

## Needs analysis for electronic teaching materials based on the merdeka learning pathway to enhance students' mathematical creative thinking skills

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**Abstrak** Penelitian ini bertujuan untuk menganalisis kebutuhan dan karakteristik bahan ajar elektronik berbasis alur merdeka yang relevan dengan kondisi siswa dan mampu menjawab tantangan pembelajaran matematika. Penelitian ini berfokus pada tahap *analysis* dalam model pengembangan ADDIE. Teknik pengumpulan data meliputi wawancara dan angket yang disusun berdasarkan hasil analisis kurikulum, analisis karakteristik siswa dan analisis tujuan pembelajaran dalam model pengembangan ADDIE. Data dianalisis secara deskriptif kualitatif dan kuantitatif untuk mengidentifikasi kebutuhan serta karakteristik bahan ajar. Temuan menunjukkan adanya kesenjangan signifikan dalam keterampilan berpikir kreatif matematis siswa. Meskipun guru mengakui peran teknologi, bahan ajar elektronik yang ada belum cukup dalam mendorong kreativitas dan kemandirian belajar. Siswa juga menyatakan kebutuhan akan sumber belajar elektronik yang fleksibel, interaktif, dan kontekstual. Secara khusus, mayoritas siswa mengalami kesulitan belajar mandiri tanpa bahan ajar yang terstruktur secara sistematis. Oleh karena itu, pengembangan bahan ajar elektronik adaptif, yang terintegrasi dengan elemen interaktif (misalnya, animasi, simulasi), masalah kontekstual, dan aktivitas eksploratif berbasis Alur Merdeka, sangat direkomendasikan untuk menjembatani kesenjangan tersebut dan mendukung pembelajaran berdiferensiasi, serta meningkatkan keterampilan berpikir kreatif matematis siswa.

**Kata kunci** *Alur merdeka, Analisis kebutuhan, Bahan ajar elektronik, Kemampuan berpikir kreatif matematis*

**Abstract** This research aims to analyze the needs and characteristics of electronic teaching materials based on the Merdeka Learning Pathway that are relevant to student conditions and capable of addressing challenges in mathematics learning. The study focuses on the analysis stage within the ADDIE development model. Data collection techniques included interviews and questionnaires, structured based on curriculum analysis, student characteristics analysis, and learning objectives analysis within the ADDIE development model. Data were analyzed using descriptive qualitative and quantitative methods to identify the needs and characteristics of the teaching materials. Findings indicate a significant gap in students' mathematical creative thinking skills. Although teachers acknowledge the role of technology, existing electronic teaching materials are insufficient in promoting creativity and independent learning. Students also expressed a need for electronic learning resources that are flexible, interactive, and contextual. Specifically, most students experienced difficulties in independent learning without systematically structured teaching materials. Therefore, the development of adaptive electronic teaching materials, integrated with interactive elements (e.g., animations, simulations), contextual problems, and exploratory activities based on the Merdeka Learning Pathway, is highly recommended to bridge this gap, support differentiated learning, and enhance students' mathematical creative thinking skills.

**Keywords** *Merdeka learning pathway, Needs analysis, Electronic teaching materials, Mathematical creative thinking skills*

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## Introduction

Educational transformation is undeniable, driven by rapid technological advancements that profoundly impact every aspect of life. In the eras of Industry 4.0 and Society 5.0, automation across various fields demands human resources who are knowledgeable, skilled, and character-driven (Melodiana et al., 2024). In this context, mathematical creative thinking skills are becoming extremely crucial. In the 21st century, students aren't just expected to master academic content; they also need diverse essential skills like critical thinking, creativity, collaboration, and technology and information literacy (Kemdikbud, 2022). Mathematical creative thinking skills play a fundamental role in preparing students to face future complexity and innovation, as they empower individuals to transcend rote learning and apply knowledge flexibly to novel situations (Sitepu & Waluya, 2023).

Mathematical creative thinking skills play a fundamental role in preparing students to face future complexity and innovation because they empower individuals to transcend rote learning and apply knowledge flexibly to novel situations. Conceptually, this ability refers to an individual's capacity to generate innovative and original solutions to problems, often differing from conventional approaches (Fitriyah & Ramadani, 2021). Similarly, Haylock (Herman et al., 2023) posits mathematical creativity as the creation of something new and meaningful, independent of conventional thought patterns. Livne reinforces this by emphasizing that creative thinking in mathematics specifically relates to the ability to produce diverse and original solutions to open-ended problems (Utami et al., 2020). In mathematics learning, students can solve given problems by developing ideas, enabling them to discover various alternative solutions (Astria & Kusuma, 2023).

