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COGNITIVE EDUCATION MODEL AS A REVITALIZATION OF CRITICAL THINKING SKILLS BASED ON THE LITERACY AND NUMERACY PROGRAM OF ELEMENTARY SCHOOL STUDENTS IN INDONESIA

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Abstract

Learning loss is felt after the pandemic as a dulling of elementary school students' critical thinking cognitive abilities. 70% of pre-adolescent students are below minimum competency in reading and mathematics. learning loss is equivalent to 6 months of study, while numeracy experiences learning loss equivalent to 5 months of study. Literacy and numeracy as educational programs act as a foundation for responsibility for carrying out repressive actions. The aim of this research is to formulate an alternative model for a literacy and numeracy program for elementary school students by contextualizing Bloom's taxonomy theory of cognitive aspects in critical thinking with Jean Piaget's theory of concrete operational stage cognitive development. This research method is a qualitative type of literature in order to collect, analyze and contextualize various relevant sources. The results of the research formulated an alternative model for literacy and numeracy programs for elementary school students, including providing digital literacy development, strengthening metacognitive skills, using active learning, and psychosocial support.

Keywords: cognitive education; critical thinking; literacy and numeracy

1. Introduction

This research is motivated by the impact of the Covid 19 pandemic in the education sector. After the Covid 19 pandemic, there is an irony that learning loss will occur among students (Teristonia et al., 2023) (Rosa, 2023) (Ristek, 2022), resulting in a dulling of students' critical thinking abilities (Makdori, 2022) (Napitupulu, 2013). Every student should have critical thinking skills including the ability to evaluate, analyze and synthesize information (Niroo et al., 2012). In order to revitalize students' critical thinking abilities, an appropriate cognitive education model is needed so that it can restore students' cognitive abilities to their ideal condition. One form of designing a program to revitalize critical thinking skills is to design a literacy and numeracy program as a form of cognitive education. It's just that the formulation of the cognitive education model in literacy and numeracy programs to revitalize students' critical thinking abilities needs to be studied further, one of which is by considering the age level or level of education that is the subject of the research study (Evans & Boucher, 2015). Because the research study focuses on the elementary school education level, the analysis and study in formulating the educational model adapts to the stages of students' cognitive development (Wei et al., 2015).

The study of the dulling of critical thinking skills in elementary school children is a problem that must be addressed immediately, considering that this age is the beginning of honing critical thinking skills (Sarwanto et al., 2021). For this reason, the literature review in this research is a means of connecting with previous research, and a means for this research to discover its novelty. The previous research relevant to this research is as follows: *first*, research by Pragati Jain and Merran Rogers in 2019 regarding critical thinking skills in numeracy for adult learners (Jain & Rogers, 2019), while this research examines critical thinking skills in literacy and numeracy in elementary school children aged seven to eleven years. *Second,* research by Yeni Rakhmawati and Ali Mustadi in 2021 regarding the importance of reflective modules for elementary school students which are useful as a benchmark for the achievement of students' literacy and numeracy skills so that they can be evaluated (Rakhmawati & Mustadi, 2021), the difference with this research is more about preventive measures and repressive in the form of formulating models that are useful in designing literacy and numeracy programs. *Third,* research by Linda Meeks and friends in 2014 regarding the analysis of the decline in literacy and numeracy skills in various countries based on the results of international surveys, as well as the solutions they offer (Meeks et al., 2014), while this research is a development of the research subject, namely, this research focuses more on studying the subject of formulating a literacy and numeracy program model that is able to revitalize the mathematical logical intelligence of elementary school children in Indonesia. *Fourth,* research by Teja Buana and friends in 2020 on improving elementary school students' critical thinking abilities using a numeracy learning method that hones students' creative abilities (Buana et al., 2020), Meanwhile, this research examines how numeracy learning methods can be in accordance with the theory of cognitive growth and development of elementary school students. Based on literacy and numeracy studies of relevant previous research, this becomes a bridge for developing this research, finding points of difference, and presenting its novelty. So the novelty of this research is a study that formulates a cognitive education model for elementary school age children that is useful for revitalizing their critical thinking skills through the design of a literacy and numeracy program.

