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Analysis of the Needs for CIMATIK (Interactive Mathematics Canva) Media Based on Problem-Based Learning with a Deep Learning Approach to Enhance Students' Mathematical Connection Ability

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ABSTRACT

Students' mathematical connection abilities remain relatively low, while the availability of interactive learning media that effectively support problem-solving and deep conceptual understanding is still limited. This study aims to analyze the need for developing CIMATIK (Canva Interactive Mathematics) media based on Problem-Based Learning (PBL) integrated with a Deep Learning approach to enhance students' mathematical connection skills. The research employed a needs analysis method involving questionnaires, interviews, and document studies conducted with teachers and students. The analysis focused on the urgency of interactive digital media, the characteristics of mathematics learning materials, students' and teachers' preferences in technology use, and the suitability of Canva features for developing PBL-oriented instructional media. The results indicate a strong need for user-friendly, visually engaging, and interactive digital media that facilitate concept exploration and meaningful learning experiences. The Deep Learning approach is considered relevant in supporting higher-order thinking skills, strengthening conceptual understanding, and enhancing inter-concept connections through contextual PBL scenarios. CIMATIK media is perceived to have significant potential to increase student engagement, improve conceptual representation, and enhance mathematical connection abilities. These findings provide a foundational basis for developing an effective CIMATIK prototype that aligns with the demands of 21st-century mathematics learning.

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1. INTRODUCTION

Mathematics education does not merely emphasize the mastery of numerical calculations; it also focuses on developing higher-order thinking skills, including the ability to make mathematical connections. Mathematical connection ability enables students to link concepts within mathematics, relate mathematics to other disciplines, and apply mathematical ideas to real-life contexts[1].

The National Council of Teachers of Mathematics (NCTM) classifies mathematical connections into three main aspects: (1) connections among mathematical topics, (2) connections between mathematics and other disciplines, and (3) connections between mathematics and students' real-life experiences[2]. In line with this perspective, the Merdeka Curriculum positions mathematical connections as an essential component of Learning Outcomes, emphasizing meaningful and contextual learning processes [3]. Despite its importance, students' ability to connect mathematically remains relatively low. Various studies report that students experience difficulties connecting mathematical concepts, understanding relationships across topics, and applying mathematics to real-world problems. At the junior high school level, research indicates that students' problem-solving abilities remain weak, particularly in conceptual integration and contextual application [4]. These findings suggest that mathematics learning is often conducted in a fragmented, procedural manner, limiting students' opportunities to develop a deep, connected understanding [5].

This condition is also reflected in the researcher's preliminary observations conducted in an eighth-grade class at SMP Negeri 2 Jatigede. Based on a mathematical connection ability test covering three indicators inter-concept connections, interdisciplinary connections, and real-life applications, the results showed that only 29% of students achieved scores above 70. More than 60% of students encountered significant difficulties in answering questions that required conceptual reasoning and contextual understanding. These findings indicate that students are not yet accustomed to thinking in a connected, reflective, and deep manner. One contributing factor to this problem is the dominance of conventional learning approaches that emphasize procedural mastery over conceptual exploration. Math instruction is often delivered in isolated segments, leaving students to struggle to recognize relationships among concepts, connections to other fields, and relevance to everyday life. In addition, the lack of learning media that support problem-solving, collaboration, and reflection further hinders the development of students' mathematical connection abilities [6].

Interactive learning media are considered a promising solution in addressing these challenges, particularly in the context of 21st-century learning. Technology-based media can facilitate visualization, engagement, and active learning processes [7]. Research by Harefa, Gulo, and Telaumbanua [8] demonstrates that using the Canva application as an instructional medium has a significant positive effect on students' learning outcomes. However, most existing studies focus primarily on learning achievement and motivation, with limited integration of pedagogical models such as Problem-Based Learning (PBL) and deep learning approaches into media design. This indicates a research gap, especially in terms of developing interactive media that explicitly aim to enhance mathematical connection abilities through structured problem-solving and deep conceptual understanding.

