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The Place of Educational Robotics in Learner's Computational Thinking: A Qualitative Study

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Conflicts of Interest
There are no conflicts to declare.

ABSTRACT

Owing to the impact created by Lego-robots based activities on learners, this study seeks to find out the place it holds in the development of young learners' computational thinking. Before embarking on this study, the author had the privilege to work with some Chinese grade five and six students as a volunteer. She reflected serially on the appropriate integration Lego robots implement to enhance computational thinking. Through these reflections, she realized that the Lego robot's use increases learners' ability to think, solve problems, and reason critically. One of the essential facets of her reflective practice was considering how students can extend this knowledge of building Lego-robot bricks to their daily lives and how their view of their environment will change. These compelled the research on educational robotics in learners' computational thinking. The researcher conducted this qualitative study in a community Training Center in Huzhou in Wuxing District Zhejiang Province, China. The research looked into how Lego-robot bricks develop students' computational thinking in problem-solving, critical thinking, creativity and what challenges teachers and students faced in the infusion of these Lego-robots bricks.

Keywords: EDUCATIONAL ROBOTS, COMPUTATIONAL THINKING.

1. Introduction

The infusion of robot-based activities into the classroom has made more impact on the learners. Investigation into this educational area has drawn the attention of several researchers. Several studies show that robots can boost the learning process of young learners by developing their problem-solving abilities, computational thinking skills, computer programming, and lots more in science, engineering technology, and mathematic STEM. The educational approach based mainly on developing logic and creativity in new generations since the first stage of education has proven very promising. (David et al. 2014). Robotics is an interdisciplinary sector of science and engineering dedicated to designing, constructing, and using mechanical robots. They substitute for (or replicate) human actions, and it is a product in the robotic field built to assist humans or mimic their

actions. In 1942 the word robotics appeared in Isaac Asimov's science-fiction story Runaround.

Several robot designs exist, such as pet robots, industrial robots, and household robots, to incorporate essential features into machines. Aside from these, they are also educational robots designed to teach and impact the educational sector. According to (Makeblock 2019), it's has been recorded that the first educational robots in the world can be traced back to the mid-1940s, after the Second World War ended. It's said that the robot toy was a "boxy, yellow, clockwork Robot Lilliput" from Japan. Due to the destruction Japan suffered from the war, manufacturers had to transition and focus on helping reconstruct the country. The interest was late sheltered to the USA and expanded worldwide. To this effect, robots systems' use is becoming fundamental if applied in the earlier years of education. For example, the teaching of Lego robots programming and coding is fun. It, therefore, represents an excellent tool for introducing computational thinking and helping the development of children's logical and linguistic abilities.

Furthermore, computational thinking consists of crucial computer science skills and practices used for various problem-solving tasks (Yadav et al., 2017). The necessity to integrate computational thinking in the classrooms was first discussed by (Papert 1972). He argued that computers could aid students to become active learners, developing procedural thinking through programming and manipulating technological learning tools like building Lego- robot bricks. Developing learners' computational thinking skills should involve solving problems, designing systems, and understanding human behavior by employing analysis, abstraction, sequencing, negotiation, and consensus-building techniques (V. Barr, & C. Stephenson 2011; J.F. Sanford, &J.T. Naidu 2016).

Furthermore, computational thinking can be regarded as a skill for every individual. It is necessary to have been added to every young child's learning, be it reading, writing or mathematics. It's an essential skill for their analytical abilities, not just for computer sciences only (Wing 2006.) Seymour Paper places a high value on computational thinking and esteem it as a 21st-century skill powerful enough to empower learners with skills to invent, carry out exciting projects and impact their future. With its rapid growth and impact on the educational system, there's no doubt that the world with life in is increasingly becoming empowered by science and technology. (Alimisis, N., A. Karatrantou & Tacho, 2005) Identify the benefits of Lego-based support in education. As of the time of writing, the researcher witnessed the impact of Lego integration on some Chinese learners in Grade 5 and 6. She was a volunteer to teach the English language to the learners in a local community center organized to help students improve on their English language and other subjects during weekends. Compared to others in countries where the users of these bricks have infused, their teaching process seems to be more open-minded, creative, and possess more critical thinking in learning and approaching daily and class problems. The overwhelming experience of the author for this short period of teaching stirs the researcher up to conduct qualitative research on the place of robotics in student computational thinking, focusing primarily on how they view and approach learning and daily situations.

1.1 Theatrical Framework

Computational thinking is described as learners' capabilities to solve genuine and complex problems using either a computer or computer scientist approach. It's associated with the essence of programming skills. Brennan and (Resnick 2012), to better improve CT, researchers have highlighted the importance of identifying an ill problem (Wing, 2011) do a formulation of a prototype (Settle et al., 2012), and evaluating its functionality (Ota, Morimoto, & Kato, 2016) during programming exercises or handling a problem. The integration of Lego-bricks-based activities in many young learners' learning triggers these thinking skills. The process of building and programming the Lego bricks increased their creativity and fostered their critical thinking, enabling them to view problems computationally.

