Systematic Literature Rivew: Improving Critical Thinking Ability through the Challenge Based Learning Model with STEM Nuances Assisted by Ouizizz

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Abstract

Critical thinking ability is one of the abilities needed in the 21st century. However, the situation of students in Indonesia is inversely proportional to the demands of the 21st century where students' critical thinking abilities are still low. The aim of this research is to analyze literature related to improving critical thinking ability through a challenge based learning model with STEM nuances assisted by Quizizz through a systematic literature review. The CBL model can empower critical thinking because in its syntax it combines important aspects that are focused on real problems. Science, Technology, Engineering, and Mathematics (STEM) also focuses on solving problems in everyday life so that students think about how to solve the problems they face, in the problem solving process a high-level thinking process occurs, namely critical thinking. Quiziz media can form critical thinking ability when answering guiz questions. Therefore, the CBL model with nuances of Science, Technology, Engineering, and Mathematics (STEM) assisted by Ouiziz can improve critical thinking abilities. The researcher recommends carrying out further research by developing it through field research in the classroom.

Keywords: Challenge Based Learning, Critical Thinking Ability, STEM, Quizizz

1. Introduction

Critical thinking ability is one of the abilities that students must master in the 21st century. Education today is very dependent on developments in science and technology which require students to be able to think critically. The ability to think critically is so important for life that it is included in one of the objectives of mathematics lessons, namely for students to have logical, analytical, systematic, critical and creative thinking ability (Depdiknas, 2006). However, the situation of students in Indonesia is inversely proportional to the demands of the 21st century.

Based on the results of the PISA report, it states that Indonesia is ranked 72nd out of 78 participating countries in the field of mathematics with a score of 379. Research by Rosmalinda et al., (2021) from an analysis of junior high school students' critical thinking abilities in solving PISA type questions shows that students' critical thinking abilities are still low. low with a percentage of 58.1%. Apart from that, Pratiwi (2019) also shows that the critical thinking abilities possessed by students in the low score category are very lacking, because students in this category are not able to meet all critical thinking indicators. Therefore, there is a need for innovation to improve students' critical thinking abilities. One of the efforts to improve students' critical thinking abilities is by implementing an appropriate learning model which includes activities that build students' knowledge to solve a problem.



Challenge Based Learning is considered capable of developing critical thinking abilities because it is a new teaching model that combines important aspects such as problem-based learning, project-based learning and contextual learning which is focused on real problems in everyday life. Challenge Based Learning can empower critical thinking abilities because it encourages students to be active in learning activities, students think about how to solve the problems they face, in the problem solving process a high level thinking process will occur which is called critical thinking (Nawawi, 2016).

Another innovation that can be applied to develop critical thinking ability processes is STEM. STEM is an abbreviation for Science, Technology, Engineering and Mathematics (Mulyani, 2019). STEM nuanced learning by integrating its four components is able to produce student thinking activities that are useful in helping to bring out students' critical thinking which is characterized by the ability to solve problems, make decisions, analyze assumptions, evaluate and carry out investigations (Khoiriyah, N., et al, 2018).

Technological developments in the world of education are able to create innovations in mathematics learning media, one of which is the application of Information and Communication Technology (ICT) which can help students. ICT as a learning medium is considered capable of providing support for the implementation of the learning process. One ICT that can be used to help learning is the Quiziz application. The use of Quiziz media or educational game websites in learning can form students' critical thinking and be able to capture students' memory Arif et al., (2021). The innovations that have been described can be combined into one as an effort to help improve critical thinking abilities. The combination of CBL, STEM and Quiz have similarities in helping students to develop their critical thinking abilities. Based on this background, this article aims to analyze literature related to improving critical thinking abilities through a challenge based learning model with STEM nuances assisted by Quizizz with a systematic literature review.

Method 2.

