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COMPUTATIONAL THINKING ABILITY THROUGH ROBOTICS AND CONSTRUCTIVISM APPROACH SANALYSIS

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KEYWORDS

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ABSTRACT

Computational Thinking (CT) is the ability needed to help solve problems. The ability to think computationally is needed to manage activities in various disciplines. Computational thinking skills requires the right learning approach. One possible approach to improving CT is the constructivism approach. Constructivist learning provides opportunities for students to explore the ability to create, understand and solve problems through direct experiments. Constructivism learning can be facilitated using media or learning tools. One of the media or tools that can be used in building computational thinking skills is robots. Some researchers have examined the relevance of using robots in learning at various levels of education including the level of basic education. Through the results of research by several experts, the use of robotics in learning has a positive impact on improving students' computational thinking skills through activities using robotics. However, there has been no exploration of learning approaches that are compatible with the use of robotics. Therefore, we need a literature study that will be discussed in this article about the relationship between computational thinking skills and constructivism approaches, a study of the relationship between computational thinking skills and the use of robotics and about how to build critical thinking skills through constructivism and robotics approaches. This article uses the literature review method with the aim of reviewing how to build computational thinking skills through constructivism approaches and the use of robotics in learning at the level of elementary education. The review of this article indicates the existence of linkages and opportunities for constructivism approaches to improve computational thinking skills by facilitating the use of robotics.

INTRODUCTION

The industrial revolution 4.0 which prioritizes the use of technology provides challenges and opportunities. One of the challenges needed in the development of industry today is the ability to master technology and the ability to solve problems. Computational Thinking (CT) is the general ability needed to help solve problems, design systems, and understand human behavior through concepts [1]. CT is not only applied to computer science, but can be applied to various disciplines [2] [3]. The ability to think computation is very important for managing various daily activities [3]. Therefore, students are expected to have computational thinking skills in order to be able to understand the material provided by the teacher. It is not easy to shape students' computational thinking skills

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through learning Robotics is a media or tool that can be used to help shape computational thinking skills [3]. The last few years robotics are very popularly used in research especially related to computational thinking skills [1] [5]. Some of the researchers used robotics as a medium to improve CT [3] [6]. Through research and literature review, states that the use of robotics has a positive influence on student learning outcomes and motivation. There are various studies on computational thinking skills in education at the level of primary, secondary and tertiary education [7] [6] [3]. The ability to think computation is possible to be built early [7]. The ability to think of good computing is expected to help students in managing learning activities and understanding the material delivered by the teacher. While constructivism is a learning approach that provides opportunities for students to develop the ability to think independently [8] [9]. The purpose of constructivism approach in learning is to enable students to learn deeply and be able to know the meaning of the learning process [10]. This article uses the literature review method that reviews and identifies various articles related to robotics, constructivism and computational thinking skills in the field of education. The purpose of this article is to review and analyze the findings of research related to the influence of computational thinking skills using a constructivist approach through robotics at the basic education level and provide support that constructivist approaches and robotics are possible to help shape computational thinking skills

RESEARCH METHODS

The method in this article uses a systematic literature review that adopts the concept of Okoli & Schabram [11]. The following are the literature review steps that have been carried out.

Step 1. Planning.
- 1.1. Determining Objectives of Literature Review
- 1.2. Determining Standards and Rules

Step 2. Selection.
- 2.1. Search for Literature
- 2.2. Literature filtering that will be used

Step 3. Sorting.
- 3.1. Unused Literature Filtering
- 3.2. Information extraction

Step 4. Work
- 4.1. Analyze findings
- 4.2. Write a Review

2.1. Planning

In this planning process, determination of objectives and standard rules are used. The determined goal is whether the use of robotics with a constructivist approach has an influence on the formation of computational thinking skills.

2.2. Selection

This selection process includes determining keywords and filtering articles that will be used as literature review material. The article database is used to find suitable articles. Then for keywords using 3 different keywords namely "computational thinking skills", "constructivism" and "robotics". For the limitation of the article used is in the context of the world of education, especially at the level of elementary education. The article used in this review process uses articles obtained from Elsevier, Google Scholar, Science Direct that are in accordance with the keywords namely computational thinking, constructivism and robotics.

