

A Study of Computer Programming by Using Sphero Robot

Theera Sathuphan* 

Faculty of computer science, Ubon Ratchathani Rajabhat University, Thailand, theera.s@ubru.ac.th

Supawee Makdee

Faculty of computer science, Ubon Ratchathani Rajabhat University, Thailand, supawee.m@ubru.ac.th

Tanet Sornpom

Faculty of computer science, Ubon Ratchathani Rajabhat University, Thailand, tanet.s@ubru.ac.th

Sukanya Nutaro

Faculty of education, Suan Dusit University, Thailand, sukanya.nut@dusit.ac.th

Somsak Khambaione

Faculty of science, Pakse Teacher Training College, Lao People's Democratic Republic

*Corresponding author E-mail: theera.s@ubru.ac.th

Received: 16 June 2023; Revised 17 October 2023; Accepted 31 October 2023

ABSTRACT: *Computer programming is now the trend of 21st century learning, and students will learn how to code from devices that can be controlled easier by smartphones and tablets: Sphero robot. By using this device, students can explore the computer language just like they would learn how to write and read in mother language. Researchers developed a manual of computer programming lessons using the Sphero robot and implemented it with 30 participants from Pakse teacher training college students. They engaged in the Sphero robot in the computer programming lesson for 8 hours. The result showed that computer programming lessons using Sphero robot can develop coding competency of all students without the barrier of basic knowledge skill.*

Keywords: Computer programming, Sphero robot and coding

1. Introduction

STEM education, is an appropriate learning choice in the 21st century, as the world has changed in many ways. Students need to adapt to catch up with the changing world, not only seeking knowledge, but also acquiring essential skills for living in the present and in the future. One skill that is increasingly being used in computer programming education is computer programming language. Computational thinking, which is a problem-solving process to find a rational answer and arrangement of work steps, analyzing the problem, which method to use, and what information to use and how each piece of information relates to each other, can distinguish what information is necessary to solve the problem (Jeannette M. Wing, 2019) and due to the past COVID-19 epidemic situation, causing problems in classroom management around the world. Computers play a big role in bringing students back into the classroom.

Programming is one of the cornerstones of the advancement of various sciences. Currently, there are a wide variety of programming learning styles, languages, and devices. And much more convenient by using the term M-Learning, which means learning presented through portable communication devices (Saroj Sophirak, 2015) for programming learning. Researchers are interested in the development of computer programming. Using a Sphero robot (figure 1.), which is a robot that supports programming on a smart phone and operates via a Bluetooth wireless network. It helps to support the learning of coding, especially through the Sphero Edu application, which can be used for both iOS and Android by connecting via Bluetooth. And can start learning code from the basics. Beginners can start by being forced to drive independently, like in a controlled car. Or order a command with a ready-made code format by arranging both scratch blocks, we can come to unpack the code to learn more language formats later. Because these commands are defined in a computer language called JavaScript. The researchers organized learning activities together with two

institutions, the faculty of computer science at Ubon Ratchathani Rajabhat University, Thailand, and Pakse Teacher's College, Lao People's Democratic Republic, with an experimental use in teaching and learning of both institutions to find guidelines for the development and application of basic computer programming learning management. Active learning was used, which is a learning management process based on the concept of intellectual creativity and constructivism that emphasizes the learning process rather than subject content. To help learners connect their knowledge or create knowledge for dairy life with real practice through media or learning activities with a teacher as a guide, encourager, or facilitator. Let the students learn through a high-level thinking process learners analyze, synthesize, and evaluate what is gained from learning activities. It can make learning meaningful and effective in other situations.



Figure 1. Sphero robot

2. Literature review

(Peerapong Promchan: 2018) has done research on the development of a learning package based on STEM education to promote programming skills and problem-solving. Using the learning plan, self-skilling exercises, and Sphero robots. The group-controlled experiments took the test before class and after class. The sample consisted of grade 10th students at Lue Khamhan Warin Chamrap School. In Ubon Ratchathani Province, 70 people who are studying in the first semester of the academic year 2018, were divided into an experimental group of 35 people and a control group of 35 people by means of purposive sampling. Assessment with pre-post-tests. The results showed that the efficiency of the learning package was 82.71 / 80.29. Learning progress for the experimental group was moderate ($\langle g \rangle = 0.52$), while that for the control group was low ($\langle g \rangle = 0.28$). Programming skills were 3.77 and problem-solving skills were 3.74, indicating that students could write programs and solve problems, and also able be to explain in more detail. The students in the experimental group had higher learning achievement than the students in the control group at a statistical significance level the .05 level. The mean student satisfaction with the learning package was 4.67 (SD = 0.49), so it could be concluded that the learning package successfully promoted the programming and problem-solving skills of grade 10th students.

