JTAM (Jurnal Teori dan Aplikasi Matematika)
http://journal.ummat.ac.id/index.php/jtam
p-ISSN 2597-7512 | e-ISSN 2614-1175
Vol. 7, No. 2, April 2023, pp. 273-282

Analysis of the Needs of the PMRI Learning Environment for Geometry Material on the Critical Thinking Ability of PGSD Students

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Article History:
Received : 16-11-2022
Revised : 24-02-2023
Accepted : 10-03-2023
Online : 06-04-2023

Keywords:
Learning Environment; critical thinking ability; geometry.

ABSTRACT

Conducive learning situation is related to the quality of learning that is packaged in a learning environment. The purpose of this study is to describe the analysis of the PMRI learning environment's needs for geometry material on critical thinking skills. The ability to think critically is a skill that must be possessed by teachers, prospective teachers, and students in the 21st century; therefore, the availability of a learning environment based on the PMRI approach is very important for teachers, prospective teachers, and students, especially prospective teachers. This study uses a quantitative descriptive research method, with the number of respondents specifically testing the critical thinking ability test questions 40 people who were PGSD students at the PGRI Palembang University and the number of respondents specifically filling out the questionnaire as many 199 people, consisting of students from PGRI University of Palembang, PGRI University of Silampari and PGRI University of Yogjakarta. Data was gathered through the use of tests and questionnaires. The data collected were analyzed descriptively and quantitatively. Based on the analysis of test data, 80% of critical thinking skills are still below average, and questionnaire analysis revealed that 60.9% of the geometry material is considered difficult for students; students also do not understand the knowledge of 21st century skills, especially critical thinking skills, and the PMRI approach is still not well applied in the student learning environment. Therefore, requires further research that applies the PMRI approach in the learning environment and geometric difficulties can be overcome.

https://doi.org/10.31764/jtam.v7i2.11970

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A. INTRODUCTION

One needs a mapping of essential competencies, (Germaine, Richards, Koeller, & Irastorza, 2016). In the world of work, world development demand changes to the competence of each individual. These competencies include the ability to think critically, solve problems and collaborate which will be linked to 21st century skills (Daryanto & Syaiful , 2017). Successes achieved in the 21st century have been formulated by education experts and other policymakers, whose members are in the Partnership for 21st Century Skills, proposed by the National Education Association. These competencies are stated in the 4Cs: (1) critical thinking and problem solving. This includes the ability to reason, think, make good evaluations and decisions, and solve problems;

(2) Communication defines oral, written, and non-verbal communication skills in various forms, contexts, and technologies; decipher meaning and purpose; and communicate in diverse environments; (3) Collaboration is defined as the ability to work diversely, be flexible, be willing to achieve common goals, collect responsibility for collaborative work, and respect individual contributions from team members; and (4) Creativity and innovation define the creative ability of new and useful ideas; they describe, revise, analyze, and evaluate ideas to improve and maximize problem-solving efforts to achieve the essential competencies needed in the 21st century. Three main components must be implemented comprehensively. (1) A more adaptive curriculum content development can inspire thinking and skills related to the challenges of the times; (2) The more participatory the learning model, the more the development of the learning model is directed at developing collaborative, interactive, creative, and innovative skills; and (3) a more meaningful assessment, namely the development of a contextual assessment model and the demands of higher-order thinking skills (HOTS). These three components must run simultaneously and be integrated (Rotherham & Wilingham, 2009).

Define critical thinking as the art of improving thinking skills in analyzing and evaluating specific problem-solving situations (Choy & Cheah, 2020). A trained critical thinker can (1) formulate key questions and issues, as well as; (2) formulate problems clearly and precisely; (3) collect and assess relevant information, using abstract ideas to interpret it effectively; (4) produce a logical conclusion and be able to test it using certain criteria and standards; (5) An open mind in alternative systems of thought in order to recognize and assess their assumptions, implications, and practical consequences as needed; and (6) communicate effectively with others to find solutions to problems (Normaya, 2015). Critical thinking skills include: (1) problem analysis, critique of arguments, and verification; (2) drawing conclusions using inductive or deductive reasoning; (3) assessing and evaluating; and (4) making decisions or solving problems. Other abilities identified as relevant to critical thinking include asking and answering questions for clarification, interpreting and exploring, and verbal reasoning, particularly related to concepts of probability and uncertainty, predicting, and seeing problems from different perspectives (Lai & Viering, Assessing 21st Century Skills: Integrating Research Findings, 2012)(Lai & Viering, 2012).

