



Are Current Indonesian Math Materials Geared for the 21st Century? An Evaluation of 3rd Grade Content for Developing Critical Thinking Skills

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ABSTRACT

This paper investigates the development of critical thinking skills in Indonesian mathematics learning, which focuses on the analysis of the 2013 curriculum revised in 2018. The objective is to assess how well current mathematics materials for 3rd-grade elementary students promote 21st-century skills, especially for the 4C skills, namely critical thinking and problem solving, communication, collaboration, creativity, and innovation. The research highlights the necessity of innovative approaches in teaching mathematics to enhance these skills. The analysis indicates that the mathematics content in the thematic books supports the development of 4C skills. Additionally, the researcher suggested implementing Realistic Mathematics Education (RME) as an effective innovation and aligning RME's characteristics with the required 4C skills to better prepare students for 21st-century challenges. While Indonesia's low PISA scores in mathematics underscore the need for improvement. The study in this paper provides insights into curriculum enhancements that can lead to better educational outcomes.

Keywords: critical thinking, 4C skills, mathematics learning, 21st century, PISA, Realistic Mathematics Education (RME)

Submitted	Accepted	Published
29 June 2024	01 July 2024	30 July 2024

Citation	:	Lestari, S., Hermansyah, A.K., & Trisnani, N. (2024). Are Current Indonesian Math Materials Geared for the 21st Century? An Evaluation of 3rd Grade Content for Developing Critical Thinking Skills. <i>Jurnal PAJAR (Pendidikan dan Pengajaran)</i> , 8(4), 329-337. DOI: http://dx.doi.org/10.33578/pjr.v8i4.9909 .
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INTRODUCTION

Education is a very important activity for humans from the past, now to the future. Education as the basic foundation of humans faces a life that cannot be denied that there is fierce competition. In the 21st century, there is a development of technology, information and knowledge. In line with these developments, education plays a role in preparing human resources who have quality and competence. Therefore, high intelligence is needed, one of which is skills in mathematical aspects.

Often we assume that the mathematics studied is different from the mathematics that exists in everyday life. In fact, mathematics comes from everyday life and is used to solve problems as well as problems in everyday life (Siregar, 2017). This is because mathematics is an abstract science, which can be understood that mathematics only exists in thought, but in essence the abstract mathematical concepts come from real contexts in everyday life. So that the abstraction process is carried out by representing the problems that occur into the form of mathematical models. Therefore, comprehension competence is needed to understand mathematical concepts using everyday language in real life.

Mathematics began to be introduced since kindergarten and taught from elementary to college (Lestari, 2020). In this case, mathematics teaching forms students to be able to develop thinking skills in solving problems in everyday life (Mardati, 2018). Discussing the nature of mathematics which is the source of various sciences, the National Research Council explained about mathematics which is the basis of science and technology. Therefore, mathematics as a science that must always develop to solve and meet human needs, so that the implementation of these changes is carried out in the process of learning mathematics in schools.

The development of mathematics is adjusted to the needs of the present and the future, thus emphasizing that students have competence in thinking and reasoning (Setiawan & Sunardi, 2016). For this reason, learning in the field of mathematics at school aims to make students have the competence to be skilled in using mathematics and provisions so that students can reason by applying mathematics in real life in the family, school and community environment (Winaryati, 2018).

In fact, the results of research in 2018 that the OECD (Organisation for Economic Cooperation and Development) in the Programme for International Student Assessment (PISA) conducted aimed to find out the competencies possessed by students such as reading, mathematics, science, and what can be done with what they get. From the test results, Indonesia is in the ranks of the lowest score, namely mathematical ability, ranked 68 out of 73 countries with an average score of 379 which fell from 63rd in 2015. In this case, various factors are influenced by which students are generally not trained to solve problems based on the characteristics of PISA questions, but students are more accustomed to doing questions according to the examples given by the teacher. It is possible that the factors causing low PISA results are also influenced by students who think mathematics is a field of study with difficult material, so that negative assessments have an impact on mathematical abilities and low student learning outcomes.