In an increasingly automated world, humans need to be the problem-solvers for issues machines can't handle, the innovators who create new technologies, and the critical thinkers who can navigate complex, unprecedented situations. Mathematical creative thinking, by its nature, fosters these abilities by encouraging the generation of diverse solutions, adaptation to new challenges, and thinking "outside the box." Pedagogical innovations that integrate technology offer a strategic opportunity to develop these abilities (Rosyiddin et al., 2022). Grounded in theories such as constructivism, which posits that learners actively construct knowledge from their experiences, technology-integrated learning can provide rich, interactive environments. By connecting technology to everyday contexts, mathematics learning becomes more engaging and meaningful, while also facilitating the development of students' creative thinking skills in solving contextual mathematical problems.

However, despite the clear urgency and importance of these skills, significant problems persist in mathematics education in Indonesia, highlighting a notable gap between theoretical ideals and practical realities. International research, such as PISA, indicates low mathematical literacy (Indonesia ranked 70th out of 81 with an average score of 379). The fact that only about 18% of students reach the minimum mathematics competency level (Level 2) indicates most 15-year-old Indonesian students still have underdeveloped higher-order thinking skills, including creative and critical thinking (Alam, 2023). This low level of creative and critical thinking is also reflected in the 2023 National Assessment (AN) data. More specifically at the regional level, the creativity scores (52.04) and critical thinking scores (52.63) of 11th-grade students in public high schools in South Sulawesi fall into the "lower-middle ranking (61–80%)" category nationally (Kemendikdasmen, 2024).

This low ability is further confirmed by observations at SMA Negeri 7 Makassar. During mathematics lessons, students frequently struggled with generating multiple solutions to open-ended problems (indicating low fluency), adapting their strategies when initial attempts failed (pointing to low flexibility), and proposing novel approaches beyond standard textbook methods (suggesting low originality). A primary cause is the limited conventional and static electronic teaching materials predominantly used. These materials primarily focus on routine procedures, fail to encourage idea exploration or divergent thinking, and aren't systematically designed to foster creative thinking through exploratory activities and open-ended problem-solving. This is compounded by limited teacher competence in developing adaptive and interactive electronic teaching materials (Harisuddin, 2019). This context underscores the urgent need for innovative teaching materials, particularly electronic teaching materials, which, unlike conventional ones, can be designed to be highly interactive, adaptive, and explicitly foster divergent thinking and problem-solving through features like embedded simulations, dynamic visuals, and immediate feedback, thereby directly addressing the deficiencies in current approaches and empowering teachers.

In response to these critical challenges—the persistent low creative thinking skills, the limitations of existing static teaching materials, and the need for enhanced teacher competence in leveraging digital tools—the government, through the Merdeka Curriculum, provides extensive freedom and flexibility for teachers to design and develop student-centered, adaptive, and differentiated learning materials (Melodiana et al., 2024). This aligns with Government Regulation Number 4 of 2022 concerning National Education Standards, which states that learning must be student-centered and provide room for the development of higher-order thinking skills, including creative and reflective thinking. The Merdeka Curriculum is notably different from previous curricula due to its explicit emphasis on differentiated and student-centered learning, empowering teachers to tailor content and methods to individual student needs and foster deeper engagement. This shift provides a crucial framework for fostering creative thinking, as it encourages learning environments where students are empowered to explore, experiment, and construct their understanding, rather than passively receive information—conditions essential for developing creative problem-solving.

The Merdeka Learning Pathway, a core component of the Merdeka Curriculum, is one such approach that allows teachers flexibility in structuring contextual, adaptive, and student-centered learning sequences while still referring to established learning outcomes (Jamaludin et al., 2023; Suroto et al., 2022). This concept, comprising stages from "Starting with Self" to "Real Action," emphasizes students' freedom to explore, discover, and solve problems independently (Jamaludin et al., 2023). Electronic teaching materials, as interactive multimedia learning tools that systematically and logically present content (Mega, 2023), are highly compatible with principles of flexible and adaptive student-centered learning (Wulandari & Widiyatmoko, 2023). Consequently, electronic teaching materials based on the Merdeka Learning Pathway have the potential to not only improve understanding of mathematical concepts but also to develop students' critical, creative, collaborative, and communicative thinking skills as part of 21st-century competencies (Rahmah et al., 2024). For instance, interactive digital tools can facilitate collaboration through shared activities and enhance communication skills by requiring students to present solutions digitally.