Problem-Based Learning (PBL) emphasizes learning through authentic problems, encouraging students to analyze, explore, and construct knowledge collaboratively[9]. When combined with a deep learning approach characterized by critical thinking, conceptual understanding, and meaningful knowledge construction, PBL can foster higher-order thinking and strengthen students' mathematical connections [10]. Therefore, integrating

PBL and deep learning into interactive media design has the potential to address the limitations of conventional mathematics instruction.

Based on these considerations, this study aims to analyze the need for developing CIMATIK (Canva Interactive Mathematics) media based on Problem-Based Learning with a deep learning approach. The needs analysis focuses on identifying user requirements, learning material characteristics, technology preferences, and the suitability of Canva as a platform for supporting interactive, problem-based, and conceptually rich mathematics learning. The findings of this study are expected to provide a strong foundation for the development of effective CIMATIK media that can enhance students' mathematical connection abilities, increase learning engagement, and support the implementation of meaningful mathematics learning in accordance with the demands of the Merdeka Curriculum and 21st-century education.

2. METHOD

This study employed a descriptive qualitative approach using a needs analysis method as the initial stage in the development of instructional media. This approach was selected to obtain in-depth information regarding the needs of both students and teachers for interactive learning media that support the improvement of students' mathematical connection abilities. The qualitative approach allows researchers to comprehensively explore users' experiences, meanings, perspectives, motivations, and expectations regarding the developed media [11]. This research is categorized as research and development (R&D) and focuses on the Analysis phase of the ADDIE model. At this stage, the study emphasizes assessing user needs, learner characteristics, learning context, and pedagogical and technological requirements as the foundation for designing the interactive learning media CIMATIK [12].

The research subjects consisted of a seventh-grade mathematics teacher at SMP Negeri 2 Jatigede and 31 seventh-grade students, who served as the main informants. The subjects were selected using purposive sampling, considering that they are the direct users of the learning media to be developed. The teacher served as both the content provider and media evaluator, while the students were the primary users who evaluated the media's effectiveness and usability.

Data were collected through semi-structured interviews, needs assessment questionnaires, and classroom observations. Semi-structured interviews were conducted with the mathematics teacher to explore perceptions of existing media limitations, required features of interactive media, and challenges in improving students' mathematical connections. The needs assessment questionnaires were distributed to students to identify their learning interests, educational technology experiences, and preferences for interactive digital media. Classroom observations were conducted during the learning process to examine students' interaction patterns, media use in the classroom, and their ability to connect mathematical concepts. To enhance data validity, data triangulation was applied by comparing and cross-checking data obtained from interviews, questionnaires, and observations [13].

Data analysis followed the Miles and Huberman model, which consists of three main stages: data reduction, data display, and conclusion drawing. Data reduction involved selecting and organizing relevant data from interviews, questionnaires, and observations. Data were presented in a descriptive narrative and in thematic tables to facilitate interpretation. Conclusion drawing focused on identifying patterns of user needs and formulating recommendations for features and content to be developed in the CIMATIK media. Data analysis was conducted simultaneously with data collection to ensure coherence between field findings and media design decisions. The results of the needs analysis served as the basis for developing a prototype of the CIMATIK interactive learning media, which was designed using a Problem-Based Learning (PBL) approach and deep learning principles. PBL was chosen due to its effectiveness in encouraging students to construct knowledge through contextual problem-solving activities [14]. Meanwhile, deep learning principles were applied to design learning activities that promote reflective thinking, conceptual integration, and real-world application of knowledge [15].

3. RESULTS AND DISCUSSION

3.1. Results

Based on the results of the mathematical connection ability test administered to students, a general overview of average scores, mastery levels, and patterns of student errors in answering questions that require conceptual connections was obtained. The analysis results indicate that students' mathematical connection ability is still in the low category. In general, the average score was 60. The following data describe the achievement of indicators of mathematical connection ability, which consist of:

1. Mathematical connections among topics within mathematics,
2. Mathematical connections with other disciplines, and
3. Mathematical connections with real-life contexts.