Entering the 21st century today, it is realized that the rapid development of IPTKES demands various fundamental changes, including changes in emphasis in mathematics learning (Prihadi, 2018; Abidin, Mulyati, & Yunansah, 2018). The demands of student competence in the 21st century are 4C skills which are described as students are able to think critical thinking, communication, collaboration and creative. 4C skills must be familiarized in the learning process that emphasizes centering learning on learners, working together and linking learning to real world contexts.

In line with the characteristics of 21st century society explained by the Partnership of 21st Century Skill, learning activities must develop competitive competencies needed in the 21st century such as critical thinking, problem solving, communication, proficient in information communication technology and updates to information and media (Saputri, Wardono, Karisudin, 2019). Therefore, an education that focuses learning on students and the development of 4C aims to form creative, innovative humans in facing the future.

In the 21st century, the purpose of learning is where teachers act as facilitators and motivators. The effectiveness of a learning is determined if the teacher begins by reconnecting material that has previously been learned so that students will easily understand and integrate the material with student experience in the real world context in order to build new concepts or understanding in the material to be studied next. In tune with research Sunardi (2016) which states that to strengthen the development of 4C in mathematics learning must use real-world context problems so that it requires students to find problems based on their initial knowledge in a meaningful way. So that there will be a realization of humans who live in the demands of the 21st century as according to NCTM (in Nahdi, 2019) that mathematics learning requires problem solving, reasoning, looking for evidence, communicating, connecting as well as representation.

Contained in Permendikbud Number 21 of 2016 concerning Content Standards for Primary and Secondary Education requires students to have critical, creative, productive, independent, collaborative and communicative thinking skills. Therefore, in order to survive in the 21st century, people must have various skills and one of these skills is critical thinking which is very important to hone in students. Langrehr (in Sunardi, 2016) stating critical and creative thinking skills is a form of competence that is important for survival to face the demands of the 21st century as well as the future. This is the purpose of learning mathematics is the formation of a human mindset that is able to think critically, logically and systematically so that it can be applied in everyday life to solve problems. Thus, mathematics subjects can hone these skills in developing the 4Cs in the learning process.

In order for 4C skills to be developed in the learning process well, it is very important for students to be accustomed to carrying out learning activities that train these 421sC skills. This can be done with a learning process that is centered on students, working together in groups, and learning related to the context of daily life. However, the fact that occurs in the field is that there are still many educators who are not fully

able to carry out learning that leads to the development of 4C skills, resulting in many students who have not obtained and have skills that are in accordance with the demands of 21st century life.

Based on the formulation of the problem, developing the 4Cs in learning is very important and must be a concern for teachers to achieve educational goals that equip the next generation to have the skills to be able to live and compete in the 21st century. Therefore, this study aims to analyze the subject matter of mathematics in the development of 4C skills in the learning process and relevant innovations related to the development in order to achieve the goals well.

METHOD

The research method used by researchers is the description analysis method, through various literature studies in strengthening the analysis obtained from various sources containing the depth of theory and experts regarding the development of 4C as provisions and skills to face the 21st century. This research aims to fulfill the symbolic message of various existing documents. In this case, the symbolic message in question is an integrative thematic content for the development of the 4Cs in the subject matter of mathematics. The documents analyzed are integrated thematic teacher and student books curriculum 2013 revised 2018 class 3rd elementary school from theme 1 to theme 8 1 and 2 semesters as well as aims to determine the skills developed in the subject matter of learning in the field of study of mathematical content and relevant innovations in the development of these skills.

RESULTS AND DISCUSSION

21st Century Mathematics Education

21st century education requires students to have learning competencies, innovate, be able to use technology and information, as well as be able to work and survive to live life (life skills). The skills needed in the development of the 21st century are life career skills, learning and innovation skills, information media and technology skills. In this case can be seen in the scheme called the 21st century knowledge-skills rainbow, as follows Figure 1.