The aim of this research is to formulate a literacy and numeracy program model in the cognitive domain of elementary school students aged seven to eleven years, so that it can become a role model in overcoming the dulling of students' critical thinking abilities caused by learning loss after the Covid-19 pandemic. The formulation of the subject studied includes contextualization of the theory of concrete operational stage cognitive development by Jean Piaget towards Bloom's taxonomy theory of cognitive aspects in critical thinking, as well as the implications of the theory in overcoming the impact of learning loss. Furthermore, the model formulated can be used as an interpretation for each educational institution that is responsible for determining the role models that will be applied to its literacy and numeracy programs for elementary school children.

This research is important to carry out considering that PISA scores have recorded no significant improvement in the last ten to fifteen years, it is stated that 70% of pre-adolescent students are below the minimum competency in reading and mathematics (Wuryanto & Abduh, 2022) (Revina, 2019). This condition got worse when the Covid-19 pandemic occurred. It was recorded that before the pandemic the

learning progress for one year for grade 1 elementary school was 129 points for literacy, and 78 points for numeracy, but after the pandemic progress for grade 1 decreased significantly (learning loss), for literacy, learning loss is equivalent to 6 months of learning, while numeracy experiences learning loss for 5 months. This data was taken from a sample of 3,391 elementary school students from 7 districts or cities in 4 provinces, in January 2020 and April 2021 (Ristek, 2022) (Teristonia et al., 2023)(Rosa, 2023). For him, the model formulation from this research can be an alternative in revitalizing students' critical thinking cognitive abilities through literacy and numeracy programs, which can later have an impact on achieving PISA test standards for elementary school students.

2. Methods

2.1. Research Design

The scientific methodological procedures carried out in this research refer to the type of qualitative research by (Creswell, 2015), which in theoretical and practical studies elaborates various scientific literature theories in order to validate research data. So, in this research, narrative processing of theories in relevant literature related to concrete operational stage cognitive development by Jean Piaget will be carried out regarding Bloom's taxonomy theory of cognitive aspects in critical thinking. Based on this analysis, a framework was created as a basic assumption for formulating a cognitive education model that is able to revitalize elementary school students' critical thinking abilities based on literacy and numeracy programs.

2.2. Data Sources

This research has two data sources, namely *First,* the data used is primary data, which comes from various library data relevant to the research, collections of theories, books, journal articles, expert opinions, and so on and then processed using a certain research methodology. *Second,* the secondary data used is not used as primary data processing material, but is useful as a data source that complements primary data, such as epithemological studies, terminology, scientific literature, and so on (Sugiyono, 2020). So the primary data comes from the basic assumption literature, namely the theory of cognitive development at the concrete operational stage by Jean Piaget and Bloom's taxonomy theory of cognitive aspects in critical thinking. Furthermore, secondary data will be obtained from literature regarding data from academic survey institutions, government policies, opinions of figures, and so on that are relevant to the research subject.

2.3 Research Procedure

In order to systematize the research, the research procedure consists of: (1) analyzing various studies regarding cognitive education, critical thinking skills, literacy and numeracy programs; (2) limiting the problem to the formulation being studied, as the study is limited by the growth and development of children's critical thinking cognitive abilities at the age of 7-11 years, limiting the cognitive aspects of critical thinking in Bloom's taxonomy; (3) after the limitations of both problems are found, the next step needs to be contextualization in order to find a meeting point that is suitable for the child's growth and development phase; (4) the results of theoretical

contextualization are then examined against the problem formulation, namely the problem of elementary school students in the form of learning loss caused by the Covid 19 pandemic, which blunts critical thinking abilities; (5) a model is formulated that is appropriate to the problem formulation based on the results of theoretical contextualization analysis.

3. Results and Discussion

3.1 Learning Loss

The Covid 19 pandemic has left deep wounds in the world of education (Pokhrel & Chhetri, 2021). The consequence that must be accepted from the pandemic in the education sector is learning loss among students (Khan & Ahmed, 2021). This is an indication of a significant decline in literacy and numeracy (Schult et al., 2022a). When the pandemic peaked, students were forced to transition into learning models which resulted in learning gaps that students had never experienced before (Schult et al., 2022b). Conventional and traditional learning has shifted to distance digital learning. Therefore, literacy and numeracy programs have experienced a decline due to limited access to intensive learning in classrooms (Mukhtar et al., 2020). Students are limited to space without participation to discuss and collaborate with their classmates, so the learning orientation is only practical (Barrot et al., 2021). New problems began to arise when the Covid Pandemic ended, marked by the competence of students who were far behind in terms of the level of education they should have undertaken according to their age. Elementary school students who should be able to read, write and understand a question presented, are still struggling at the spelling level (Kompastv, 2021). It was noted that based on the results of a survey conducted by the Ministry of Education and Culture, it was stated that for more than a year the pandemic had resulted in learning loss equivalent to six months (Ristek, 2022).