The mathematical connection ability test was administered to 17 eighth-grade students at SMP Negeri 2 Jatigede. The test aimed to measure students' achievement in indicators of mathematical connection ability. The results of the students' mathematical connection ability test are illustrated in the following figure.

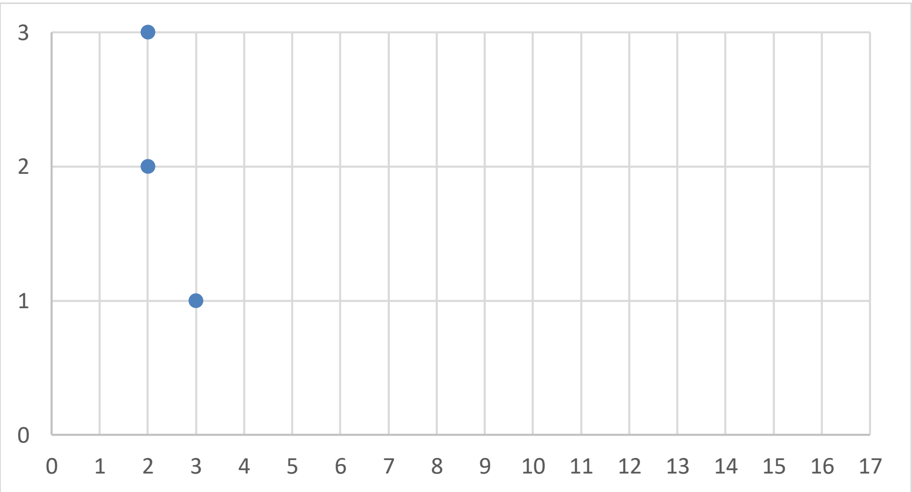

Figure 1. Achievement of Mathematical Connection Ability Indicators

Based on the figure above, among the 17 students who participated in the mathematical connection ability test, only three students correctly answered questions related to Indicator 1, two students to Indicator 2, and only two to Indicator 3. Of the students who took the test, 71% did not meet the mastery criterion (score > 70), whereas only 29% did. These findings indicate that students experience difficulties not only in procedural problem-solving but, more critically, in connecting mathematical concepts to real-world contexts and applying them. The analysis of students' responses revealed consistent patterns of errors, particularly on items requiring the integration of multiple concepts. More than 85% of students failed to answer questions that required connections with other disciplines and real-life situations. Students were unable to relate mathematical concepts to real-world contexts, such as interpreting contextual data or formulating mathematical problems based on narrative situations.

This condition arises because learning activities tend to remain procedural and offer insufficient opportunities for deep conceptual exploration. These findings align with Surface Learning theory, which emphasizes procedural memorization rather than deep understanding. In line with Rahmawati et al., surface learning is characterized by rote learning methods, fragmented knowledge, and minimal critical reflection. Therefore, the low level of mathematical connection ability found in this study provides evidence that students have not yet achieved Deep Learning, which involves analytical, reflective, and integrative thinking. Deep learning cannot occur when instruction focuses solely on worked examples and procedural exercises without allowing students to explore concepts and establish meaningful connections [16].

The profile of students' mathematical connection ability strengthens the urgency of developing interactive learning media such as CIMATIK for several reasons. First, students need more concrete visualizations and conceptual representations to better understand the relationships among mathematical topics. Second, the high percentage of students who did not achieve mastery indicates that conventional instructional approaches have not been effective in fostering mathematical connections. Third, the Problem-Based Learning (PBL) and deep learning approaches embedded in CIMATIK are appropriate for training conceptual integration, reflective thinking, and real-world application, particularly in areas where students demonstrate the greatest weaknesses. Fourth, interactive media enable teachers to present contextual problems more engagingly, thereby facilitating students' ability to build meaningful bridges between mathematics and everyday life.

