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PRELIMINARY STUDY FOR THE IMPACT OF SCRATCH BLOCK CODING FOR SPECIAL NEED STUDENTS WITH HEARING DISABILITY

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Abstract:

In the pursuit of modernizing and advancing high-tech implementation in daily life, it is essential for everyone to stay updated by learning how to use emerging technologies. While many children can learn about these technological developments in school, special needs students, such as those with hearing impairments, may face challenges. For these students to effectively use new mobile apps or computer programs, instructors must be capable of translating and explaining how to navigate and manipulate the technology. Scratch blocks programming offers a simple yet effective approach for beginners to learn programming through the intuitive action of dragging blocks containing preset code. This method is not only enjoyable but also highly effective in teaching hearing-impaired children basic programming concepts. Throughout the process, these students have shown positive responses in class and were able to follow the lessons. Teachers observed positive changes in cognitive skills by the end of the course. Our study evaluates the impact of Scratch block programming on the cognitive abilities of hearing-impaired students, using interviews with school teachers and observation during the learning session. The students' engagement and progress during the lessons were notably positive, and cognitive improvements were clearly recognized by the teachers at the conclusion of the program.

Keywords:

Cognitive Skills; Hearing Impaired; Scratch Coding

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Introduction

Hearing-impaired students encounter distinct challenges in their educational journey. Their hearing impairment often limits access to verbal communication, which can hinder their cognitive development, social interactions, and overall learning experience (Çakır et al., 2021). However, recent advancements in robotics technology provide a promising solution to bridge this gap, offering hearing-impaired students innovative tools to enhance their cognitive abilities. Additionally, interacting with classmates who share similar disabilities can help special needs students overcome challenges during the learning process (Ioannou & Andreva, 2019).

The integration of advanced technology into daily life not only improves the quality of our lives but also enhances the outcomes of everyday activities (Shi et al., 2023). For example, smartphones now incorporate various features essential for daily tasks such as biometric identification, finance management, travel, communication, entertainment, and even office work. The widespread digitalization of data, from physical paper to cloud computing, has made these capabilities possible (Bakala et al., 2021).

Thus, it is crucial for everyone to adapt, apply, and use new technologies to ensure no one is left behind. This is why teaching and learning technology at an early age is encouraged, to spark interest and help children adapt to the continuous advancements in technology (Tsarava et al., 2022).

As for special needs students (SNS) with hearing impairments, tailored guidelines are necessary, as they cannot rely on auditory instructions. SNS tend to focus more on kinaesthetic learning, using visual cues to interact with their environment during lessons. Research has shown that primary school SNS can develop an interest in robotics, coding, and technology-related activities (Papadakis, 2020a). Many SNS are already familiar with smartphones in their daily lives, which aids the learning process. However, teachers skilled in sign language are still essential, particularly during the initial stages of instruction, to interpret and guide the students effectively.

Literature Review

Scratch Coding

Scratch is a free, block-based programming language developed by the Lifelong Kindergarten Group at the Massachusetts Institute of Technology (MIT). Because it is free to use, it is widely employed to create simple video games, apps, and programs that introduce students to the basics of programming (How Robots Can Assist Students With Disabilities - The New York Times, n.d.).

In this study, both instructors and special needs students (SNS) will need access to a phone or tablet for coding. There are two apps available for both Android and iOS devices: mBlock – Learn Coding and mBlock Blocky – STEM Education. Both apps use Scratch programming, allowing users to arrange commands independently to achieve the desired results.

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These apps come with built-in introductory tasks for SNS to complete. Throughout the session, instructors must monitor the students' progress and provide assistance, as some SNS may require additional explanations during the process.