(Chaloemwut Phuakthongbai: 2019) has conducted research on the study of learning management to develop computer programming skills in grade 2 students by using a programming skill practice set with the application Sphero Edu with a sample group of student in grade 2/4, a total of 40 students derived from purposive selection. The research tools consisted of a set of practice programming skills with application Sphero Edu, Sphero, the first set of pre-learning and post-learning tests. The result of comparing the scores of 40 sample students from the pre-test and post-test. Programming with application Sphero Edu found that the average score before using the programming skills training kit with application Sphero Edu was 3.08, the mean score after using the programming skills training kit with application Sphero Edu was 7.65, the students had an average score increase of 7.65. $-3.08 = 4.58$ or a score increased

by 4.58 percent, indicating that after using the programming skills training package with application Sphero Edu, students had developed programming skills better.

(Loannou, M. and Bratitsis, T, 2022) Using Sphero robot to design learning activities on the topic of speed with kindergarten to engage student interest STEM education and enhance problem-solving skills to develop essential skills in the future.

(Wheeler, A. et al, 2020) Using Sphero robot to learn mathematics in conjunction with computer programming with undergraduate students. The results showed that the students were able to construct the robot's roll direction, measure the distance, speed, and time of the movement.

From the review of relevant literature. The researcher has therefore created a research project to develop learning computer programming using Sphero robots. The objective is to develop a manual for learning computer programming with Sphero robots. To produce video media to teach computer programming with students from the faculty of computer science at Ubon Ratchathani Rajabhat University and students of Pakse Teachers College Lao People's Democratic Republic.

3. Methodology

3.1 Population and Sample

For the population used in this research, it is a collaborative research project between Ubon Ratchathani Rajabhat University and Pakse Teachers' College. The researcher used the population of both institutions, Ubon Ratchathani Rajabhat University, and the population of Pakse Teachers College students, Champasak Province, Lao People's Democratic Republic. Sample groups were computer science students Ubon Ratchathani Rajabhat University, 30 students and Pakse Teachers College students, Lao People's Democratic Republic, 30 students.

3.2 Collecting data tools.

1. Sphero robot
3. Computer programming skills exercises using Sphero robots
3. A survey suggesting learning computer programming using Sphero robots.

3.3 Data analysis and statistics used.

Data were analyzed using mean, percentage, variance and content analysis.

4. Result of the Research

The researchers designed a computer programming learning activity using the Sphero robot. There are steps as follows:

1. Engage students by introducing a video clip of Sphero robot. From the following video with QR code in figure 2.
2. Introduction to use, connection, control, and basic commands of Sphero robot.
3. Divide into groups, so that students can plan to work together as shown in Figure 3.



Figure 2. Introduction of using Sphero robot on YouTube



Figure 3. Pakse Teachers' College students practice writing computer programs to control Sphero robots.

4. Student practice by using a computer programming skill exercise using the Sphero robot as shown in figure 4, with levels of difficulty of the mission. Sorted from easy to hard. At the end of the activity, the assessment of programming competency. Every group would do the same task by planning programming and determining the movement, light, and sound of the robot from the attached video, the QR code as shown in Figure 5.

Activities

1. เมื่อกำหนดให้คำสั่ง `roll(0, 100, 1)` ทำให้ หุ่น sphero เคลื่อนที่ไปได้ 50 cm. แล้ว `roll(0,200,2)` จะทำให้หุ่น sphero เคลื่อนที่ไปได้100..... cm.

 1.1 `roll (0, 50, 1) --- sphero 50 cm` | `roll (0, 100, 1) --- sphero 100 cm`

`roll (0, 50, 1) --- sphero 50 cm` | `roll (0, 200, 1) --- sphero 200 cm`
2. คำสั่ง main (LED) เป็นคำสั่งกำหนดสี ซึ่งมีค่าตัวเลข 3 ตำแหน่ง คือ (R ,G ,B) ถ้ากำหนด `main (R = 0, G = 255, B = 0)` หุ่น sphero จะแสดงสีอะไร สีแดง....

Figure 4. An example of an activity in the computer programming skill exercise program using the Sphero robot



Figure 5. Using Sphero robot for computer programming learning activity and assessment on YouTube

5. tudents completed a survey to suggest learning computer programming using the Sphero robot as shown in figure .6

3. ให้เสนอแนะกิจกรรมที่ใช้หุ่น Sphero อย่างน้อย 3 อย่าง

3.1 ... การ เรียนรู้ ใน การ ใช้ โปรแกรม ใน ชีวิต ประจำวัน .

3.2

3.3 ... การ ติดตั้ง Program .