Critical thinking is a thinking skill that can be developed through learning and assessment in the classroom. Improve the critical thinking skills of teachers and students in schools (Tresnawati, Hidayat, & Rohaeti, 2017). This can be done by (1) using a learning model that involves students actively in the learning process rather than relying on lectures, notes, and memorization; (2) Focus the lesson on the learning process and not just on the material; and (3) using assessment techniques that require HOTS, giving students an intellectual challenge, and minimizing assessments involving only memory. Critical thinking (critical thinking skills) has become one of the tools used in our daily lives to solve several problems because it involves logical reasoning, interpreting, analyzing, and evaluating information to enable a person to make reliable and valid decisions (Jumaisyaroh, Napitupulu, & Hasratuddin, 2015).

In studying mathematics, critical thinking needs to be integrated and emphasized in the curriculum. Therefore, students can learn skills and apply them to improve their performance and reasoning abilities (Chukwuyenum, 2013). Based on the description above, it is possible to

conclude that critical thinking skills are essential. This includes the skills of analyzing and solving problems, critiquing arguments, verifying, drawing conclusions using inductive or deductive reasoning, assessing and evaluating, making decisions, interpreting and exploring, predicting, and the skills of seeing problems from different perspectives.

In the 2013 curriculum, students' mathematical abilities and attitudes have an important role in shaping students' mindsets in solving problems (Afriansyah, 2014). And also has the goal that Indonesians have the ability to become individuals who are productive, obedient, creative and innovative, and have attitudes that can contribute to the nation and the world (Sultika & Hartijasti, 2017). According to (Fuadi, Johar, & Munzir, 2016), the objectives of learning mathematics listed in the 2013 Curriculum emphasize the modern pedagogical dimension, namely the scientific approach. Mathematics learning activities carried out using this approach are designed in such a way that learning becomes more meaningful. In practice, students are the subjects of learning which learning in the 2013 curriculum is student-centered (Kuncara, Sujadi, & Riyadi, 2016), so that students can be independent in mastering the basic and core competencies of all material concepts. Therefore, teachers are required to think critically and creatively and need to have the ability to make various kinds of problems (Chapman, 2015) which can require students to learn independently, mathematics is a subject that must be taught at all levels of education in Indonesia (Faturohman & Afriansyah, 2020) start from elementary school, junior high school, senior high school. In learning is competency-oriented, learning emphasizes knowledge and skills in a balanced way, and learning will be better using technological means (Ratumanan & Tetelepta, 2019). The stages of student learning activities consist of observing, asking, trying, reasoning, presenting, and creating (Rhosalia, 2017); (Maulina, Puspita, & Usman, 2018).

Improving the quality of mathematics learning is carried out not only because of the urgency of mathematics in other branches of science but also to improve the mathematical abilities of Indonesian students. The ability of students to solve problems that require problem identification, make various conjectural thoughts, choose appropriate strategies, find relationships between material content, reason, prove, review, analyze processes and results, and generalize conclusions is still below average (Afriansyah, Herman, Turmudi, & Dahlan, 2020). Some of the student's abilities mentioned are indicators of critical thinking skills. So it can be seen that students' mathematical critical thinking skills are still low.

Several previous studies revealed the problem of the low mathematical critical thinking ability of a teacher, resulting in the process of Learning is not going well (Hayati & Setiawan, 2022). The low ability of the teacher's mathematical critical thinking results in students not having the opportunity to see, identify, evaluate, and analyze with their abilities (Chukwuyenum, 2013); (As'ari, Mahmudi, & Nuerlaelah, 2017); (Aminudin, et al., 2019). Therefore, it is necessary to have alternative learning solutions that can be used as a tool to improve students' mathematical critical thinking skills, especially for teachers and prospective teachers who are trained to think critically.

The PMRI approach is an alternative learning solution that is considered capable of solving the problems in this study, even though PMRI is not a new learning innovation. The PMRI approach is expected to improve the learning quality of prospective student teachers. PMRI allows teacher-student candidates to better understand the learning transition process of students Gravemeijer &

Stephan (2002); Mudaly & Sukhdeo (2015); Afriansyah & Dahlan (2017), because learning is more student-centered, in this case with prospective teacher-students. Therefore, we need the right solution for this problem. Based on this description, the researcher is interested in describing the needs of a PMRI-based learning environment in geometry material for the critical thinking skills of PGSD students. It is hoped that this research will lead to a finding that can be used as a basis for the development of a PMRI learning environment in geometry material to improve the critical thinking skills of PGSD students.

