Scratch application can develop the potential of prospective teachers or students to create ICT-based interactive media in learning

2. Literature Review

2.1. Interest & Motivation in Learning

According to Prykhodchenko et al. (2020), scratch is an object-oriented visual and programming environment that enables students to create computer animations, multimedia presentations, interactive stories, games, models, and more. In the curriculum of Ukrainian elementary schools, the subject "Informatics" is related to the study of computer technologies. This discipline is studied from the second grade, while under the curriculum, in the third grade, students begin to study the Scratch programming language. Thus, to better understanding the language constructions, it is proposed to create a game in which the student will create a Scratch structure in a game with prompts from the teacher or from the game itself.

2.2. Thinking Skills

According to Kordaki (2012) these categories of activities can be used by computing teachers to create daily classroom environments that are suitable for teaching beginners

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how to programme in Scratch. Most significantly, students are rarely aware of the issues that computers can resolve and the advantages of using programming. The well-known educational tool Scratch (provides both a new programming language and a suitable environment for novices) includes both features to improve students thinking skills. According to Hadjerrouit (2008), the progress has been made in solving some learning problems in programming using constructivist learning theories and specific educational software, the problems and difficulties associated with the learning of introductory programming by novices remain to be researched. Scratch is designed to provide students with a rich set of programming tools and support for thinking skills and visualization of the program and its output in a real time execution. Scratch emphasizes the design of the algorithmic solution rather than memorizing the syntactic rules of a specific programming language.

2.3. Computational Thinking

According to Simon et al. (2018) many individuals all over the world contend that students should be taught how technology works and that the "computational thinking" abilities gained through programming are valuable in a variety of contexts. However, Scratch users frequently find it difficult to identify and fix "code smells" (poor programming techniques) like duplicated blocks and lengthy scripts, which can result in difficult-to-understand programmes. These "odors" are brought on by programmes' deficiencies in abstraction and decomposition, two abilities essential to computational thinking. To eliminate these odors in Scratch, employ repeats (loops), custom blocks (procedures), and clones (instances). Players can move through a grid, gather objects, and deal with obstacles by using Scratch blocks. Researchers found that using Scratch's repeats, custom blocks, and clones all of which are available right away and lack much built-in guidance players can spot and fix code smells. Thus, programming games often entail guiding an item around a grid using either text-based or block-based instructions. There are also suggestions that these games might be used to teach computational thinking.

The goal of the Scratch tool, which tests for the existence of the concepts and provides feedback with suggestions and tips on how to improve the code, is to inspire students to continue improving their programming skills, according to research by Serbec et al. (2018). By working on projects in an educational programming environment and using computers as learning tools, students can strengthen their CT and Scratch abilities as well as their creativity and originality. This statement supported by Brennan and Resnick (2012) which is they proposed that computational concepts, computational practises (such as project debugging or remixing) and computational viewpoints (reflective thinking about coding) in teaching because some students already have prior understanding of Scratch, future instructors must engage in project-based learning through the same activities that they would work on with their students in the classroom.

In this study, the researcher (Gutierrez & Neira, 2020), finds that the use of Scratch-based applications in the teaching of programming and computational thinking of gamification in technical education increased the student's motivation. This motivation may be intrinsic, when the student tries to complete tasks for their own interest, or extrinsic, when the student completes the tasks for a reward, when all the elements are integrated into the learning process. Computational thinking is strongly related to the teaching of programming. The Scratch programme, which enables students to correct, analyze, and catalogue the level of learning of a project by allocating a score dispersed among the

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various computational concepts, can play a role in this aspect of learning Another noteworthy is the creation of a fosters the growth of computational thinking and it can enhance assess computational thinking among students and Scratch can serve as an illustration of how theoretical ideas and computational thinking can be introduced to young children.