## Research gap and novelty

Several studies support the effectiveness of similar approaches in enhancing creative thinking and student engagement, indicating the viability of this research direction. For instance, Jamaludin et al., (2023) demonstrated that applying the Merdeka Learning Pathway in the learning process can make learning more engaging, facilitate student comprehension, enhance efficiency and concentration, and create comprehensive learning experiences that encourage students' creativity and potential development. Other research also indicates that learning supported by engaging multimedia, such as E-LKPDs featuring illustrations, learning videos, STEM aspects, and cultural content presented communicatively, can make it easier for students to understand what they are learning and enhance their creative thinking abilities (Subakti et al., 2021). Suantini et al. (2022) found that illustrated E-modules were effective in improving the creative thinking skills of fourth-grade elementary school students. Furthermore, research by (Wakhid et al., 2023) showed that mathematics learning with a STEM approach created engaging learning conditions and increased student motivation, creativity, and innovation. Additionally, research by (Mufliva et al., 2023) focusing on the development of LKPDs based on the Merdeka Learning Pathway, emphasizing correct concept development, relevant illustrations, and context, proved highly viable and helpful in improving student comprehension and meeting diverse student needs in overcoming mathematics learning obstacles.

Despite numerous studies highlighting the importance of developing innovative teaching materials and the effectiveness of certain approaches, there remains a significant research gap regarding the specific needs analysis for developing electronic teaching materials systematically designed based on the Merdeka Learning Pathway to explicitly enhance students' mathematical creative thinking abilities within the Indonesian context, particularly in South Sulawesi. Most studies tend to focus on product development or the effectiveness of product use (Hamdani et al., 2023), rather than a foundational needs analysis that integrates the philosophy and stages of the Merdeka Learning Pathway to stimulate specific creative thinking indicators (fluency, flexibility, originality, elaboration).

Therefore, this study specifically aims to analyze the needs for developing electronic teaching materials based on the Merdeka Learning Pathway to enhance students' mathematical creative thinking ability. This research is a needs analysis study, specifically conducted within the "Analysis" phase of the ADDIE development model. The objective is to identify the specific needs and characteristics of electronic teaching materials based on the Merdeka Learning Pathway that align with the curriculum and student characteristics, and effectively address challenges in mathematics learning, particularly in developing students' mathematical creative thinking skills.

## Theoretical review

This research is underpinned by several key theories that form its conceptual foundation, particularly concerning creative thinking abilities and the implementation of the Merdeka Learning Pathway in mathematics education. These theories will be further elaborated to provide a framework for understanding and analyzing the needs in developing the teaching materials.

## Creative thinking ability

The conceptualization of creative thinking ability in this research is based on the theory put forth by Torrance, as adapted by Siswono (2010). Torrance identified four main indicators of creative thinking ability: fluency, flexibility, originality, and elaboration (Febrianingsih, 2022). Fluency refers to the ability to generate a large number of ideas or relevant solutions. In mathematics, this translates to proposing multiple ways to solve a problem or listing various examples for a given concept; flexibility refers to the ability to view a problem from various perspectives or use diverse strategies. This involves shifting approaches when one method doesn't work or exploring different conceptual angles; while elaboration relates to the ability to develop ideas in a detailed and structured manner. In the context of mathematics learning, these indicators are highly relevant for assessing how students can solve problems in diverse ways, discover new solutions, and comprehensively explain their thought processes.

This Torrance theory serves as the primary conceptual framework for our research, specifically during the needs analysis phase. Torrance's indicators will be our lens to systematically:

- Analyze existing data: We'll examine National Assessment results and observations at SMA Negeri 7 Makassar to specifically identify which dimensions of creative thinking (fluency, flexibility, originality, elaboration) most urgently need to be addressed in mathematics learning. For example, we'll look for evidence of students struggling to generate multiple solution methods (fluency) or rarely offering unique approaches (originality).
- Design research instruments: Our questionnaires and interview guides for teachers and students will be structured to explore student difficulties in demonstrating these specific creative thinking indicators, as well as teachers' perceptions of how current teaching materials support or hinder them.
- Inform the required characteristics of electronic teaching materials: The findings from our needs analysis, grounded in Torrance's indicators, will guide us in determining what features and types of activities should be incorporated. For instance, to promote *fluency*, materials might present problems with multiple possible solutions; for *flexibility*, they'll offer opportunities to try different approaches; for *originality*, they'll encourage out-of-the-box thinking; and for *elaboration*, they'll prompt students to explain their processes in detail.