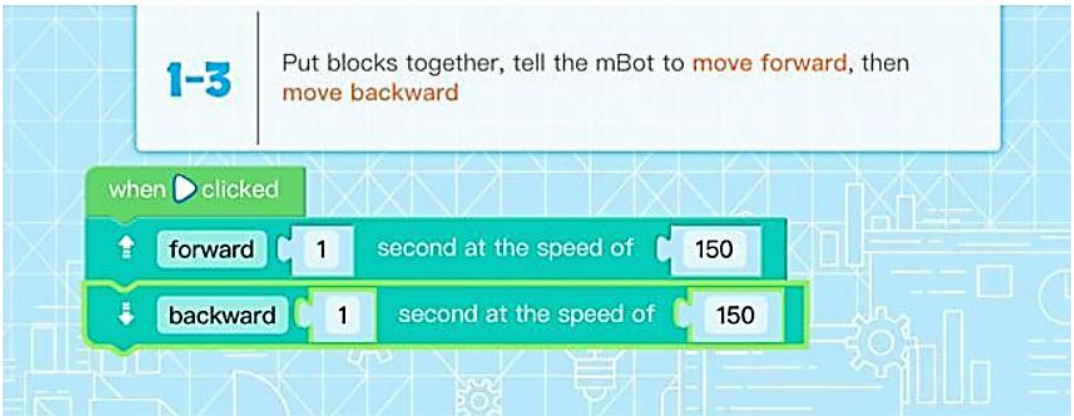

Diagram 1: Example Of Coding Line From mBlocky App

What makes this app user-friendly is that SNS only need to select the desired command and arrange it according to the instructions provided for the tasks. The instructor may need to be proficient in sign language to explain and interpret how to use the commands correctly.

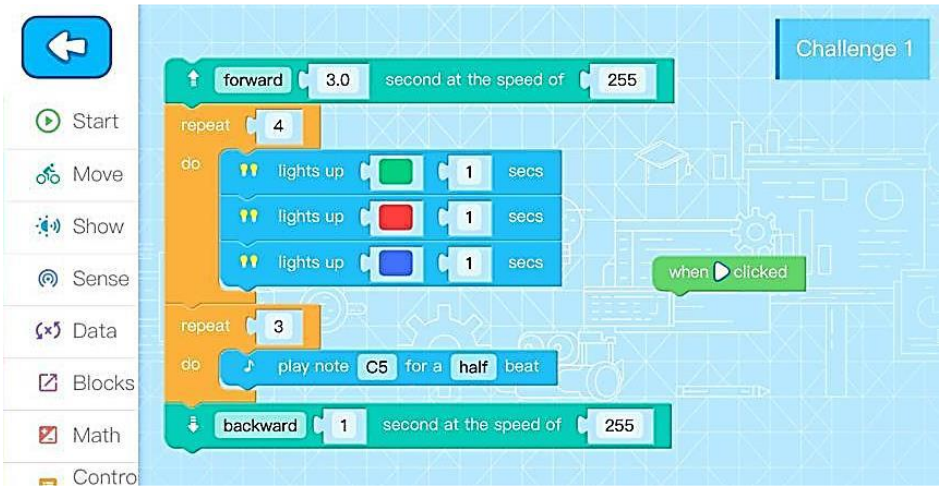

Diagram 2: Lists Of Commands That Can Be Compiled Together To Complete Given Task

As SNS get better understanding on how each command works and how to use it properly, the instructor may proceed by giving task that required SNS using multiple command to solve it. As example, by arranging 3 obstacles at different place, instructor will show what is the required outcome. SNS may use their own creativity doing scratch coding.

Methodology

This study involved special needs students (SNS) with hearing disability from two schools: (Sekolah Pendidikan Khas Besut, Terengganu with 10 SNS and Sekolah Pendidikan Khas

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Kelantan with 11 SNS). The students were divided into groups of 3 or 4 student each, with each group was provided with one set of mBot robotic kits. The instructions for assembling the robots were given in step-by-step formats, accompanied by diagrams for each step. SNS were encouraged to explore the process independently with minimal assistance from the instructor. They could experiment with different screws, for example, to see how choosing the wrong size might affect the robot's movement or mechanics (Chalmers, 2018).

Once the robots were assembled, SNS proceeded with activities designed to help them understand how the proximity sensor and line sensor function.

Proximity Sensor Activity: SNS were instructed to turn on the mBot in obstacle avoidance mode and use their hands to wave or block the mBot's path as it moved forward. The instructor could modify the activity by asking SNS to design their own obstacles and observe how the robot responds to these changes.

Line Sensor Activity: SNS were asked to draw a thick line (at least 3 cm wide) on a piece of mahjong paper using different-colored markers. The line needed to be thick enough for the sensor to detect the reflected light. The students then placed the mBot at the start of the drawn line, turned it on in line-follow mode, and observed whether it could follow the path. The instructor provided examples of the required line thickness and the pattern of the lines, which should have about a 6 cm gap between adjacent lines, to ensure the sensor could function correctly.