Therefore, this profile analysis provides strong evidence that CIMATIK's development is not only relevant but also responsive to students' actual needs. Overall, the profile of students' mathematical connection ability indicates that most learners have not yet been able to deeply integrate mathematical concepts, whether across topics, across disciplines, or within real-life contexts. These findings provide an important foundation for the development of CIMATIK based on PBL and deep learning approaches, which are expected to bridge these gaps through interactive visualizations, contextual problems, and reflective activities that stimulate conceptual connections.

Based on the questionnaire results and observations of the mathematics learning process in Grade VII at SMP Negeri 2 Jatigede, an overview of the teaching methods predominantly used by the teacher was obtained. The questionnaire data completed by students indicate that teaching practices remain largely teacher-centered. The data on the teacher's current teaching methods are presented in Table 1.

Table 1. Questionnaire Data on Teachers' Teaching Methods

Observed Learning Method	Percentage
Teacher-Centered Learning	80%
Group Discussion-Based Learning	10%
Problem-Based Learning (PBL)	5%
Interactive Media-Based Learning	5%

These results are consistent with the teacher interviews documented in the research data, which indicate that learning activities are still predominantly conducted through lecture-based methods, verbal explanations, and procedural problem-solving, with insufficient visual and contextual exploration. The data show that approximately 80% of the learning process remains teacher-centered. This situation leads students to receive information passively, limiting their involvement in the knowledge-construction process. When instruction mainly focuses on lectures and procedural exercises, higher-order thinking activities such as conceptual exploration, reflection, and strengthening relationships among concepts do not develop optimally.

As a result, the Deep Learning approach has not been implemented effectively, as students are not given sufficient opportunities to analyze, connect concepts, and apply knowledge in real-world contexts. Similarly, the Problem-Based Learning (PBL) model is rarely applied, as evidenced by the low percentage of students who reported having been involved in solving contextual problems that stimulate discussion or collaboration. Teachers also stated that limited learning media is one of the main barriers to implementing more interactive, visual, and student-centered instructional methods. These findings further reinforce the urgency of developing learning media aligned with PBL and deep learning principles, as identified in the previous needs analysis.

The dominance of teacher-centered learning has several impacts, including the low level of students' mathematical connection ability, as students tend to focus more on procedural steps than on conceptual understanding; limited opportunities for students to think critically, engage in discussions, and relate mathematical concepts to real-life situations; declining learning motivation due to monotonous and less interactive instruction; and the absence of facilities that support deep learning, even though such abilities are essential for developing conceptual understanding and connections across topics.

This situation is directly related to the students' mathematical connection ability profile, which shows a high level of non-mastery and a low ability to connect concepts across mathematical topics. The finding that learning remains highly teacher-centered emphasizes the importance of introducing learning media that promote active student engagement, provide contextual problems, facilitate group discussions through PBL, present clear conceptual visualizations, and stimulate deep learning processes. CIMATIK is therefore positioned as an appropriate solution to shift learning patterns from teacher-centered to student-centered approaches, in line with the demands of 21st-century learning and the Merdeka Curriculum.

The results of interviews and observations with mathematics teachers and seventh-grade students at SMP Negeri 2 Jatigede indicate a clear need for more innovative, interactive, and contextually relevant learning media. Teachers reported that classroom mathematics instruction still relies heavily on conventional, teacher-centered methods, with content delivered predominantly verbally and abstractly. Topics such as algebraic operations, linear equations, and geometry are often presented symbolically, with limited use of adequate visual approaches. As a result, students struggle to understand the relationships among concepts and fail to connect mathematical learning to real-world contexts.

Teachers also revealed that the limited availability of current learning media, both in terms of content and features, makes it challenging to implement instruction that encourages exploration and meaningful conceptual connections. Furthermore, questionnaire results from 32 students indicate that 57% require interactive learning media, 16% prefer PowerPoint, 7% require physical teaching aids, 16% need learning modules, 2% require worksheets (LKS), and 2% prefer other learning media. The majority of students also reported greater enthusiasm when using digital media, such as animations, interactive presentations, and problem simulations, than when relying solely on textbooks.