Thus, the Torrance framework not only provides a clear definition but also acts as our operational guide for identifying specific needs and formulating appropriate features for future electronic teaching material development.

## Merdeka learning pathway

The Merdeka Learning Pathway (*Alur Merdeka*), as a learning approach within the Merdeka Curriculum, offers a flexible yet guided structure for achieving learning outcomes. This concept comprises several stages designed to support student-centered learning and develop various competencies, including creative thinking. These stages include: Starting with Self (Mulai Dari Diri), Concept Exploration (Eksplorasi Konsep), Collaboration Space (Ruang Kolaborasi), Contextual Demonstration (Demonstrasi Kontekstual), Understanding Elaboration (Elaborasi Pemahaman), Inter-Material Connection (Koneksi Antar Materi), and Real Action (Aksi Nyata) (Jamaludin et al., 2023; Suroto et al., 2022).

The theoretical basis of the Merdeka Learning Pathway lies in its embrace of constructivist principles and differentiated instruction. It acknowledges that learning is an active process where

students construct meaning through exploration and interaction, rather than passively receiving information. This aligns with Vygotsky's sociocultural theory, which emphasizes the role of social interaction and collaboration in cognitive development, particularly evident in the "Ruang Kolaborasi" stage where students collectively build understanding. Each stage is designed to encourage active student engagement, self-directed learning, and peer collaboration, which are all vital for fostering higher-order thinking skills. For example, the "Mulai Dari Diri" stage encourages students to activate prior knowledge and express initial ideas freely, promoting autonomy and critical reflection essential for fluency. The "Eksplorasi Konsep" stage aligns with constructivist ideas by encouraging students to delve into new concepts from multiple angles, fostering flexibility in thinking. The "Ruang Kolaborasi" further promotes originality and flexibility by allowing students to build understanding together and learn from diverse perspectives and unique contributions. This student-centered and flexible approach inherently provides a conducive framework for nurturing divergent thinking, originality, and comprehensive problem-solving, making it a robust pedagogical solution for developing mathematical creative thinking abilities. A deep understanding of each of these stages is crucial for designing electronic teaching materials that effectively integrate the Merdeka Learning Pathway and foster students' mathematical creative thinking abilities.

## **Methods**

### **Type of research**

This research is a needs analysis study, specifically conducted within the "Analysis" phase of the ADDIE development model. Focusing exclusively on the Analysis phase is crucial as it lays the foundational groundwork for any effective instructional design. This phase systematically identifies the problem, determines learner characteristics, analyzes the context, and specifies the learning goals (Nuruddin et al., 2021). Without a thorough needs analysis, subsequent development phases (Design, Development, Implementation, Evaluation) risk producing materials that are misaligned with learner needs or fail to address the core educational problem effectively (Branch, 2009). Therefore, dedicating this study to a comprehensive needs analysis ensures that any future electronic teaching materials will be empirically driven, highly relevant, and precisely targeted to enhance students' mathematical creative thinking ability within the specified context. The objective is to identify the specific needs and characteristics of electronic teaching materials based on the Merdeka Learning Pathway that align with the curriculum and student characteristics, and effectively address challenges in mathematics learning, particularly in developing students' mathematical creative thinking skills.

### **Research subjects**

The subjects in this study were 37 11th-grade students of SMA Negeri 7 Makassar in the 2024-2025 academic year and 3 mathematics teachers at SMA Negeri 7 Makassar. The subjects in this study were 37 11th-grade students of SMA Negeri 7 Makassar in the 2024-2025 academic year and 3 mathematics teachers at SMA Negeri 7 Makassar. These research subjects were chosen using purposive sampling, a technique where participants are selected based on specific criteria relevant to the research objectives (Abdussamad, 2021). Students from the 11th grade were chosen because this stage is pivotal for developing higher-order thinking skills, including creative thinking in mathematics, as they transition towards more complex concepts and

problem-solving. Furthermore, the teachers were selected due to their direct involvement in teaching mathematics, providing crucial insights from their practical experience with current teaching materials and student learning challenges related to mathematical creative thinking. Their perspectives are essential for understanding the specific needs and characteristics of new electronic teaching materials based on the Merdeka Learning Pathway.