In addition, constructivism is a theory and observation that reveals how people construct their understanding and knowledge in learning and teaching. This is a result of their experience from the events around them. Constructivism is viewed by (Elliott et al. 2000, p. 256). As "an approach to learning that holds that people actively construct or make their knowledge and the learner's experiences determine the reality. It's stated by (Arends 1998) that constructivism believes in the personal construction of meaning by the learner through experience. Sense is subjective by the interaction of prior knowledge and new events. They consider learners or children as beholders of expertise, not empty vessels who can't make out the meaning. The effectiveness of problem-solving results from students' ability to construct their learning through available learning tools. (John Dewey 1859–1952) argued that human thought is practical problem-solving. According to the constructivist learning theories, these experiences occur in social contexts such as a classroom where students bring real-world problems into the school curriculum, per more attention to the prior knowledge obtained by the learning to the learning environment (Turuk, 2008). This is recognized as a dynamic character of the relationship between instructors as facilitators, learners, and tasks, and it offers a perspective on learning as a result of social interactions.

The current study seeks to answer the question of the relationship between robots-based activities and computational thinking on grade 6 Chinese young learners?

2. Objectives

1. To access the role of Lego-based activities in building young learners' computational thinking in problem-solving.
2. To examine the relationship between Lego-based activities and students' computational thinking in critical thinking and creativity.
3. Identify the challenges faced in integrating Lego-based activities in the teaching and learning process.

Significance of the study

a. To identify the role of Lego-based activities in developing young learners' computational thinking.
b. To make the findings supportive to other young learners.

3. Method

This study engaged a qualitative research approach in seeking answers to questions. This study approach is known to help find solutions to yes and No questions 0n how people experience things and the way they form thoughts and act (Keegan, 2009). It's referred to as the study of phenomena' nature, including "their quality, different manifestations, the context in which they appear or the perspectives from which they can be perceived. Its practice transforms the world and turns it into a series of representations, including field notes, interviews, conversations, photographs, recordings, and memos to the self. At this point, qualitative methods are more descriptive, and the inferences can be drawn quite easily from the obtained data, involving an interpretive and naturalistic approach to the world (Yeboah, 2015). It was more convenient to use the qualitative approach for the nature of the study the researcher wanted to engage in. However, the method is not without limitations. The sample size is generally too small to generalize data beyond the samples selected for the particular study. Its benefits are overwhelming. The author used interviews, questionnaires, and observation to collect data, and descriptive narrative analysis was used in the data presented.

Target population

A research population is usually any extensive collection of specified human beings or non-human entities such as objects, educational institutions, time units, geographical areas, prices of wheat, or salaries drawn by individuals as the main focus of a scientific query. The target population generally is defined as a group or set of elements you want to know more information about (Rothman et al., 2008). In this light, the target population of this study is the students, teachers, and headteacher of the Huzhou community center.

Population

Chinese teacher	2
Foreign Teachers from grades 5 and 6	2
Students from grade 5 and 6	20
Total	24

Samples

Every population member should be included when carrying research. Nonetheless, this is unfeasible considering the large population, and it is hardly possible to collect data from every person in the group. Sampling is the process of selecting a sample from the inhabitants. Sampling allows large-scale research to be carried out with a more realistic cost and time frame because it uses a smaller number of individuals in the population to stand in for the whole. Two advantages of sampling are lower charges and faster data collection than measuring the entire population (Wikipedia.org, 2021).

This study makes use of probability and stratified sampling methods. Probability sampling makes use of a random sample that allows you to make use of statistical interferences about the whole group.

The researcher must divide the population into homogeneous subpopulations called strata using stratified sampling. The strata define the partition of the population (Thomas 2021), and it is formed based on members' shared attributes or characteristics. In this method, every person has an equal chance to be nominated from within a particular stratum to represent adequately.

Chinese teachers	2
Foreign teachers	2
Students	20
Total	24

The above sample was, therefore, the participant of the study.

Before the researcher collected the data, consent was given by the headteacher in charge of the community center, who then informed the parents of the students. This ensures that the data collection didn't interfere with students' daily learning.

Data collection instrument

For the success of this research, the main instrument used for the data were structured observations, questionnaires, and interviews.

Structured observation

It is a collecting method in which researchers gather data without direct involvement with the participants. In this methodology, the event or series of events is observed in its natural setting and recorded by an independent researcher (Davis 2018). It requires a precise definition and protocol of the observed behavior. It was a concerned fit for the study because of its flexibility, allowing the researcher to change the length of the observation periods from time to time.