2.3. Sorting

This sorting process is related to which articles will not be used, then extract information. Articles containing linkages with predetermined keywords but not related to education and learning are not used in the reference list but are still used as review material to deepen identification. Then for the information extraction process, a matrix is used. The concept of this matrix adopts the concept of writing the Webster & Watson review literature [12]. The matrix contains the article author, article title, context of article research, methods used, findings obtained and development for further research. The matrix is made with the aim of facilitating the process of identifying information when it enters the work stage.

Table 1. Articles used as review material

Article Topics	Number of articles not included in the reference list	The number of articles used in the reference list
The ability to think computationally	8	7
Constructivism	7	5
Robotics	10	7

2.4. Processing

This process of work involves combining information and writing literature. The process of combining information based on a matrix that has been made. Based on the matrix concept made at the sorting stage, there will be harmonious results between the findings of the articles that have been reviewed with the intended objectives. Then write in the form of articles according to the findings of information obtained through the matrix.

RESULTS AND DISCUSSION

The ability to think computation is one of the important abilities that must be possessed by someone to manage and control cognitive activity and solve problems [3]. The ability to think computation consists of several stages of the concept of decomposition, recognition, abstraction and algorithm [3]. The stages of computational thinking ability aim to solve a problem through searching for clues, solving data into small parts so that it is easily managed and making steps to solve problems. The following is a table that explains the concept of computational thinking skills.

Table 2. The syntax of computational thinking abilities

Syntax	Description
Decomposition	The ability to break complex data, processes or problems into smaller parts to be more manageable
Recognition	Ability to view and recognize the characteristics or patterns of data and problems that will later be used as troubleshooting instructions
Abstraction	Generalize and identify patterns of data that have been obtained previously
Algorithm	Write down the steps for solving problems based on the instructions that have been found

Initially the ability to think of computing was the conceptual ability that programmers used to make computer programs. But in the last few years computational thinking skills have been studied in the world of education and are associated with the use of robotics in learning. The use of robotics in learning has a positive impact on computational thinking skills, motivation and student learning outcomes [1] [3]. Through the use of robotics in direct learning students will be more interested in learning activities. Indirectly this is effective in building students' computational thinking skills through direct experience with robotics. While the constructivism approach provides opportunities for students to build their own knowledge through direct experience [13].

Constructivist approaches have characteristics including: 1) Active students in learning to shape their own knowledge, 2) Teachers as facilitators in learning, 3) Students must be able to link information obtained through experience with subject matter [14] [15]. Through a constructivist approach facilitated by robotics it allows learning to be interesting and effective. Student learning activities become more interesting with direct activity with objects in real and not only through verbal explanations by the teacher. This allows students to understand the surrounding environment through events that have been studied [16]. So that the constructivist approach has a positive effect on computational thinking skills, namely the ability to analyze, manage activities and solve problems in various disciplines [3].

There is a link between constructivism approaches and the use of robotics that have a positive impact on computational thinking skills. Through the use of robotics as a medium in learning provides opportunities for students to solve problems through direct experience. The result is that students are able to form computational thinking skills through robotics

Table 3. The relationship between computational thinking skills, constructivist approaches and robotics

Author	Level of Education	Outcomes
Atmatzidou[3]	Senior High School	The use of robotics has a positive impact in developing students' computational thinking skills
Bers[7]	Early Childhood Education	Robotics has a positive influence on student interaction
Chen[17]	Basic education	The use of Robotics has the potential to improve competence and improve students' computational thinking skills
Ana[18]	Senior High School	Robotics has a positive influence to help build computational thinking skills
Goktruk[19]	Primary school	Constructivist approaches have a positive influence on the formation of thinking skills
Adak[8]	Junior high school	Constructivist approaches are recommended for building high-level thinking skills, one of which is computational thinking

Based on the information shown in Table 2, it shows that the use of robotics and constructivists has a positive impact on students' computational thinking abilities. Not only does it affect the computational thinking ability, but also the motivation and interest of students in learning that uses robotics through a constructivist approach.

CONCLUTION

Through the review process that has been done, the results obtained are positive links to the use of robotics and constructivism approaches to computational thinking skills. The constructivist approach that gives students the opportunity to develop knowledge independently and facilitated using robotics has a positive impact on developing computational thinking skills. Then the constructivism approach with robotics facilitation can be used in learning to improve computational thinking skills.

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