Following the assembly and sensor activities, each group continued with Scratch coding using their assembled mBot robots. Throughout the session, teachers remained with the SNS to observe their responses and behaviors (Ioannou & Andreva, 2019).

Since the SNS were unable to complete surveys or participate in direct interviews, the teachers who worked closely with them during the entire session were interviewed. The primary method of data collection in this study was interviewing the teachers before and after the session to observe any changes or improvements in the SNS. According to Merriam (2009), the interview method is highly effective for gathering detailed data from participants and can provide valuable insights in a short amount of time. Stake (2010) identified three key purposes of interviews: first, to gather unique information from the study participants; second, to obtain candid or honest statements; and third, to acquire detailed information about a subject that cannot be captured through observation alone.
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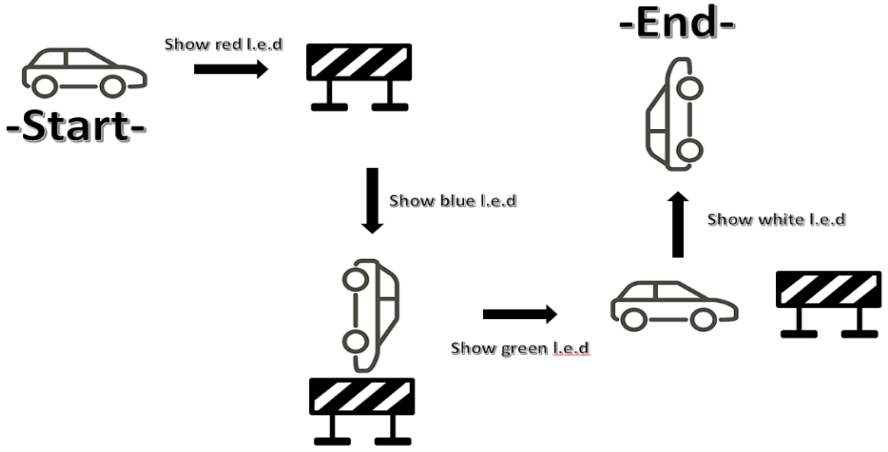

Diagram 4: Example Of Task For SNS To Complete By Scratch Coding Using mBlocky App.

Result And Discussion

5 series of questions were prepared and verified by external experts to validate the interview questions.

Q1) Should SNS Be Exposed To Science And Technology Learning At School?

Teacher 1/School 1: *"sangat perlu, MBK ni kalau belajar, teknologi ni macam menarik dia, macam magnet untuk dia.kalau ajar sesuatu benda, dari tak fokus dia boleh tengok, dia boleh tunggu input dari cikgu."*

Teacher 1/School 1: "of course, this technology is like a magnet that can attract SNS during learning sessions, it can help them to focus, to see and wait the input from teachers"

SNS may experience difficulties when it comes to the learning process in classroom. The approach of using robot and simple coding will help them to get more focus solving the problems related with task given. At the same time, SNS will have better communication with the team members as they are more committed in the activities using robot.(Lorenzo Lledó et al., 2024)

Teacher 3/School 2: *"amat perlu, sebab untuk kelangsungan kehidupan. Sekarang ni, kehidupan kita, bersama seiring selangkah dengan teknologi. Jadi, kita perlu dedahkan murid ni kepada sains dan teknologi."*

Teacher 3/School 2: "definitely, because for the survival/life. Now, our life is moving along with the new technology. So, we need to expose the students to science and technology."

Q2) What Are The Teaching And Learning Challenges When Educating MBK About Science And Technology?

Teacher 1/School 1: *"pengurusan masa memang sukar, sebelum kelas bermula perlu pastikan mereka sedia untuk kelas. Kalau kelas satu jam, 1 jam tu kena urus murid untuk bersedia dulu sebelum mula kelas."*

Teacher 1/School 1: "time management is quite difficult, before starting the class, I need to make sure the students are ready. If the time for the class is 1 hour, within 1 hour, I need to manage them to make sure they are ready."