Inequalities in the world of education globally after the pandemic have improved, but in fact there are still many new problems that have arisen because of it (Tsiligkiris & Ilieva, 2022) (Wijayanti et al., 2023). So, in order to improve the gaps that exist in the world of education, it is necessary to formulate a cognitive education model that is able to overcome the occurrence of learning loss, one of which is an effort to revitalize students' critical thinking abilities. A model that is not only oriented towards delivering material but also develops alternative concepts of literacy and numeracy as one of the keys to improving critical thinking skills among students. The integration of literacy and numeracy programs into cognitive education models can be an offer in the world of education to immediately improve the problem of learning loss, so that at least the PISA test target can be achieved, especially in literacy and numeracy.

3.2 Literacy and Numeracy

Functionally, the literacy and numeracy program is an approach in education to sharpen students' abilities in using symbols, understanding narratives, and manipulating numbers in mathematics (Kovas et al., 2013). For this reason, literacy and numeracy are things that students must have in reading, writing and arithmetic,

so that at the end they can do critical thinking about mathematical patterns, relationships between numbers, and their application in students' daily lives (Carreiras et al., 2015). At the elementary school level, literacy is basically used as a means for students to understand, evaluate written word information, while numeracy is used to solve mathematical problems. Therefore, it is important to develop students' critical thinking skills in analyzing and solving complex problems according to their age level (Rakhmawati & Mustadi, 2022). So that with good literacy and numeracy skills for elementary school age students, it will definitely be able to help them with their daily life and academic skills.

3.3 Cognitive Education of Elementary School Students

Integrating literacy and numeracy programs into a cognitive education model means that it is necessary to adapt literacy and numeracy programs to a series of rules that exist in cognitive education itself. Based on its roots, as in the numeracy program it is known as mathematical logic, where if an individual has excellence in mathematical logical abilities it is certain that he has critical analytical power in solving complex mathematical problems (Ndiung et al., 2019). The form of mathematical logical intelligence itself is part of the theory of multiple intelligences by Howard Gardner through his book entitled "Frames of Mind: The Theory of Multiple Intelligences" (Gardner, 2011). Opportunities for individuals with high analytical power regarding complex quantitative problems have greater opportunities for future career paths as scientists, mathematicians, accountants, mechanical technicians and programming experts (Ponomareva, 2021). So it is important to formulate an appropriate literacy and numeracy program model based on the principles of a series of relevant theories, so that it is able to shape and revitalize students' critical thinking abilities.

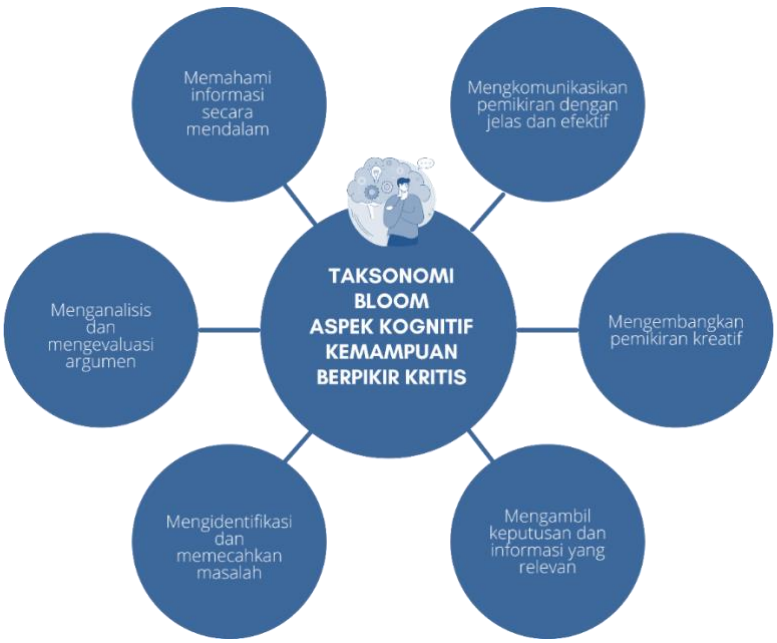

Figure 1. Bloom's Taxonomy: Cognitive Aspects of Critical Thinking Abilities.