B. METHOD

Methods this research is an initial research that is included in the first stage, namely research and data collection in research procedures. This research is limited to needs analyzes originating from test result and students questionnaires. Data collection techniques in this study used needs analysis instruments, namely tests and questionnaires for students, to find out the initial conditions in the field related to develop a PMRI learning environment.

This research is quantitative and descriptive. The purpose of this study is to describe the geometry material needs of the PMRI learning environment on critical thinking skills. This research involved 40 students who answered test questions and 199 students who filled out a questionnaire. The data in this study were collected through document analysis and questionnaires. The test questions are prepared based on indicators of critical thinking, the indicators are namely with the indicator writing down the information contained in the problem, identifying or formulating the right question, forming the problem from the given math problem, identifying reasons clearly and precisely, writing conclusions correctly, and questionnaires, which are statements compiled to find out students' opinions about 21st century skills, especially critical thinking, geometry material, and the PMRI Approach, the indicators are as follows indicators for skill 21 are knowing 21^{st} century skills, understanding the concept of skills, realizing the importance of 21^{st} century skills, applying 21^{st} century skill, appliying learning and innovation skills, applying information, media and technology skills, indicators on geometry are knowledge and difficulties geometry material and in PMRI the indicator is knowledge of the PMRI approach. The questions consist of four questions, while the questionnaire consists of 18 questions related to the needs of the PMRI learning environment for geometry material on critical thinking skills. The test questions were made to determine students' critical thinking skills, and the questionnaire used by the researcher was a closed questionnaire with yes and no answer choices. Select several answers and fill in the answers. The test questions were tested directly on PGSD students at PGRI Palembang University, and questionnaires were distributed to PGSD Palembang, Silampari, and Yogyakarta students via the Google form. The data were analyzed with the help of the computer program Microsoft Excel. Furthermore, after collecting data on the PMRI learning environment's needs for geometry material on their critical thinking skills, the data was analyzed descriptively and quantitatively by means of corrected test questions from the results of student answers and questionnaires seen from the result of answers or responses contained in the Google form.

C. RESULT AND DISCUSSION

The results of this study are the results of processing student test answers and questionnaire data that have been given and filled out by respondents with a total of 18 questions. The results of the responses can be seen in Table 1 and 2.

Table 1. Result of the Critical Thinking Ability Test Data

Score Interval	Frequency	Percentage (%)	Category
13,7 – 18,3	0	0%	Best
9,2 – 13,7	3	7,5%	Good
4,6 – 9,1	5	12,5%	Enough
0 – 4,5	32	80%	Less
Total	40	100	

Source: Research Analysis Results, 2022

Table 2. Results of Data Filling Questionnaires on 21st Century Skills, Geometry, and PMRI Approach

No	Question	Yes (%)	No (%)
1	Do you know about 21st century skills?	92,1	7,9
2	Where did you find out about 21st-century skills? (Answer choices can be more than one.)	93,6 (Internet)	
3	In your opinion, which skills are included in 21st-century skills? (Answer options may include more than one.) Do your lecturers apply 21st-century skills to learning?	47,5 (Innovate), 55 (Critical Thinking), dan 39,1 (Collaborative)	
4	In lectures, do your lecturers use models or methods for learning? Based on the choices below, which model, method, or approach has your lecturer used? (Answer choices can be more than one.)	94,6	5,4
5	Based on the choices below, what sources did you use to find reference sources? (There can be more than one answer choice.)	98,5	1,5
6	Based on the choices below, which model, method, or approach has your lecturer used? (Answer choices can be more than one.)	Project Based Learning (51,5), Discovery Learning (37,1) PMRI Approach (26,7), etc (32,7)	
7	Based on the choices below, what sources did you use to find reference sources? (There can be more than one answer choice.)	89,1 (Journal), 39,1 (Module), 67,8 (Book),	
8	What technologies have you used for the lectures? (There can be more than one answer choice.)	81,2 (Video), 95 (Power Point), 86,1 (Word), 60,4 (SmartPhone), 30,2 (LCD)	
9	Do you know what materials are included in the field of geometry at the elementary level?	95,5	4,5
10	In your opinion, is elementary school geometry difficult?	60,9	39,1
11	Try to write down what materials are considered difficult?	Build space, flat build, volume, and area, 3 dimensions	
12	So far, do you know what an approach to learning is about?	93,1	6,9
13	Do you have any knowledge of the learning	94, 6	5,4

	method at this time?		
14	So far, do you know what a "learning model" is in learning?	93,6	6,4
15	Do you know about the PMRI approach?	71,3	28,7
16	Do you know about PMRI principles?	65, 3	34,7
17	Choose one of the PMRI principles below:	Guided Reinvention and Progressive Mathematiz (74,3), Didactical Phenomenologi (23,3), Self-Developeds Models (28,2)	
18	Choose which of the following PMRI characteristics applies to you:	Use of Contextual Problems (38,1), Use of Model of Bridging by vertical instrument (28,7), Use of Students Contribution (33,7), Interactivity (39,1), Intertwining of Learning Strands (19,3)	