These findings are consistent with the study by Fiani et al. (2024), which demonstrates that interactive learning integrating technology and collaborative methods significantly increases student engagement and motivation. In addition, Priani et al. emphasize that PBL-based interactive learning media have been shown to significantly enhance students' critical thinking skills [17]. The use of PBL-oriented media facilitates students' development of critical thinking abilities, which are essential for addressing both academic challenges and real-world problems, while also encouraging active participation in the learning process.

The need for learning media that not only present material in an engaging manner but also promote deep learning has become increasingly important. According to Siregar et al. al the use of interactive PowerPoint media makes classroom learning more dynamic and meaningful, enabling students to more easily connect mathematical material with practical applications [18]. Moreover, integrating deep learning principles with interactive PPT media has significant potential to address challenges in mathematics learning, particularly in topics such as trigonometry. Through this integration, students are expected to develop a deeper understanding, engage actively in the learning process, and cultivate more positive attitudes toward mathematics.

From the teachers' perspective, learning media must also meet criteria of ease of use, flexibility in content development, and alignment with the curriculum. User-friendly platform-based media such as Canva Edu are highly promising, as they enable professional visual content presentation, adaptability to students' needs, and flexibility for teachers to structure learning flows in accordance with the PBL approach.

Thus, the need for learning media is not limited to the attractive presentation of information, but also encompasses the integration of strong pedagogical approaches, such as

Problem-Based Learning (PBL) and deep learning, which enable students not only to learn but also to think deeply, reflectively, and make meaningful connections among concepts.

Expected Media Criteria

The results of questionnaires and observations conducted with 32 seventh-grade students at SMP Negeri 2 Jatigede indicate that students have relatively high expectations regarding mathematics learning media. Students expect media that are not only visually appealing but also interactive, relevant, and supportive of active, deep learning. Based on the questionnaire analysis, four main criteria are expected by students from learning media, namely:

Attractive and Interactive Visualization

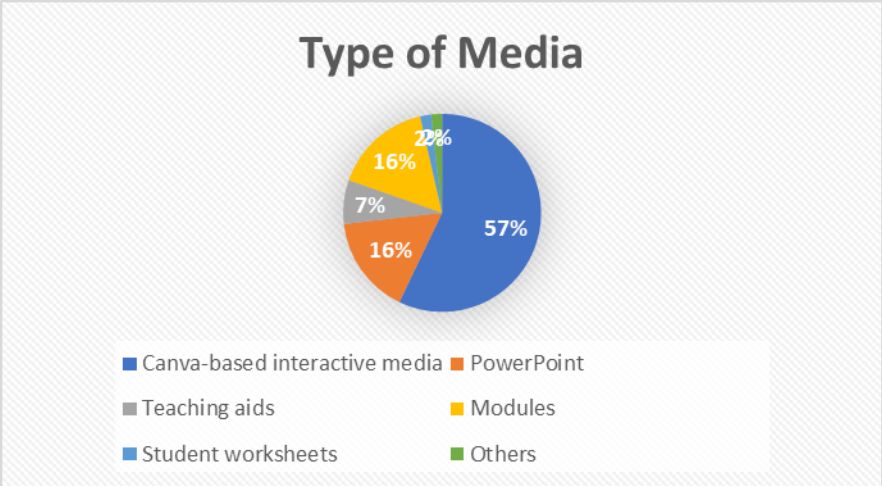

Figure 2. Results of Media Needs Observation

Based on the pie chart above, the analysis of the interactive multimedia needs observation sheets completed by 32 students as respondents shows that 57% of students require interactive learning media, 16% prefer PowerPoint, 7% require physical teaching aids, 16% need learning modules, 2% require worksheets (LKS), and 2% require other types of learning media. These results indicate that the majority of students prioritize interactive learning media as their primary learning support, highlighting the importance of visual and interactive elements in facilitating student engagement and understanding.