## **Research instruments**

Research instruments serve as essential tools that assist researchers in the data collection process. Instruments serve as vital mechanisms for measuring a phenomenon by gathering and recording necessary information for evaluation, decision-making, and ultimately achieving a deeper understanding (Widiana et al., 2020). The instruments used in this study were interviews and questionnaires. These instruments were meticulously developed by the researchers based on the "analysis" indicators of the ADDIE development model, ensuring their alignment with the overall research objectives of identifying the specific needs and characteristics of electronic teaching materials.

The interviews with mathematics teachers were structured to gather their perceptions of current challenges in fostering students' mathematical creative thinking skills and the limitations of existing teaching materials. This qualitative data provided rich insights into the instructional context and teachers' felt needs for more effective resources.

Meanwhile, the questionnaires administered to students aimed to collect data on their learning preferences, motivation, current learning experiences, and specific needs and desires concerning electronic teaching materials. This instrument captured student perspectives on how new materials could better support their engagement and the development of higher-order thinking.

These instruments were designed to identify the needs for developing students' mathematical creative thinking skills. We did this by collecting teachers' professional insights and students' expressed preferences and input on what effective learning materials should offer.

To ensure the quality of these instruments, both the interview protocols and questionnaire items underwent a rigorous development process. We crafted them based on theoretical frameworks of mathematical creative thinking (e.g., indicators like fluency, flexibility, originality, and elaboration). Content validity of both the interview guide and student questionnaire was established through expert review. Two qualified experts with extensive competence in mathematics and curriculum development evaluated the instruments: a Vice Principal of Curriculum with over ten years of experience teaching mathematics and managing the curriculum at the high school level, and an expert lecturer in mathematics education from a leading university with a relevant publication record in instructional material development. These experts independently assessed each item using a 4-point Likert scale (1=Not Relevant, 2=Less Relevant, 3=Quite Relevant, 4=Very Relevant). The results of this validation indicated an average relevancy score of 3.5 out of 4, with no item scoring below 3. This meticulous instrument design ensures the collected data accurately reflects the contextual requirements for new teaching materials aimed at fostering students' creative thinking.

## **Data collection techniques**

The data collection techniques used were interviews and questionnaires for the needs analysis of electronic teaching material development.

## 1. Interview method

Semi-structured interviews were conducted with 3 mathematics teachers at SMA Negeri 7 Makassar. Interviews, as a form of dialogue conducted for a specific purpose to obtain in-depth information and insights related to the research (Abdussamad, 2021), were aimed at gaining comprehensive insights into the current learning situation, challenges, expectations, and the specific needs for new electronic teaching materials based on the Merdeka Learning Pathway. The key aspects explored during these teacher interviews are summarized in Table 1.

**Table 1.** Key aspects explored in teacher interviews

| No | Aspect of interview                                   | Descriptions                                                                                                                                                                                                                                                              |
|----|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Current Learning Methods and Teaching Materials       | Discussion on the predominantly used mathematics learning methods and types of teaching materials (e.g., conventional textbooks, LKS, PowerPoint presentations, e-books, YouTube videos), including their perceived effectiveness and limitations.                        |
| 2  | Effectiveness in Fostering Creative Thinking          | Inquiry into how existing teaching materials and methods specifically support (or fail to support) students' mathematical creative thinking skills, independence, interaction, and ability to generate new ideas for real-world problems.                                 |
| 3  | Challenges in Digital Material Implementation         | Identification of obstacles encountered during the implementation of existing electronic materials, such as internet connectivity issues, device limitations, digital distractions, and teachers' competence in developing interactive e-materials.                       |
| 4  | Needs for Electronic Teaching Materials               | Exploration of teachers' expectations and specific requirements for new electronic teaching materials based on the "Merdeka" learning pathway, including desired features, content, and pedagogical approaches that can enhance students' mathematical creative thinking. |
| 5  | Alignment with Curriculum and Student Characteristics | Discussion on how future electronic teaching materials should align with the Merdeka Curriculum principles and cater to diverse student characteristics and learning styles to optimize engagement and skill development.                                                 |