According to Korkmaz (2016), he stated that computer programming education should focus on developing advanced thinking skills such as problem-solving and logical and mathematical thinking. Learning computer programming is also an effective way to develop these skills, according to the researcher. Students can improve their problem-solving and logical-mathematical thinking abilities by studying and learning programming, which will ensure that they perform well in computer programming. Additionally, computational thinking aims to enable students to use their computational thinking abilities outside of the computer sciences classroom. Korkmaz (2016) also stated when someone solves a problem, they not only draw on their prior knowledge but also pick up some new information. It is believed that improving problem-solving abilities will further motivate students to conduct research and to share what they have learned with one another. Students who are developing thinking and problem-solving skills are considered to be one of the primary objectives of education.

2.4. Mathematical Ideas

According to Fessakis, Gouli, and Mavroudi, (2013) children were engaged and appreciated the issues presented to them, which included mathematical skills (one-to-one correspondence, counting, number comparison, introduction to and reinforcement of orientation skills, angle turn concepts) as well as the development of problem-solving strategies and communication and collaboration skills in an authentic communicative framework. They were also taught computer programming concepts and they lived tasks using either a planned strategy or a trial and error model, and they engaged in a range of social interactions, including a mix of competition and teamwork, which helped them keep their interest and increase their learning. The teacher guided and assisted the students in overcoming hurdles and coordinating their learning.

Martínez, Calero, and López (2020) stated that scratch can be used to build both students' mathematical ideas and computational thinking, and it can also be utilized as a visual environment tool to help students elaborate on the growth of mathematical thinking. Furthermore, scratch can be used as a visual environment tool to assist children in developing mathematical reasoning. Much of the current study on Scratch's function in the development of mathematical thinking focuses on the use of critical, metacognitive, and reflective abilities that are closely related to mathematics

Calao et al (2015) stated that using the Scratch visual programming environment to develop computational thinking helps elementary students enhance their arithmetic ability. It contributes to the establishment of engaging learning environments by promoting mathematical activities such as modelling, reasoning, problem solving, and exercise. Among the skills evaluated, he discovered that the exercising skill (comparing and executing procedures and algorithms) is the one that is least gained in traditional math classes but is especially strengthened by programming. He also stated that programming improves modelling and reasoning skills significantly. Finally, problem-solving skill improves, but it is the one with the most room for advancement. To target this ability, some viable methods include building specific programming projects or

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introducing specific programming learning approaches. Finally, problem solving improves, but it is the one with the most room for improvement. To address this skill, some recommended methods include creating specific programming challenges or introducing specific programming learning approaches.

According to Nurul, Nurfauza and Syahrul (2022), when compared to traditional ways of learning, games do not completely improve mathematical skills, but they do change attitudes toward mathematics. Because mathematics is difficult to learn, instructors and parents must use enticing tactics to capture pupils' attention from an early age. Students are more likely to be interested in games because games can provide ideal venues for practicing abilities, particularly in mathematics, where mastering the process requires extensive practice. Scratch programming was built primarily for youngsters to help them understand computer programming. Scratch teaches programming by connecting colourful command blocks to control various objects. This method is referred to as sprite motion on the stage background.

3. Methodology

This paper is conducted using primary research. Primary and secondary data were collected through library research. All the data and information collected are analyzed using the content analysis method.

4. Discussion

The syllabus provided is at a simple level for the students so that the teachers need to explain in more depth to sharpen the interest of the students to produce more effective and creative results. The additional training provided can further move the minds of students by combining techniques between one student with another student and can even produce a more effective PdP result by following the requirements of the questions provided.

Students using Scratch are investigating mathematical principles and beginning with the cartesian coordinates required to move sprites around the screen. Students can draw coordinate planes in Scratch to make that idea more concrete, or remix one of many comparable projects to add their own spin (for example, this game involving cartesian coordinates is a nice way to practice and has yielded several remixes).

Furthermore, math learning with Scratch does not have to be restricted to math-focused projects. Short issues can readily be incorporated into games, where solving them may allow a player to advance in the game or gather additional currency. Almost every form of project allows students to practice foundations such as cartesian coordinates, so students can pursue projects based on own interests while becoming acquainted with these principles.

5. Challenges

5.1. Teachers face difficulties in the process of applying computer programming elements in classroom.

In the use of computer programming, not all teaching runs easily and smoothly without any problems related to Scratch applications, therefore training and technical assistance

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do not get a high position to reduce all problems in ICT. This causes teachers to just let go of the problems if there is damage to the computer system. Problems that occur in the computer system cause teachers not to take kindly to the problems encountered.