These findings reinforce Jala's findings, which emphasize the effectiveness of visual learning media in improving students' understanding of mathematical concepts. Previous studies have demonstrated that visualization facilitates deeper conceptual understanding and better information retention [19]. Effective visualization not only makes learning more enjoyable but also supports students' sensory and cognitive engagement. Interactive media function as learning tools that actively involve students through visual, auditory, and even kinesthetic stimulation, thereby enhancing concentration, engagement, and information absorption [20]. Furthermore, research has shown that the use of interactive animated media can increase students' memory retention by up to 25% compared to conventional instructional methods [21].

Presenting Real-Life (Contextual) Problems

This criterion aligns with the principles of Contextual Teaching and Learning (CTL), which emphasize that learning should help teachers connect instructional content to real-world situations and motivate students to relate their knowledge to everyday life [22]. Learning media that incorporate contextual stories, case studies, or real-life simulations can help students build logical, applicable connections to mathematical concepts. Supporting this view, states that contextual learning enables students to connect academic subjects to their daily lives to find meaning. Such experiences expand students' personal contexts by stimulating the brain to form new connections and construct new knowledge [22].

Supporting Problem-Based Learning (PBL)

Students also expect learning media that provide challenges and opportunities for exploration rather than merely delivering information in a one-way manner. In this regard, media that support Problem-Based Learning (PBL) are considered ideal. Such media typically present an initial problem trigger, provide space for collaboration, and guide students in progressively developing solutions. PBL is a learning model oriented toward problem-solving, in which students are confronted with real problems that encourage the development of higher-order thinking skills, problem-solving abilities, and the acquisition of new knowledge related to the given problems. This aligns closely with mathematical connection ability, which requires students to utilize prior knowledge to solve problems and connect mathematical concepts comprehensively [23]. Learning media designed using a PBL structure can therefore support the development of mathematical connection abilities by requiring students to integrate multiple concepts into problem-solving.

Encouraging Reflective and Deep Thinking (Deep Learning)

Finally, students expressed the need for learning media that not only present information but also provide opportunities for reflection and conceptual exploration. Students expect media that challenge them to think critically by asking questions such as *'why,' 'how,' and 'how does this concept relate to other materials?'* Deep learning approaches supported by interactive media have been proven effective in improving students' learning outcomes [18].

The CIMATIK (Canva Interactive Mathematics) media was designed to meet all of the criteria described above. Developed using Canva Edu, CIMATIK offers a modern, colorful, and user-friendly visual interface. Each learning unit begins with contextual problems drawn from students' everyday experiences, such as calculating garden areas, managing finances, or interpreting social statistical data. Learning activities within the media are structured according to the PBL approach, including exploration, group discussion, and individual reflection. The media also provide opportunities for reflective writing, personal conclusions, and exercises that connect one concept to another. By fulfilling these four criteria, CIMATIK is believed to effectively address the needs of mathematics learning in the digital era, which demands cognitive engagement, contextualization, and critical thinking skills from students.

CIMATIK as an Integrated Learning Solution

In response to the need for engaging, contextual, and mathematically connected learning media, Canva Interactive Mathematics (CIMATIK) is introduced as an innovative solution that integrates Problem-Based Learning (PBL) and deep learning principles. This media was developed using the Canva Edu platform, which enables professional visual design, interactive navigation, and flexible multimedia integration.

CIMATIK is systematically organized following the stages of problem-based learning recommended in the PBL model, as follows:

1. **Problem Orientation**
   At the initial stage, students are presented with a problem trigger in the form of real-life situations from everyday experience. These problems are designed to stimulate curiosity and establish meaningful learning contexts.
2. **Concept Exploration**
   Students are guided to explore concepts related to the problem through visual explanations, interactive animations, and short videos. This stage aims to support active knowledge construction, consistent with constructivist learning principles.
3. **Group Discussion**
   The media provide collaborative activity sheets for students to engage in group discussions, either face-to-face in the classroom or online via platforms such as Google Jamboard or Padlet. This feature supports the development of mathematical communication and collaboration skills.
4. **Individual Reflection**
   At the end of each session, students are encouraged to complete reflective journals or respond to open-ended questions that prompt them to connect new material with prior knowledge and project its application to other contexts. This stage is essential for building meaningful learning.