Figure 1. 21st Century Knowledge-Skills Rainbow

The competencies needed for primary and secondary education levels are enough to master the ability of Reading, Writing, and Arithmetic (3R's). Discusses the functions of the 3R core subjects in the context of the translated 21st century skills, namely (1) life and career skills, including (a) flexibility and adaptability, (b) initiative and self-regulation, (c) social and cultural relations, (d) generating and accountability, and (e) leadership and carrying responsibility. (2) Learning and innovation skills, include (a) critical thinking and problem solving, (b) able to communicate and collaborate, (c) create creativity and innovate. 3) information, media and technology skills including (a) information literacy, (b) media literacy, (c) ICT literacy (information, communication, technology).

In the 21st century humans are required to have competence, knowledge and skills in all fields. In line with this, the Ministry of Education and Culture formulates a paradigm where learning must emphasize problem giving, train analytical thinking and be able to work together and collaborate in solving, solving problems (R&D of the Ministry of Education and Culture, 2013). In order to achieve goals as demanded by humans in the 21st century, educators need to develop 4Cs in the mathematics learning process, which is explained as follows: (C1) Critical Thinking and Problem Solving is a critical thinking ability that is indispensable to face the 21st century. Discussing critical thinking is the ability to think at a higher level that is able to use and manipulate material that has been learned and adjusted to the situation needed. It is also aligned according to (Yusliani, at al, 2019) Critical thinking is a process where thinking carefully by reasoning, analyzing and being able to solve problems with alternative solutions so as to increase the knowledge and understanding of students. As for indicators of critical thinking ability, it can be seen in the following Table 1.

Table 1. Critical Thinking Ability Indicators

No.	Indicator
1.	Collect the necessary information Systematically
2.	Determine problem-solving strategies
3.	Data analysis
4.	Conclude

In this case, in order to achieve learning objectives, it is very important to create and provide opportunities to express ideas in mathematics learning so that they can train and develop students' critical thinking skills. (C2) Communication means communication is a form of delivery of thoughts in the form of ideas as well as a form of social interaction of students with their environment. Communication activities carried out such as exchanging ideas, asking, listening, analyzing, speaking, reading, writing and evaluating. Aligned according to (Ningrum and Caswita in Nahdi, 2019) Stated under communication skills is the ability of each learner in communicating clearly using oral, written and non-verbal language. Written communication, especially in mathematics learning, can change tables, graphs, or diagrams so as to train the thinking process of students. While oral communication through interaction activities between students and their environment such as learning carried out with group discussions. As for indicators of communication ability, it can be seen in the following Table 2.

Table 2. Communication Capability Indicators

No.	Indicator
1.	Communicate effectively
2.	Convey thoughts in the form of ideas or ideas effectively in various forms and contents orally, in writing and multimedia
3.	Listening with the aim of understanding meaning, knowledge, values, attitudes, and interests
4.	Communicate by providing information, instruction, motivation, and persuasion
5.	Utilizing communication technology media effectively
6.	Communicate effectively in a variety of environments

In this case, mathematics learning can hone students' communication skills, the communication process in learning is carried out by means of verbal representation, proof in mathematics in the form of conveying ideas and arguing, this is due to the provision of open problems so that students are required to use and communicate varied solving strategies. As well as student communication that can be done in mathematics learning, namely by finding and uniting various views and knowledge and developing related to problem solving. Furthermore (C3) *Collaboration* means collaboration which is a form of activity working with others

to achieve a common goal. In this case, the mathematics learning process is created with *team work*, so that students are accustomed to being able to work together, equate ideas or ideas, respect others, make decisions wisely and be responsible for the group. Collaboration according to Sunardi (2016) State an activity that can be done such as jointly seeking information, building a group so that each member is active, setting a common goal, managing time, exchanging opinions to solve problems. In this case, students are required to be able to show their abilities in groups, be able to adapt responsibly to their roles, work actively, appreciate differences in views and be able to empathize with others. In other words, group learning as a step to instill the competence of socializing and controlling emotions to create a peaceful situation. As for indicators of communication ability, it can be seen in the following Table 3.