In this study, the researcher used observation to notice learners' behavior and reactions toward using Lego bricks in learning and their application of computational thinking in problem-solving, creativity, and critical thinking. It helps the researcher to obtain accurate information.

Interview

According to Oakley, a qualitative research interview is a framework in which the practices and standards are recorded, achieved, challenged, and reinforced. It seeks to describe the meanings of central themes in the life world of the subjects. The main focus in interviewing is to gain a sense of and understanding of what the interviewee is saying. Interviewing has various forms, including individual, face-to-face, and focus group interviewing. In this study, the author interviewed two Chinese and English foreign teachers to find in-depth knowledge about the topic. The interview conducted was face-to-face, and most of the questions were open-ended. An interview guide was established to infuse computational thinking in problem-solving, creativity, and critical thinking,

Questionnaire

A questionnaire is a research instrument consisting of questions to gather information from respondents (Saul McLeod, 2018). Questionnaires can be referred to as a written interview, and they can be carried out face to

face, by telephone, computer or post. Questionnaires provide a relatively cheap, quick, and efficient way of obtaining large amounts of information from a large sample of people. In as much the use of questionnaires have many privileges, including being economical and less time-consuming, the results provided by this data collecting instrument lacks in-depth detail because the respondent is limited, there is less scope for respondents to supply answers that reflect their true feelings on a topic. In this, the students of the Huzhou community center were given a translated questionnaire guided by their teachers by reading the questions for them in cases they couldn't or lacked clarity to choose their opinion.

4. Data analysis

The qualitative data collected were transcribed and processed into information that the researcher could explain. Tables and graphs were drawn to illustrate the data, which helped to show the simple frequencies and percentages.

5. FINDINGS AND DISCUSSIONS

5.1 Student computational thinking and problem solving

In this case, Lego robots in the classroom influence learner computational thinking and ability to solve daily and class situations. The learners could approach problems in the classroom without the teacher's help. Move so, apart from classroom problems, do students record past difficulties they've encountered and were able to solve them alone? From the interview questionnaire and observation, the researcher realized that learners have experiences of handling problems encountered on their own, even when it comes to their housework. From the interview conducted with the Chinese class teacher, she said many of the learners could handle semi-complex problems and assemble the Lego bricks by themselves following the handbook and Program on their computers at home. The English foreign teacher said in her opinion; she sees that using the leg-bricks makes the learners more active, innovative, and prompt when asked questions; they often give quick answers. In the absence of a face-to-face interview with the parents, the researcher could still receive assurance from the teacher that the parents support the use of Lego bricks in teaching and are ready to provide the tools for home study after school. "It helps them learn and reduces environmental distractions," she said."

5.1 Critical thinking

The researcher observed that most of the learners believed in themselves, enjoined group work, and could carefully assemble the bricks given to them during lessons to build. They could contribute ideas to each other and kindly followed their class teacher's appointed leader's lead. Some of the groups asked exceptional questions, though I couldn't understand. The class teacher translated that he was asking if he could program the Lego he built to "father a child," the learners, when very happy with what they were doing, ideas kept coming up from different individuals. The class teacher said two group leaders were very critical in thinking. In the previous classes, they have individually assembled a Lego robot at home and programmed it on their computer without the teacher's assistance and instruction. She is so proud of them, "she recommended other parents to

buy home Legos for their kids to support their learning," she added a learner confessed he loves working and learning with the Lego bricks because it makes him think and image things he wants to do in the future; the child added by saying the big trucks he sees on television, I will use the bricks to build it in future when am old and have a company for cars.

5.3 Computational thinking

When observed, the author noticed that majority of the learners handled the bricks with care and wouldn't talk anyhow or be rude to their classmates. They will also make sure they tell their friends "du bu qi" (am sorry) when they offend them and prefer reporting an odd behavior to the class teacher. A student said it is awful to make her friend cry in class, and she will take care of the bricks because if they are broken, her teacher will ask her grandmother to pay for and she won't be happy with her.

Lego-robots relationship and computational thinking

5.4 The challenges face with using Lego-robots activities in the classroom.

Though Lego robots make the learning process exciting and interactive, as per Lev Vygotsky 1978 and Maria Montessori, learning through play is a critical element for young children to develop essential language, emotion, creativity, and problem-solving skills. Social interaction pulls together the logical and creative areas of the brain. It's also very challenging when care is not taken, and it might drive the kids' attention from other lessons wherein these bricks are not integrated. Some of these challenges also come as a result of the learners having difficulties in using a mouse, typing, remembering where the letters on the keyboards are, understanding the syntax of coding languages, and let's not forget the much shorter attention spans for someone who is already allowed to do programming after building the Lego-robots. The author noticed that those learners who couldn't fully participate were isolated through observation.