This approach aligns with the idea that PBL-based learning enables students to effectively connect academic knowledge with real-world contexts, thereby supporting the development of students' ability to connect academic knowledge with real-world contexts [24].

Deep Learning Principles in CIMATIK

CIMATIK not only presents visually engaging content but is also designed to facilitate higher-order learning that emphasizes:

1. Elaboration and connection among concepts
2. Critical and reflective thinking
3. Cross-contextual application

These deep learning principles are implemented through reflective questions, conceptual connection activities, and case studies that require students to think beyond rote memorization and routine procedures. Research by Dahroni et al. shows that deep learning is more effective in enhancing students' mathematical reasoning and higher-order thinking skills [25].

Visual Design and User Experience

The appeal of CIMATIK also lies in its modern and user-friendly visual design. Canva Edu enables the integration of various graphic elements, including:

1. Conceptual infographics
2. Procedural animations
3. Contextual problem illustrations
4. Navigation buttons and interactive quizzes

With its responsive and dynamic design, students become more engaged in the learning process. Interactive digital media significantly enhance students' motivation, mathematics learning outcomes, and positive attitudes toward the subject [26]. CIMATIK is developed in alignment with the graduate profile dimensions and learning outcomes (CP) of the Merdeka Curriculum, particularly in fostering critical thinking skills, numeracy literacy, and collaboration.

Limitations of CIMATIK

Despite its strong potential to support PBL implementation and strengthen mathematical connection abilities, CIMATIK has several limitations that must be acknowledged.

1. Dependence on Stable Internet Connectivity
   CIMATIK requires a relatively stable internet connection to access interactive features such as hyperlinks, embedded videos, animations, and digital navigation. In areas with limited connectivity, learning activities may be disrupted by incomplete loading or slow interactions.
2. Requirement for Digital Literacy among Teachers and Students
   Not all teachers are familiar with creating or managing interactive Canva-based media. Teachers who lack experience may need time to adapt, particularly when managing hyperlinks, navigation elements, and multimedia content.
3. Unequal Access to Devices
   Not all students own personal devices (smartphones or laptops) or have adequate access to devices capable of running CIMATIK smoothly, especially those with lower specifications. This may lead to participation gaps among students.

Nevertheless, these limitations do not diminish CIMATIK's potential as an interactive learning medium that aligns with the learning styles of the digital generation. Future development efforts may focus on offline integration, improving teachers' digital literacy, and providing supporting devices at schools to optimize implementation.

3.2. Discussion

Based on an analysis of students' mathematical connection skills, it was found that most seventh-grade students at SMP Negeri 2 Jatigede have not yet been able to deeply integrate mathematical concepts, both within and across topics, disciplines, and real-life contexts. The test results showed that, out of 17 students who participated, only 3 answered correctly to the indicator of connections between topics, 2 to the indicator of connections with other disciplines, and 2 to the indicator of connections with real-life situations.

Furthermore, 71% of students did not reach the mastery score, while only 29% scored above 70. These findings indicate that students struggle not only with procedural problem-solving but especially with integrating concepts and applying them to real-life contexts. Consistent errors were observed in questions requiring cross-concept integration, reflecting the characteristics of Surface Learning, a learning pattern focused on procedural memorization without deep understanding [27]. This condition indicates that students have not yet achieved *Deep Learning*, which requires analytical, reflective, and integrative thinking.

The classroom teaching process also revealed a dominance of teacher-centered learning (80%), while group discussions, problem-based learning (PBL), and interactive media use accounted for 10%, 5%, and 5%, respectively. Teachers reported that the learning methods remain primarily lectures, verbal explanations, and procedural exercises, with little visual or contextual exploration. Consequently, students' mathematical connection skills are low, motivation decreases, and opportunities for critical and reflective thinking are limited. This confirms that conventional teaching has not sufficiently implemented *deep learning* or PBL approaches [24].