Table 3. Collaboration Capability Indicator

No.	Indicator
1.	Able to work together effectively and with mutual respect in groups
2.	Able to adapt, help each other, discuss to achieve common goals
3.	Work productively and responsibly

As the purpose of collaboration skills provides benefits, namely through collaboration, students have a high chance of solving more complex problems because of the combination of several thoughts that work together. Apart from that, cultivating the slightest appreciation of activities and roles to motivate students in increasing achievement to learn and a form of instilling a character of respect for each other. The development of important collaboration skills familiarized to students aims to be a provision for working together and being responsible for themselves and others, so that students can provide benefits and be able to live in the surrounding environment. (C4) *Creative and Innovation* means creativity and innovation, according to (Izzati in Nahdi, 2019) Creative thinking is a process of creating new ideas that start from a combination of several previous ideas and then put together. Aligned according to (Sugiyanti, Marlina in Yusliani, at al, 2019) which states that critical thinking skills and innovation are the ability to produce something new. In this case, creativity is developed so that students can convey new ideas to others openly. From some of these opinions, it can be concluded that creative skills and innovation are a form of developing, implementing, conveying the latest ideas, as well as being open to new and different opinions and finding many strategies in solving problems, while creativity that produces a new work is called innovation. As for indicators of communication ability, it can be seen in the following table.

Table 4. Creative and Innovation Capability Indicators

No.	Indicator
1.	Can use various strategies in creating an idea
2.	Generate new ideas
3.	Elaborate, analyze, evaluate, improve ideas in improving and maximizing creative efforts

Creative and innovative thinking in mathematics learning is a process to produce various strategies in solving problems and create new approaches. Many things can affect the creativity of students, namely from the teacher and the learning environment so that it can provide stimulus to students in thinking, asking, adding, opening views as well as new ideas. Thus, creative thinking and innovation skills train and require students to be more creative in generating, creating ideas, ideas, findings and can be implemented in life. Therefore, 4C skills are skills that provide benefits and can help students to face, keep up with the times.

Mathematics Material in 4C Development

Curriculum Development aims to improve the quality of education, this requires students to be more active in the learning process contained in the 2013 Curriculum which focuses on the formation of

competencies, character of students by integrating knowledge, skills, and attitudes (Fastiyed in Yusliani, at al, 2019). The 2013 Curriculum Development contains three educational concepts, namely skills adapted to the demands of the 21st century, scientific approaches, and authentic assessments (Hosnan in Yusliani, at al, 2019). Therefore, the development of 4C skills in the 2013 Curriculum is a skill that must be equipped to students to be able to face challenges in the 21st century. According to NCTM (in Nahdi, 2019) which requires that mathematics learning develop problem-solving, reasoning, proving, communicating, connecting and representation skills so that the learning is compatible with 21st century skills.

Mathematics learning is an alternative to the development of 4C in mathematics subject matter that provides provisions for students to face the demands of the 21st century. According to Sunardi (2016) which states that the teaching and learning process in the field of mathematics must be carried out by, namely: (a) developing activities by using process skills about mathematics to identify, solve problems critically and creatively (*critical thinking, problem solving and creative*), (b) work together in groups to strengthen understanding of mathematics resulting from various thoughts (*collaboration*), (c) observe a fact, context or phenomenon then collected, processed, presented and communicated (*communication*) the results of the acquisition of verbal, nonverbal knowledge using various forms of models in mathematics such as symbols, tables, graphs and diagrams.