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Teacher 1/School 2: *"cabaran untuk bentuk pelajaran tu seperti bermain. Kelas tak boleh macam murid normal, dalam bentuk permainan la saya nampak boleh digunakan"*
Teacher 1/School 2: "the challenge to make the lesson as in playing games. Unlike normal students' class, using games is possible for them."

The important part during the learning session is how to make it less stressful and make it fun. (Papadakis, 2020)Some SNS is volatile when given instruction with complex steps but by giving them toy-like learning materials will provide them more comforting situation.(Chalmers, 2018)

Teacher 3/School 2: *"cabaran berkomunikasi. Contoh, murid dengan masalah pendengaran, kita nak berkomunikasi dengan dia. Dalam bidang sains dan teknologi, kita boleh bagi sign language tapi kita tak pasti murid tu faham ke tak apa yang kita isyaratkan".*
Teacher 3/School 2: "problem with communication. As example, the students with hearing impaired, we want to communicate with them. In science and technology, we can give the students sign language, but we are not sure they can understand the sign given."

This was shown during the practical session with the SNS as it will take a few minutes to make sure all students are ready and can focus on the task given. The usage of robotic kit will give SNS an excitement to start assembling the kit and then preparing the codes to control the robot. The practical approach using physical interaction between the tools during the process is very helpful to help the SNS to focus and work in the team. It helped them to working in a group and focus their attention.(Yang, 2024)

Q3) Give Suggestions To Ensure That SNS Can Learn Together In The Field Of Science And Technology That Is Rapidly Changing Today.
Teacher 4/School 2: *"perlu kerjasama antara pihak sekolah dengan pihak luar untuk memastikan murid terdedah kepada aktiviti sains dan teknologi"*
Teacher 4/School 2: "need cooperation with other party outside of school to provide students with science and technology activities."

Q4) What Is Your View On The Impact Of This SNS Robotics Program?
Teacher 2/School 1: *"sangat membantu dan murid sentiasa bertanya untuk aktiviti dengan robot"*
Teacher 2/School 1: "very helpful dan the students always asking about the activities using robot."

Teacher 4/School 2: *"impak yang baik kepada murid dan juga guru yang sebenarnya tidak terdedah kepada program ini"*
Teacher 4/School 2: "good impact for students and teachers whom never been exposed to the activity before.

Positive feedback on this activity has been observed during the learning time as well as after the class. (Bakala et al., 2021)

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Q5) Is SNS Able To Learn "Coding" Effectively?

Teacher 2/School 1: *"boleh belajar, tapi sukar sikit sebab tiada isyarat,sign language yang boleh digunakan untuk mengajar. Ada certain command di dalam app tetapi tiada sign language yang boleh digunakan.*

Teacher 2/School 1: "can learn, but a bit difficult because there is no sign language that can be used for teaching the students. There is some action command within the app but no sign language that can be used to represent it."

The main obstacles during the learning session were how to explain each step for assembling the robot and the coding command in the app. (Ioannou & Andreva, 2019) However, as more sessions take place, better understanding and knowledge were shown by SNS. As they keep on practicing, positive improvement in robot coding were observed.

Teacher 3/School 2: *"untuk menguasai kemahiran teknologi ni memang bukan untuk murid ni. Kalau nak jadi pengguna, ok..tapi kalau nak jadi inventor bukan masanya lagi"*

Teacher 3/School 2: "to master this technology skill definitely not for these students. However, it is ok to use it as a user, but to become an inventor, now is not the right moment."

Conclusion

This approach of teaching Scratch coding to hearing-impaired special needs students offers a promising option for achieving significant positive results. SNS can gain an understanding of programming fundamentals through activities such as assembling, troubleshooting, and interacting with the robot in a simple, enjoyable manner. The students showed notable improvements in group work, peer communication, and focus during the sessions. The ability to create and issue commands to the assembled robot provided the SNS with an enjoyable learning experience while simultaneously accomplishing the tasks set by the instructor.

Although the expected positive outcomes were observed, challenges arose in preparing the necessary equipment, as a single set of robotic kits, including the mBot and tablet compatible with the app, can be costly. Additionally, there were delays in the initial stages of interaction, as instructors needed time to explain how the robot's mechanics and Scratch coding function in conjunction with the app. In conclusion, with skilled teachers and the right equipment, SNS can have a more effective and enjoyable learning experience, keeping up with the rapidly evolving fields of science and technology.

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