The need for interactive learning media is further confirmed by a survey in which 57% of students expressed a need for interactive media, 16% preferred PowerPoint, 16% preferred modules, 7% preferred teaching aids, 2% preferred LKS, and 2% preferred other media. Students showed higher engagement with digital media such as animations, interactive presentations, and problem simulations than with textbooks [28]. Moreover, PBL-based interactive media have been shown to significantly enhance students' critical thinking skills [29] and support *deep learning* by allowing students to explore and reflect on concepts [18].

From survey and observation analysis, four main criteria for expected learning media were identified: (1) engaging and interactive visualization, (2) presentation of real-world problems (contextual), (3) support for problem-based learning (PBL), and (4) promoting reflective and deep thinking. Interactive visualization facilitates students' sensory and cognitive engagement and improves information retention [20], [21]. Contextual problems help students build logical and applicable connections to mathematical concepts [22]. PBL requires students to integrate various concepts to solve problems, thereby enhancing mathematical connection skills[30]. Finally, *deep learning* approaches supported by interactive media effectively improve learning outcomes through reflection and exploration of concepts[18].

These findings highlight the urgency of developing interactive learning media that meet students' needs, namely CIMATIK (Canva Interactive Mathematics). CIMATIK is designed to:

1. Present concepts visually and concretely to help students understand relationships between topics.
2. Provide contextual problems relevant to students' daily lives.
3. Integrate PBL activities, from exploration and group discussion to individual reflection [24].
4. Promote *deep learning* through reflective questions, concept-connection activities, and case studies that encourage analytical, reflective, and integrative thinking [25].

CIMATIK also offers modern, user-friendly visual design, infographics, procedural animations, contextual problem illustrations, and navigation buttons between pages and interactive quizzes, engaging students more actively in learning [31]. Therefore, CIMATIK development is not only relevant but also a strategic solution to improve mathematical connection skills, engagement, and deep understanding in the digital era.

4. CONCLUSION

This study concludes that students' mathematical connection abilities require systematic support through learning approaches that emphasize meaningful, contextual, and integrative thinking. The overall learning conditions indicate that mathematics instruction has not yet fully enabled students to construct relationships among mathematical concepts across disciplines and within real-life contexts. This situation reflects a learning paradigm that still prioritizes procedural understanding over conceptual depth and reflective reasoning.

The findings imply that integrating interactive learning media with pedagogical models that promote active problem-solving is essential. The use of CIMATIK (Canva Interactive Mathematics) media, designed on a Problem-Based Learning and deep learning framework, has strong potential to address these challenges by fostering student engagement, supporting conceptual exploration, and encouraging higher-order thinking. From a pedagogical perspective, this research reinforces the importance of aligning instructional media design with learning models that emphasize inquiry, reflection, and contextualization, particularly in mathematics education.

This study is limited to a needs analysis conducted in a specific junior high school context and focuses primarily on identifying learning challenges, media preferences, and instructional gaps. It does not evaluate the effectiveness of CIMATIK implementation in improving learning outcomes, nor does it involve large-scale testing across diverse educational settings. Therefore, the generalizability of the findings remains limited to contexts with similar characteristics.

Future research is recommended to focus on the development, implementation, and experimental evaluation of CIMATIK media to examine its effectiveness in enhancing mathematical connection abilities. Further studies may also explore its integration with other learning models, its applicability across different grade levels, and its impact on other higher-order thinking skills such as critical thinking and creativity. Beyond academic contributions, this research offers practical value to teachers, curriculum developers, and educational institutions by providing a conceptual framework for designing interactive, problem-based digital learning media. For the general public, particularly students and parents, the development of CIMATIK has the potential to support more meaningful mathematics learning experiences that are relevant to real-life problem-solving and the demands of 21st-century education.

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