In Table 1, it explains the critical thinking ability of students 7.5% is good, 12.5% is quite good and 80% is less, while the results in table 2 are about 21st century skills questions 1-8. The results are Question 1: (92.1% yes, 7.9 no), question 2: (93.6% internet), question 3: 47.5 (innovate), 55 (critical thinking), and 39.1 (Collaborative), question 4: (94.6% 5.4%), Question 5: (98.5% yes 1.5% no), question 6 (Project Based Learning (51.5%), Discovery Learning (37,1%) PMRI Approach (26.7%), Others (32.7%), Question 7: 89.1% (Journal), 39.1% (Module), 67.8% (Book) , Question 8: 81.2% (Video), 95% (Power Point), 86.1% (Word), 60.4% (SmartPhone), 30.2 (LCD). Questions 9 – 11 about knowledge of geometry material, the results are question 9: (95.5% yes, 4.5% no), question 10: (60.9% yes 39.1% no), question 11: Build space, Shape Flat, Volume and area, dimensions. While questions 12-18 about the knowledge of the PMRI approach, the results are question 12: (93.1% yes 6.9% no), question 13: (94.6% yes 5.4% no), question 14: (93.6 % yes 6.4% no), question 15 : (71.3% yes 28.7% no), question 16 : (65.3% yes 34.7% no), question 17: Guided Reinvention and Progressive Mathematiz (74.3%), Didactical Phenomenology (23.3%), Self-Developeds Models (28.2%), Question 18: Use of Contextual Problems (38.1%), Use of Model of Bridging by vertical instrument (28 .7%), Use of Students Contribution (33.7%), Interactivity (39.1%), Intertwining of Learning Strands (19.3%)

From these results, it can be concluded that 80% of students still lack critical thinking skills. From these data, there must be further steps that must be taken, and also based on the questionnaire filled out by these students, it can be concluded that knowledge about 21st century skills is still lacking, especially critical thinking skills, and that the geometry material is still considered difficult for students. From the problems that have been described, there must be a further solution to the student learning environment that must be done. The right solution is the PMRI Approach. Judging by the results above, knowledge about the PMRI Approach is still lacking. (Sembiring, 2010) added that PMRI is an approach that is oriented towards the technical abilities of mathematics education based on problem solving. Furthermore, the PMRI approach can

overcome some of the previously mentioned problems in geometry material, especially in changing the classroom climate and provide guidance on how to develop and implement quality curriculum materials for teaching mathematics (Chairil, Hairun , & Suparman, 2020) . This is also in line with several studies conducted with (Meirisa, Rifandi, & Masniladevi, 2018); (Rosalina, Lestariningsih, & Kusumawati, 2022) (Sholilah & Rejeki, 2020), which stated that the use of PMRI had an effect on students' critical thinking skills. Afriansyah et al. (2021), stated that in general, the MTK achievement of prospective teacher students who received RME-EM learning was higher than the MTK achievement of prospective teacher students who received conventional learning, specifically their critical thinking abilities, and also in the characteristics of PMRI can make teachers and students think, as can be seen from the characteristics of PMRI, namely (1) using real-world contexts as a starting point for learning; (2) using the model as a bridge between the abstract and the real world; (3) using the students' own results or strategies; (4) interaction as an important element in learning mathematics; and (5) connecting each learning strand (Zulkardi & Putri, 2019).

D. CONCLUSIONS AND SUGGESTIONS

Based on the findings and discussion, it can be concluded that students need a PMRI learning environment on geometry material to solve critical thinking skills problems, as seen from the test results that are still lacking in geometry material and questionnaire result which really require knowledge and a learning environment using the PMRI approach, for researchers then the PMRI learning environment can use other material that is more in-depth. The researcher would like to thank the students of PGRI University Palembang, PGRI University Silampari and PGRI University Yogjakarta for being willing to be the subject of this research.

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