(a) Translation:

- 3.1 Learning to use programs in everyday life
- 3.2 -
- 3.3 Installing the program

3. ให้เสนอแนะกิจกรรมที่ใช้หุ่น Sphero อย่างน้อย 3 อย่าง

3.1 ... ให้นำไปสอนที่โรงเรียนอื่น ๆ เพื่อช่วยกันเรียนรู้

3.2 ... เพื่อให้นักเรียนได้คลายเครียดในการเล่นกับหุ่น

3.3 ... นำไปใช้ในการเรียนการสอน เช่น วิชา คณิตศาสตร์ - วิทยาศาสตร์

(b) Translation:

- 3.1 Transfer knowledge to various schools.
- 3.2 Make us relieve stress when play with robot.
- 3.3 Can be used in teaching mathematics and physics."

3. ให้เสนอแนะกิจกรรมที่ใช้หุ่น Sphero อย่างน้อย 3 อย่าง

3.1 ... นำไปสอนที่โรงเรียนอื่น ๆ เพื่อช่วยกันเรียนรู้

3.2 ... เพื่อให้นักเรียนได้คลายเครียดในการเล่นกับหุ่น

3.3 ... นำไปใช้ในการเรียนการสอน เช่น วิชา คณิตศาสตร์ - วิทยาศาสตร์

(c) Translation:

- 3.1 Can be used to teach people who do not know how to use robots.
- 3.2 Apply to learning English subjects.
- 3.3 Be able to teach about manufacturing and operating robots.”

Figure 6. Example of using Sphero robot suggestion from students

6. Conclusion and discussion

The sample group included both students who did not study in a field that required basic computer subjects and students who directly studied computer subjects. Effects of active learning and cooperative learning by assorting students this time show that learners of all disciplines can learn and develop basic computer writing skills using Sphero robots in conjunction with research-developed manuals (Nardelli, 2019). For students to practice thinking and solving problems in sequence (Shepherd et al., 2019). From Figure 6 (c), this suggestion came from English major students. The researcher interviewed further found that the students were proud to use their knowledge of English and were proud of their field of study because they could help their friends translate block commands (Stefanut & Tripon, 2017) because programming requires basic English. It is also a presentation representative of the group. Even if it's a student who doesn't study computer programming directly. It has been shown that the development of basic computer programming competencies can be done for learners of all majors, even without prior knowledge.

Acknowledgement

The research team would like to thank Ubon Ratchathani Rajabhat University for supporting the budget for international research and thanks to the faculty members and students from Pakse Teachers College, Champasak Province, Lao People's Democratic Republic, co-developing activities for using the activities in teaching and learning.

Authors' information

Theera Sathuphan is an Assistant Professor and lecturer in program of computer science, faculty of computer science, Ubon Ratchathani Rajabhat University, Thailand

Supawee Makdee is an Assistant Professor and lecturer in program of computer science, faculty of computer science, Ubon Ratchathani Rajabhat University, Thailand

Tanet Sornpom is an Assistant Professor and lecturer in program of multimedia and animation, faculty of computer science, Ubon Ratchathani Rajabhat University, Thailand

Sukanya Nutaro is an Assistant Professor and lecturer in program of elementary education, faculty of education, Suan Dusit University, Thailand

Somsak Khambaione is a lecturer in division of biology, faculty of science, Pakse Teacher Training College, Lao People's Democratic Republic

References

- Peerapong Promjan. (2022), Development of a learning package based on STEM education to promote writing skills. programs and solutions. Faculty of Science Khon Kaen University.
- Panumas Thiemsriratchanikorn. (2021). The development of EM learning lessons combined with self-directed learning. about programming languages Introduction to Python for students majoring in computer studies Nakhon Pathom Rajabhat University: Development of M-Learning Lessons Combined with Self-Guided Learning on Introduction to Python Programming. Journal of Faculty of Education Pibulsongkram Rajabhat University, 8(1), 1-13.
- Saroeh Sophirak. (2015). M –Learning. Journal of Bangkokthonburi University, 3(2),32-33.
<https://ascs.ac.th/wp-content/uploads/2020/09/นายเชลิมวุฒิ-เชื้อทองใบ.pdf>
- Jeannette M. Wing. (2562). Computational Thinking. Retrieved September 25, 2019.
from <https://www.cs.cmu.edu/~15110s13/Wing06-ct.pdf>
- Loannou, M., & Bratitsis, T. (2022). Utilizing Sphero for a speed related STEM activity in Kindergarten. Innovating STEM Education: Increased Engagement and Best Practices, 109.
- Nardelli, E. (2019). Do we really need computational thinking? Communications of the ACM, 62(2), 32-35.

- Shepherd, C. E., Smith, S. M., & Buss, A. (2019). Introduction to Block Programming with Sphero Robotics.
- Stefanut, T., & Tripon, A. C. (2017). Educational Mobile Application using Sphero SPRK+ in an Augmented Reality scenario. *Romanian Journal of Human-Computer Interaction*, 10(3), 231-249.
- Wheeler, A., Smith, S., & Gardner, D. (2020). Using the Sphero BOLT to engage students mathematically. *Journal of Mathematics Education at Teachers College*, 11(2), 55-60.