Departing from Bloom's Taxonomy theory, cognitive abilities included in the critical thinking aspect include several indications. *First,* understand the information received comprehensively and thoroughly, make an analysis in the context received, so that you understand the basic assumptions of the information received. *Second,* evaluate arguments by making an analysis of the objectivity of arguments based on the strengths and weaknesses of an argument, so that you can evaluate the credibility of supporters of an argument. *Third,* identify solutions to problems based on the accompanying indications, so that you are able to look for rational and effective opportunities to overcome them. *Fourth,* the ability to make decisions and relevant information, determine and make analyzes in critically deciding on information options. *Fifth,* develop creative thinking by thinking outside the box, generating new ideas, thoughts and products from a series of points of view. *Sixth,* the ability to communicate thoughts clearly and effectively, persuasively convey ideas, concepts and arguments with clear articulation, so that information can be received by other individuals more easily (Arievitch, 2020). For this reason, the six indications of critical thinking cognitive abilities in Bloom's taxonomy are one of the basic reference frames in formulating more accurate literacy and numeracy programs.

Figure 2. Correlation Concrete Operational Stage

The basic frame of reference is even more complex by taking into account the age of students' cognitive growth and development. So that factually, the formulated model can be applied on target. According to the Primary School Directorate of the Ministry of Education, Culture, Research and Technology, the ideal age for a child to enter primary school is seven years (Kemendikbud, 2023). For this reason, the theory (Piaget, 1960) regarding cognitive development at the concrete operational stage is suitable for studying the age stages of students. In his theory, it is stated that the grouping of individual operational thoughts regarding objects that can be manipulated or known through the senses. Furthermore, in his theory, it is stated that the concrete operational stage of cognitive development ranges from the ages of seven to eleven years, where this is the age when logical thinking will be more successful if students can manipulate real (concrete) materials or images. Operational

thinking has problems in reasoning abstract things and hypotheses, so it needs to be adjusted. For this reason, in this phase it will be more effective if students are asked to reason about material that is physically present, meaning that it can be sensed by them (Mcleod, 2023). So in designing a literacy and numeracy program at this stage it is necessary to adapt to the conditions of children's growth and development, where it is easier for students to absorb physical/concrete material.

Adjusting the six aspects in Bloom's taxonomy also requires paying attention to the rules that exist at the concrete operational stage for students. Contextualization of the two is a relationship that cannot be separated. As with the first aspect, providing a learning approach that facilitates a deep and thorough understanding of real information that can be sensed by students. *Second,* providing a real time presentation of arguments where students can immediately analyze the advantages and disadvantages of an argument and its underlying basis. *Third,* students are presented with a problem that originates from information they can access, so that students do not hypothesize too far and abstract, so they can solve the problem presented. *Fourth,* provide information to students optionally, but can be concretely reached by their senses. *Fifth,* facilitate students to carry out real experiments, providing space to provide ideas and findings that are tested by them. *Sixth,* encourage students to express themselves to other parties with good articulation.

Discussion

The impact of learning loss on critical thinking skills

The impact that is still felt today in the form of learning loss, which blunts students' critical thinking abilities, needs to be studied and re-evaluated in order to improve the level of education. The right literacy and numeracy program now is a preventative action for more severe damage in the future, and a repressive action that revitalizes the damage that has already occurred, to restore the amount of learning loss caused by the Covid 19 Pandemic. The formulation of the model offered is not only in theory only but must also be compared and reviewed with the level of damage that has occurred. Some of the impacts that can be felt are; Poor and underprivileged students are affected by 10% more learning loss than affluent and well-off families, their abilities in subjects related to Indonesian and Mathematics have decreased significantly, the condition is made worse by difficulties understanding more complex material at higher grade levels compared to pre-pandemic by students, one of the reasons is that, especially at the elementary school level, the school assignments given by teachers were actually carried out by the students' parents during the pandemic, so students experienced metacognitive dullness due to being overly spoiled by their parents. Of the overall dulling of students' critical thinking abilities, what is actually becoming a big problem is children's psychological disorders due to the pandemic which is forcing education to make a different transition. Students experience anxiety disorders and excessive stress (Putri et al., 2020).