6. Recommendations

Taken into account that this study was carried out in a smaller population wherein the teachers and learners are few, the educational service in schools integrating Lego-robots into the teaching and learning process should make available more STEM and educational technology trained teachers to help the learners, make available laptops and increased the Lego-robots in the classes to limit the number of learners in a group for effective participation of each learner. There should be regular in-service training on integrating technology into teaching and learning. Videos and games should improve the assimilation and retention of knowledge.

7. Limitations

This study was conducted on a smaller sample of students in a training center in a local community with just a few students in Huzhou Wuxing District in China using limited variables and tools. Hence, the results cannot be generalized to a larger population. Also, the language barrier and full access were challenges to the author, who could not freely interact with the students.

8. Conclusion

The integration of Lego robots in the classroom plays an excellent role in students' computational thinking. A well-furnished and equipped STEM classroom will widen the reasoning and understanding of the students, increase their problem-solving skills, and also introduce their technological world, promoting engineering where students can take the various plastic pieces to construct robots, buggies, or devices, while ensuring they can physically "move" or "operate" together to successfully and repeatedly perform a task, encourage them to build team spirit as the work in groups to accomplished tasks. As they make the robots, they become aware that computers don't think for themselves. All technology is based on coding despite its complex nature; it will cause them to think and imagine what their robot will do and how they will drag and drop for it to function and into the plain language blocks into correct sequences using logic. Lastly, with some of the questions posed to the learners on what problems they face daily, whether they think others face such issues, and how can they solve such problems? The prompting of these questions helps learners consider their environment and apply their computational skills.

References

1. Arends, R., I. (1998). Resource handbook. Learning to teach (4th ed.). Boston, MA: McGraw-Hill.
2. Alimisi, D., N. s, A. KaratrantouTacho, Technical school students design and develop robotic gear-based constructions for the transmission of motion, in: Eurologo 2005, Digital Tools for Lifelong Learning, Warsaw, DrukSfera, 2005, pp. 76–86 electronics (MIPRO), pages 958–960, May 2017.
3. Brennan, K., & Resnick, M. (2012). New Frameworks for Studying and Assessing the Development of Computational Thinking. Proceedings of the 2012 annual meeting of the American Educational Research Association, Vancouver, Canada.
4. Barr, V., & Stephenson, C. (2011). Bringing computational thinking to K-12. ACM Inroads, 2(1), 48. https://doi.org/10.1145/1929887.1929905.
5. David et al., 2014 L.A. David, C.F. Maurice, R.N. Carmody, D.B. Gootenberg,
6. Elliott, S.N., Kratochwill, T.R., Littlefield Cook, J. &Travers, J. (2000). Educational psychology: Effective teaching, effective learning (3rd ed.). Boston, MA: McGraw-Hill College
7. "Makeblock: Global STEAM Education Solution Provider". www.makeblock.com. Archived from the original on November 4, 2019. Retrieved November 5, 2019.
8. Mcleod, S., (2018). Questionnaire: Definition, Examples, Design and Types. SimplyPsychology
9. Oakley A., Gender, methodology and people's ways of knowing: Some problems with feminism and the paradigm debate in social science. Sociology. 1998;32: 707–31. [Google Scholar]
10. Papert, S., Teaching children thinking, Program. Learn. Educ. Technol. 1972) 245–255.
11. Published on September 18, 2020 by Lauren Thomas.
12. Rothman, K. et al. (Eds.) (2008). Modern Epidemiology. Lippincott Williams & Wilkins.
13. Turuk, M. (2008). The Relevnavce and Implications of Vygotsky's Sociocultural Theory in the Second Language Classroom. ARECLS, 5, 244-262.
14. Vygotsky, L. (1978). Interaction between learning and development. Readings on the development of children, 23(3), 34-41.
15. Wing, J., M. Computational Thinking. Communications of the ACM 49(3), pp. 33-35. 2006.
16. Wing, J., M. (2011, March 06). Computational thinking: What and why. The Link. Retrieved from http://www.cs.cmu.edu/link/research-notebook-computational-thinking-what-and-why
17. Yadav, S., Daugherty, S., Shetty, A.C., Eleftherianos, I. (2017). RNAseq Analysis of the Drosophila Response to the Entomopathogenic Nematode Steinernema. G3 (Bethesda) 7(6): 1955--1967.
18. Yadav, A. S., Gretter, J. Good, T. Mclean, Computational thinking in teacher education, in: P.J. Rich, C.B. Hodges (Eds.), Emerging Research, Practice, and Policy on Computational Thinking, Educational Communications and Technology: Issues and Innovations, Springer, Cham, 2017, pp. 205–220.

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