The method used in this research is Systematic Literature Review. The research method through Systematic Literature Review is a research methodology by collecting and evaluating several studies on certain relevant topics (Lusiana & M. Suryani, 2018). Through this method, identification, study, evaluation and interpretation of various available research are carried out (Afsari et al., 2021). In this research, articles have been collected from Google Scholars. The keywords used are critical thinking abilities. Challenge Based Learning, STEM, and Quizizz. The articles collected are articles with publication years from 2017 to 2023 and are related to keywords.

Results and Discussion 3.

3.1. Critical Thinking Ability

The definition of critical thinking can be interpreted as the ability to think and reexamine, as well as restructure existing thinking. This is due to the rapid development of today's era, which requires people to always perfect their abilities so they can function more effectively and efficiently in global communication and interaction (Davidi, E. I. N., 2021). A person cannot function or do something in just one way, in



fact there will always be turmoil, unpredictable and complex dynamics. Therefore, critical thinking abilities are needed (Setyaningtyas, 2019). Assuming that critical thinking is part of cognitive abilities, critical thinking abilities become a process of optimizing thinking abilities towards more complex stages. Meanwhile, according to Screven, Paul, & Angelo (2008) critical thinking is a disciplined process of conceptualization, application, analysis, synthesis and active evaluation as well as abilities collected or produced by observation, experience, reflection, application, or communication to obtain a conclusion. Based on the definition stated above, it can be concluded that critical thinking is an activity of solving problems, collecting and analyzing information, formulating assumptions, testing, and drawing conclusions which are then evaluated.

3.2. Challenge Based Learning

The CBL model is a learning model with the aim of making it easier for students to find ways to present or solve a problem (Yoosomboon, S., & Wannapiroon, 2015). CBL is a learning model that focuses on learning by doing and provides learning experiences to students to form student knowledge based on solving problems that occur in the real world (Johnson, L., Smith, R., Smythe, J., 2009). CBL is also a learning model that uses a problem and project-based approach (Baloian, N., Hoeksoma, K., Hoppe, U., Milrad, 2006).

Challenge-based learning is a learning method that starts learning from phenomena that are familiar in our daily lives (contextual) or rooted in global problems or issues and carries out a plan to solve them (problem solving) (Johnson, L., Smith, R., Smythe, J., 2009). In CBL, students are challenged to solve problems presented or projects that must be completed or can also originate from phenomena to be discussed. The solution taken should be in the form of concrete action and the solution obtained should come from simple things that they usually encounter in their daily lives.

There are several phases in the CBL model that are interconnected, namely (1) engage phase, (2) investigate phase, and (3) act phase. In the engage phase, the teacher asks important questions (Essential Questions) that come from big ideas (Big Idea) so that students can move from big ideas to challenges (Challenge) that are real and actionable. In the investigate phase, all students plan and participate in the process of creating the foundation for a solution and meeting curriculum requirements. In the act phase, students develop evidence-based solutions and implement them with an authentic audience and the results are evaluated (Nichols, et al., 2016).

3.3. Science, Technology, Engineering, and Mathematics

The application of STEM in learning activities consists of the 4Cs, namely creativity, critical thinking, collaboration, and communication, so that students can find innovative solutions to real problems they face and can convey them well (Beers, 2011). Learning using STEM can help students solve problems and draw conclusions from previous learning by applying it through science, technology, engineering and mathematics (Roberts, et al., 2017). The National Research Council puts forward a definition of STEM subjects in Table 1.



STEM Subjects	Explanation		
Science	Learning about the natural world, including the laws of nature's relationship to physics, chemistry, biology, as well as the application		
	of certain facts, principles, or relationships to the subject.		
Technology	Consists of the entire system of people, knowledge, processes and equipment necessary for the creation and operation of technological objects.		
Engineering	Basic knowledge about product design and creation as well as problem solving processes. Engineering uses concepts in science, mathematics, and technology.		
Mathematics	Learning patterns and relationships between quantity, number, and shape. Mathematics includes theory and application of mathematics.		
	(Table Source: National Research Council, 2012)		

Table 1. Definitions of STEM subjects

3.4. Quizizz

One of the technological developments in the world of education today is the innovation of website-based learning media that is effective and fun for children (Arif et al., 2021). Quizizz is useful in stimulating students' creativity in taking tests and questions given by the teacher. Quizizz is a game that makes it easier for students to learn because it is interesting by including moving and non-moving images. Options for creating questions can be determined by the account owner (Lestari et al., 2018).