Cognitive Education Model as revitalization of Critical Thinking Skills based on Literacy and Numeracy Programs

Considering the six aspects in Bloom's taxonomy in the cognitive domain of students' critical thinking abilities and reasoning in the concrete operational stage, further reconsidering the problems that arise as a result of learning loss due to the

Covid 19 pandemic, the formulation is carried out by analyzing its overall suitability, so that a precise formulas and formulations. The first consideration is how to overcome the time and opportunities lost due to the pandemic, which if we only rely on literacy in schools is still limited and does not reach all levels of access. Then an information system is needed that is able to reach various platforms, of course taking into account the limitations of high costs. For this reason, the development of digital literacy which is able to strengthen conventional literacy can reach various information systems from various platforms, at relatively affordable costs, anytime and anywhere. Students in digital literacy are able to go to the information they want directly using the right search engine keywords, this is in line with the construct of Bloom's taxonomy theory and the first concrete operational stage, namely providing a learning approach that facilitates deep and thorough understanding of information in a real and accessible way. sensed by students. Moreover, currently in the online digital world, it is strengthened by industrial technology 5.0 where artificial intelligence or AI makes it easier to cover students' literacy. Intelligence and creativity are not only determined by AI generated results, but also good AI generated results are produced from unique and detailed commands or prompts. The breadth of using artificial intelligence is also in line with the construct of Bloom's taxonomy theory and the fifth concrete operational stage, namely facilitating students to carry out real experiments, providing space to provide ideas and findings that are tested by them.

Considerations in the second formulation include consideration of the blunting of students' critical thinking abilities, which during the pandemic were less exposed to complex problems. Students are faced with learning that spoils them because it is only a summative assessment without knowing more about how students get these grades. This is because during the pandemic, assignments given by teachers tend to be carried out more intensively by parents. Bad traits that are too pampered carry over to students entering post-pandemic learning. For this reason, the model that educators should apply must sharpen students' metacognitive skills. In the context of metacognitive learning, students need more intensive monitoring of their learning process, so that they can regenerate students' thinking skills. The forms of learning in literacy and numeracy programs can be of various types, such as teacher monitoring of student note sheets and reading, so that reflection can then be carried out using mind mapping and summaries, as well as a series of other learning methods that are relevant to improving students' metacognition, not just value-oriented pragmatics. end of students only. Strengthening metacognitive skills is able to rebuild students' thinking skills, this is in line with the construct of Bloom's taxonomy theory and the second concrete operational stage, namely providing real time presentation of arguments where students can directly analyze the advantages and disadvantages of an argument and its underlying basis. In this sense, this aspect is a concept that hones students' analytical skills through real experience and is oriented towards control of learning stages.

Another urgency that is taken into consideration includes the loss of active learning during online learning, which has an impact on reducing students' intensity in building attractive learning, as a result of which their problem-solving abilities, social abilities and decision-making abilities become weak. So it is important to design active learning. The context of active learning in literacy and numeracy studies

emphasizes that there are more factors involved in revitalizing it. A series of factors determine the ideal return to active learning, which is at least verbally articulate, collaborative and problem solving. So literacy and numeracy programs must be able to be presented to students to accommodate active learning. Some learning method designs include group discussions, collaborative projects, and case studies, to improve analytical and problem-solving skills. For him, this is in line with the construct of Bloom's taxonomy theory and the third, fourth and sixth concrete operational stages, namely that students are presented with a problem that originates from information they can access, so that students do not hypothesize too far and abstractly, and then can solve it. The problem presented, furthermore, educators can provide information to students optionally, but can be concretely reached by their senses, and finally, educators can encourage students to express themselves to other parties with good articulation. So the design of the literacy program must also be active in order to revitalize the part of critical thinking skills, namely verbal articulation, collaboration and problem solving.

Considering that the problems faced in the world of education are increasingly complex, especially with the Covid 19 pandemic disaster, it has worsened the psychological condition of students. As a result of implementing education that is not statically dynamic, students experience anxiety disorders and excessive stress. Of course, children's psychological disorders have an impact on reducing their critical thinking abilities, as delusions cause individuals to think irrationally. So in addition to revitalizing academics, literacy and numeracy programs must be designed in such a way that they are able to provide psychosocial support through literacy and numeracy programs. Such as not providing learning material that further harms students' psychology, as well as mentoring and monitoring students' psychosocial development. Providing guidance and material according to their growth and development, such as the opinion of the concrete operational stage theory of cognitive development by Jean Piaget to provide concrete material presentation.