The relevance of mathematics subject matter in the integrated thematic teacher and student books class 3rd Curriculum 2013 revised 2018 by analyzing the content achievements of the field of mathematics studies in the development of 4C (*Critical Thinking and Problem Solving, Communication, Collaboration, Creative and Innovation*). The percentage of basic competency analysis (KD) results related to the development of 4C in class 3rd elementary school mathematics content, can be seen in the following figure.

■ Critical Thinking ■ Communication
 ■ Collaboration ■ Creativity

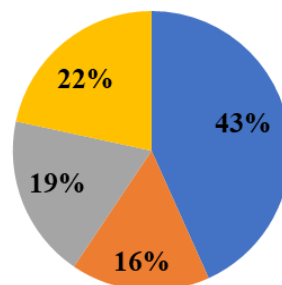


Figure 2. Percentage Analysis of 4C Development on Mathematical Load

Based on the results of the analysis of the picture above, it can be seen that mathematics learning class 3rd elementary school emphasizes the development of 4C. The percentage score on *critical thinking and problem solving* skills was 43%, communication skills were 16%, *collaboration skills* were 19% while *creative and innovation* skills were 22%. In each mathematics learning theme develops *Critical Thinking and Problem Solving* skills, this is because class 3rd students are at a low grade level who will advance to high grades, namely IV, V and VI, so emphasis is needed to teach students to be able to have critical thinking skills.

In Permendikbud Number 21 of 2016 concerning the content standards of primary and secondary education in which the subject matter of mathematics at the basic education level of grades I-VI elementary school is: (1) natural numbers, (2) geometry, (3) simple statistics. In general, mathematics content from theme 1 to theme 8 semesters I and II is found in learning 1, 3, 5 and 6 which focuses on training students in observing, finding, *processing, solving problems given so that they can be applied in their daily environment, and as the results of the analysis also developed collaboration, communication and creativity* skills are also developed. Therefore, overall the development of 4C is carried out in mathematics learning.

Innovation Development of 4C Mathematics Learning

The innovation of mathematics learning in the 21st century at the elementary school level is the answer to the problem that is often found that students are not interested in the field of mathematics studies, this is because students consider that mathematics is a difficult and uninteresting subject. There are various factors that cause these problems, namely because of a negative perspective that makes students give up first when given problems that require them to find solving strategies, even students complain of following mathematics subjects, this is because students find it difficult to learn formulas, numbers and calculation operations. In addition, students are required to memorize how to solve so that when given different problems, students find it difficult to do it. Though according to Siagian (2015) Explaining the field of study of mathematics is a basic subject that is very important to learn, because mathematics is closely related to the real-world context. But it does not rule out the possibility that the problem factor in the field of mathematics also lies in the role of the teacher in the classroom, this is stated by (Sobel and Maletsky, 2004:1) that most teachers tend to start learning by discussing assignments then give new material and end with giving assignments again. The method that is used continuously makes learning boring so that it instills students' disinterest in mathematics, therefore it is very important to make fundamental changes in mathematics learning.

In essence, mathematics material is almost mostly abstract, thus in learning mathematics it is necessary to use methods that make it easier for students to learn, such as learning that begins with giving real problems in accordance with the real world context. As stated by Suherman, et al (2001:65) The characteristic of mathematics learning is gradual, it means that mathematical material is learned from concrete things to abstract or from simple to complex. In harmony with Russell (in Aningsih, 2012) explaining that the field of mathematics studies starts from discussing parts that are very easy to know or simple to parts that are unknown or called complexly. Thus, Russell means that the direction in mathematics learning is carried out gradually towards a more complicated direction.

It is contained in Permendikbud Number 65 of 2013 that a learning process at the educational level is carried out interactively, inspirationally, fun, challenging, motivates students to be active, and provides space to develop creativity, independence in accordance with the interests, talents as well as physical and psychological development of students. Thus the learning of mathematics developed by Dienes (in Suherman, 2003:49) that is, each concept must be learned by presenting it in concrete form so that it will be well understood by students.