Senior teachers in marginalized schools in receiving ICT training either ICT training organized by the District Education Office. State Education Department or organized by the Ministry of Education. Teachers from mathematics and science department, language department, vocational technical department are seen to have more opportunities to be sent to computer courses. The perception of difficult to accept change, slow to understand teaching using needs to be corrected. Incomprehensive distribution of training causes senior teachers to be unable to apply their lessons with computer programming-based teaching.

5.2. Lack of mastery in the techniques of using Scratch applications.

Teachers who do not know how to use the Scratch application do not have computer-related skills and in fact they do not take specific subjects regarding computer skills as a side subject. Teachers only focus on specific subjects. This causes teachers in schools to only have computer-related knowledge and only basic knowledge. They do not have extensive knowledge of the Scratch application or any computer programming application. The knowledge related to computers of these teachers is very thin because they may feel unsure in applying the use of computer programming in the teaching and learning process.

5.3. Lack of Initiative Factors to Strengthen Teacher Knowledge and Skills in Integrating Scratch Application

Teachers that carry out the teaching and learning process have the practice of using primary sources such as printed materials, textbooks, and others to continue the teaching and learning process to students. This is due to the time it takes to enter information into programming while attempting to start a teaching session. When there are issues with programming software or hardware, teachers take the initiative to carry out the teaching process using just primary sources, where the teaching process only applies in the classroom.

6. Recommendations

6.1. More school need to adopt Scratch games as one of the literacy courses in elementary and secondary level of education.

Students must develop and apply computer skills, as well as their imagination to create animations in the form of new computer games based on their creativity and imagination. However, the decoration of each series of computer games to be made is based on arrangements and combinations of 'blocks' and 'sprites' to produce units that can be utilized for effective teaching and learning (PdP).

6.2. Financial and facilities support from Ministry of Education and higher level administration

When technological facilities are completely provided, students' awareness in programming-based learning can be strengthened, as can students' motivation to learn

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through the technique digital learning. The technological facilities supplied by educational institutions do not reflect the seriousness with which digital learning is being implemented. To support the vision and mission of generating human capital goods that align with the needs of the business, the Ministry of Education should provide support and assistance in the form of hardware and software to educators and students based on need. In such cases, teachers will unite to join organizations such as professional communities to support programming-based learning. This would inspire teachers to educate in groups where resource development can be done collaboratively, and digital learning can be pushed more productively while motivating more students.

7. Conclusions

Scratch games are enjoyable and contain many useful features for problem-solving and learning tasks. However, there are some gaps or inadequacies in several areas where scratch games could improve. Aside from that, Scratch games are still a wonderful choice for problem-solving learning exercises because the existing features are fun, free, and open source. Furthermore, it is simple to use for both teachers and students. Scratch games in learning are one method of attracting students' attention and building interest during sessions. Scratch games are one of the learning methods utilized nowadays to promote interactive learning. Scratch games enable teachers to develop interactive content and share it with their students and colleagues. Students can simply access the content at any time and from any location. Scratch games include interactive activities such as Fill in the Blanks, Flashcards, Drag and Drop, Quiz, Mark the Words, and Memory Games. Other users can share and reuse the contents. These interactive activities are intended to engage students in active learning, produce deeper learning outcomes, and assist students in remembering and comprehending the topics. Teachers can also provide comments to pupils based on their performance. And this strategy should be extensively adopted to encourage active participation from pupils. Scratch games should be considered for inclusion in the teaching practice. After that, students can delve into and explore how to use backgrounds, audio and sprites effectively. Therefore, the rate of answering students' questions is more efficient and accurate. Where students become more confident and cheerful in the practical class while being able to improve the techniques of using Scratch applications and computer techniques more efficiently inside and outside the practical class.

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Conflict of Interests

The authors reported no conflicts of interest for this work and declare that there is no potential conflict of interest with respect to the research, authorship, or publication of this article.

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