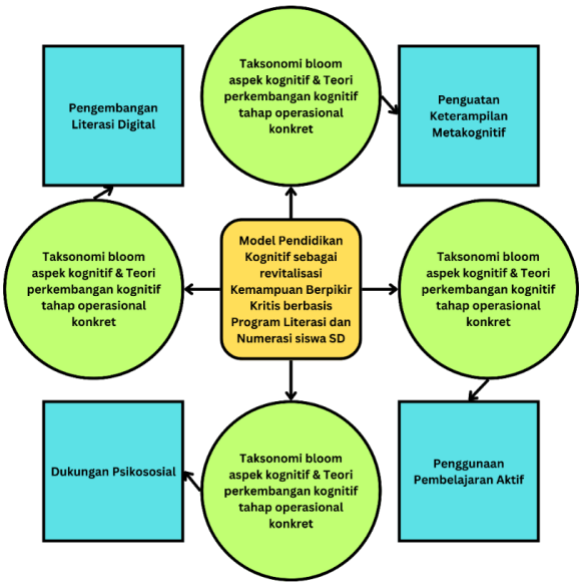

Figure 1. Cognitive Education Model as a revitalization of Critical Thinking Skills based on the Literacy and Numeracy Program for elementary school students.

In order to revitalize critical thinking skills in elementary school-age children affected by the Covid-19 pandemic, an educational model is needed that is able to offer alternatives as repressive measures for the damage that has occurred. For this reason, several formulation adjustments have been made, especially in formulating the literacy and numeracy program so that it is able to achieve the target, namely returning to ideal conditions from learning loss, to achieving the PISA test target as an indicator of revitalization which has been successfully carried out. For this reason, based on the contextualization of Bloom's taxonomy theory of cognitive aspects and the theory of cognitive development at the concrete operational stage, it wasconcluded that the cognitive education model as a revitalization of critical thinking skills based on literacy and numeracy programs for elementary school students includes a program design model that must have several aspects, namely being able to develop literacy. digital, able to strengthen metacognitive skills, use active learning, and able to provide psychosocial support.

4. Conclusions

Education as a means of honing the critical thinking skills of elementary school students has been degraded by factors that cannot be prevented, namely the existence of the Covid-19 pandemic for quite a long period of time, giving rise to new problems after the pandemic has ended. One of the problems that arises is the dulling of critical thinking skills caused by learning loss. For this reason, alternative cognitive education models are needed that are able to revitalize students' critical thinking abilities. One way to revitalize students' critical thinking skills in cognitive education is through designing a program approach to strengthen literacy and numeracy. Therefore, there are adjustments to develop the program model. Adjustments were made by contextualizing Bloom's taxonomy of cognitive aspects and the concrete operational stage theory of cognitive development. From the contextualization of the two theories, it was found that in designing cognitive education for elementary school age children, several concepts are needed: First, providing a learning approach that facilitates deep and thorough understanding of real information that can be sensed by students. Second, providing a real time presentation of arguments where students can immediately analyze the advantages and disadvantages of an argument and its underlying basis. Third, students are presented with a problem that originates from information they can access, so that students do not hypothesize too far and abstract, so they can solve the problem presented. Fourth, provide information to students optionally, but can be concretely reached by their senses. Fifth, facilitate students to carry out real experiments, providing space to provide ideas and findings that are tested by them. Sixth, encourage students to express themselves to other parties with good articulation.

Departing from the six concepts offered from the construction of Bloom's taxonomy theory of cognitive aspects and the theory of cognitive development at the concrete operational stage, it produces an alternative cognitive education model based on literacy and numeracy programs which in its design is able to overcome learning loss due to the Covid 19 pandemic, including literacy and numeracy program models. numeracy that provides digital literacy development, strengthening metacognitive skills, use of active learning, and psychosocial support. By considering

alternative models, it is hoped that they will be able to overcome learning loss which has not been resolved to date.

Suggestion

This research is only limited to the concept of formulating a cognitive education model, therefore the next development of this research is to test the literacy and numeracy program on learning units in elementary schools, so that the design can be assessed for its level of effectiveness in achieving the PISA test standard targets, which have been degraded. dulling of critical thinking abilities due to leaning loss.

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