The innovative learning approach that can be applied in the development of the 4Cs in mathematics learning is Realistic Mathematics Education (RME), so the effort must emphasize various aspects such as *critical thinking and problem solving*, communication and collaboration and creativity and *innovation* which is in line with the concept of RME pioneered for the first time by Fruedental from the Netherlands, so that since 2001, RME was developed in Indonesia and called Indonesian Realistic Mathematics Education (PMRI) this is due to the adaptation of RME with adjustments to cultural, geographical and social conditions of Indonesian society (Soedjadi, Marpaung in Setianingsih, 2016).

The application of PMRI provides breadth to students to find concepts in mathematics derived from contextual problems. In this case, the role of the teacher is very important as a facilitator who provides stimulus, motivation, guidance as needed by formulating various contextual problems about the material so that students think about finding and making the center of learning for students.

Basically, mathematics learning with a realistic approach uses the reality and environment of students as an effort made to expedite the process and achieve mathematics learning goals. In this case, it is also explained that what is meant by reality is something that is real or concrete so that it can be observed and understood by students through imagining or paying attention directly, while the environment of students is the daily environment of both family, school and community (Soedjadi in Setianingsih, 2016).

PMRI has five characteristics, which are explained as follows: (1) the uses of contexts, in this case learning begins with providing contextual problems in a simple way that is recognized or easily understood by students, (2) the use of models, where students are required by themselves to develop a model, which aims to be a bridge so that students can understand various materials or as a process of understanding students from

simple mathematics to complex, (3) using student contributions that in learning the greatest contribution is that which comes from students such as various answers, perspectives and strategies, (4) interactivity namely optimizing the learning process between the interaction of students with their environment so that there is discussion, cooperation that requires students to be able to explain, state the truth, agree and disagree, ask for alternatives and reflect, (5) related to various topics (intertwining) that is, the structure and concept of mathematics are interrelated, thus the integration of various topics between contextual problems and the material taught can make the learning process meaningful.

Thus, the five characteristics of PMRI are aligned in the development of the 4Cs, namely learning mathematics various things that are close to everyday life and requiring students to be able to think critically, solve contextual problems given, as well as being able to collaborate by creating something that aims to hone students' creativity and innovation skills and communicate their findings or perspectives before Friends and teachers so that they can train skills so that students are able to compete with the times. Agree with the research conducted Setianingsih (2016) stated that the characteristics of Indonesian Realistic Mathematics Education (PMRI) are in line with the provision of 4C characters to students according to the demands of the 21st century, therefore PMRI needs to be implemented in mathematics learning in schools.

CONCLUSIONS AND RECOMMENDATION

Based on the results of the research analysis, it can be concluded that 3rd-grade elementary mathematics learning in Indonesia emphasizes the development of 21st-century skills, particularly critical thinking. The mathematics content in themes 1 to 8 for semesters 1 and 2 focuses on equipping students by training them in observing, discovering, processing, and solving problems so that they can apply these skills in their daily lives. The analysis results also show that this learning approach develops critical thinking and problem-solving, collaboration, communication, and creativity skills. Overall, the development of 4C skills is carried out in mathematics learning. One of the efforts that can be made is to implement RME. It is known that the characteristics of RME are relevant to the development of 4C skills as a provision for students to face the demands of the 21st century.

However, this analysis only focuses on 3rd-grade curriculum materials and does not explore how the emphasis on 4C skills changes across other grades. Further research is needed to study curriculum materials across various grade levels to gain a more comprehensive understanding of the mathematics curriculum in Indonesia. Additionally, teacher training in implementing the RME approach needs to be enhanced to ensure the effective development of 4C skills. Further research is also required to develop assessment methods that can accurately measure the development of 4C skills and to explore the reasons behind students' disinterest in mathematics.

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