3.5. CBL, STEM, and Quizizz to improve critical thinking ability

The results of the research data included in this literature review are tabulations of documented article data related to critical thinking abilities, CBL, STEM, and Quizizz in a total of 10 articles. For more details, see Table 2.

Table 2. Article Data Tabulation Results			
Peneliti dan Tahun	Judul	Hasil	
Sardi, 2022	Peningkatan Kemampuan	The CBL model is able to improve	
	Berpikir Kritis Siswa melalui CBL	students' critical thinking abilities.	
Rizky I. & Ardiansyah	Upaya Mengembangkan	Learning through STEM	
A. S.	Kemampuan Berpikir Kritis	integrated CBL can be used to	
	melalui Challenge Based	develop critical thinking abilities.	
	Learning Terintegrasi STEM		
Ash-Showy N. H.,	Pengembangan Bahan Ajar	Teaching materials are	
2020	Perbandingan Terintegrasi	comparative materials that are	
	Challenge Based Learning	integrated with CBL with a STEM	
	dengan Pendekatan STEM	approach and are able to develop	
	terhadap Kemampuan Berpikir	students' critical thinking	
	Kritis	abilities.	
Lestari et al., 2018	Implementasi LKS dengan	The STEM approach to learning	
	Pendekatan STEM untuk	can improve students' critical	
	meningkatkan Kemampuan	thinking abilities.	
	Berpikir Kritis Siswa		



Peneliti dan Tahun	Judul	Hasil
Ritonga & Zulkarnaini, 2021	Penerapan Pendekatan STEM untuk Meningkatkan Berpikir Kritis Peserta Didik	Implementing STEM can improve students' critical thinking.
Sappaile et al., 2023	The Effect of the STEM Learning Model on Stident's Critical Thinking in Indonesia: Meta- Analysis	The STEM model has a huge influence on students' critical thinking abilities. The STEM model helps students be more creative and innovative in the learning process.
Rahmawati L., 2022	Implementasi STEM dalam Meningkatkan Kemampuan Berpikir Kritis dan Kreatif Matematis	STEM has a positive influence on improving students' creative thinking and critical mathematical thinking abilities.
Davidi, E. I. N., 2021	Integrasi Pendekatan STEM untuk Peningkatan Kemampuan Berpikir Kritis	The STEM approach has been proven to be effective in improving critical thinking abilities.
Arif et al., 2021	Penggunaan Media Quizizz sebagai Pengembangan Berpikir Kritis Siswa	The use of educational game website media in learning with quizizz media is able to shape students' critical thinking.
Nurmanita, 2022	Efektivitas Pembelajaran Pancasila Berbasis Google Sites Berbantuan Quizizz untuk Meningkatkan Kemampuan Berpikir Kritis	Learning Google Sites with the help of Quizzizz can improve critical thinking abilities.

Based on the results of the literature review, it was found that: 1) learning with the Challenge Based Learning learning model is good for improving students' critical thinking abilities, 2) learning with a STEM approach is considered effective for training students' critical thinking abilities, and 3) the use of guizizz media in learning can shape students' critical thinking abilities. Thus, the CBL model with STEM nuances assisted by Quizizz can be used as an effort to improve students' critical thinking abilities.

4. Conclusion

From the discussion above, it can be concluded that the Challenge Based Learning model with STEM nuances assisted by Quiziz can be an innovative solution in improving students' critical thinking abilities. Using the CBL model, students have a lot of space and opportunities to solve problems by developing solutions to challenges critically. Through STEM, students gain knowledge or new things related to other scientific disciplines and are able to solve everyday problems in the real world with solutions that encourage critical thinking. The application of Quiziz media will motivate students to learn mathematics and can improve student learning outcomes which lead to critical thinking abilities. Suggestions from researchers to conduct further research by developing it through field research in the classroom.



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