## 2. Questionnaire method

Questionnaires were administered to 37 eleventh-grade student respondents via Google Form to gather quantitative data regarding their needs, characteristics, and preferences for electronic teaching materials. The questionnaire was systematically developed based on the "analysis" indicators of the ADDIE model, covering three main aspects with specific indicators: (1) Student Characteristics: Assessed student knowledge and perception of electronic teaching material utilization, the potential of presentation systems for independent learning, and identified preferred learning styles (visual, auditory, kinesthetic, multi-modal). Identifying multi-modal learning preferences is crucial for this research because it directly informs the design of electronic teaching materials, ensuring they cater to diverse sensory inputs, thereby enhancing

engagement and the potential for creative exploration, which aligns with the observed needs; (2) Learning Needs: Explored the perceived effectiveness and relevance of current teaching materials, and the necessity for systematic resources to support independent learning; (3) Learning Objectives: Evaluated students' clarity on learning goals and how electronic materials could align with objectives to encourage creative thinking, problem-solving, real-life connections, and foster independent learning. Specifically, questions in this section, such as those gauging student interest in generating multiple solutions or adapting strategies, were designed to capture their perceptions of how materials could better facilitate aspects of creative thinking (*fluency, flexibility, originality, elaboration*), thus identifying the needs for developing these abilities, rather than measuring their current skill level. The questionnaire's development ensured alignment with the research's analytical goals and the specific indicators for each aspect.

### **Data analysis techniques**

The data collected from interviews (qualitative) and questionnaires (quantitative) were analyzed systematically to identify the needs and characteristics for developing electronic teaching materials. Qualitative data from teacher interviews underwent descriptive analysis, involving transcription, thematic categorization, and synthesis of key insights. Quantitative data from student questionnaires were analyzed using descriptive statistics, including frequencies, percentages, means, and standard deviations, to identify dominant trends and patterns in student needs and preferences.

### **Findings and Discussion**

The analysis of needs for developing electronic teaching materials based on the "Merdeka" learning pathway was conducted through interviews with three mathematics teachers and questionnaires administered to 37 eleventh-grade students. The findings are presented in two main categories: insights from teacher interviews and data from student questionnaires.

#### **Teacher interview findings**

Based on the interviews with mathematics teachers, it was identified that current mathematics learning predominantly utilizes conventional teaching materials such as textbooks, traditional Student Worksheets (LKS), and PowerPoint presentations. The core problem with these conventional materials, as revealed by teacher perceptions, is their inherent limitation in fostering higher-order thinking skills, particularly mathematical creative thinking. They are typically designed for routine procedures and knowledge recall, rather than encouraging exploration, divergent thinking, or problem-solving beyond standard algorithms.

While most teachers have integrated technology into their teaching (e.g., e-books, mobile-accessible electronic materials, and YouTube learning videos), the effectiveness of these digital resources in fostering specific skills remains limited. Teachers reported this technological integration aids in creating a more flexible, non-classroom-confined learning environment and allows students to independently explore information. However, a significant gap was identified: the existing electronic teaching materials are not yet capable of sufficiently developing students' mathematical creative thinking skills or independence. They are also suboptimal in enhancing student interaction and participation, and their content often fails to stimulate new ideas for solving real-world mathematical problems.

These materials often lack content and activities that encourage creative thinking, focusing instead on rote learning and routine practice problems without interactive elements for independent learning. For example, one teacher stated, "We often use YouTube and e-books, but I feel students are still not challenged to think creatively with those materials; they often just watch and imitate." (Andi Nurmilawanti, S. Pd., M. Pd.). Another teacher lamented, "The current textbooks cannot encourage students to find various solutions or new ideas, even though that's crucial for creativity." (Riska, S. Pd.). This implicitly highlights that existing conventional materials are insufficient for developing creative thinking, indicating a clear need for materials that actively promote diverse solutions and novel ideas, which are fundamental to creative thinking (Siswono, 2010).

Furthermore, the implementation of these electronic materials faces practical challenges, including internet connectivity issues, device limitations, and digital distractions that can divert student attention. One teacher highlighted, "The main obstacles here are internet connectivity, and sometimes students focus more on phone notifications than the material." (Halifah, S. Pd., M. Pd.). These findings indicate that despite the potential of electronic teaching materials, their successful implementation necessitates well-planned strategies to avoid hindering the learning process.

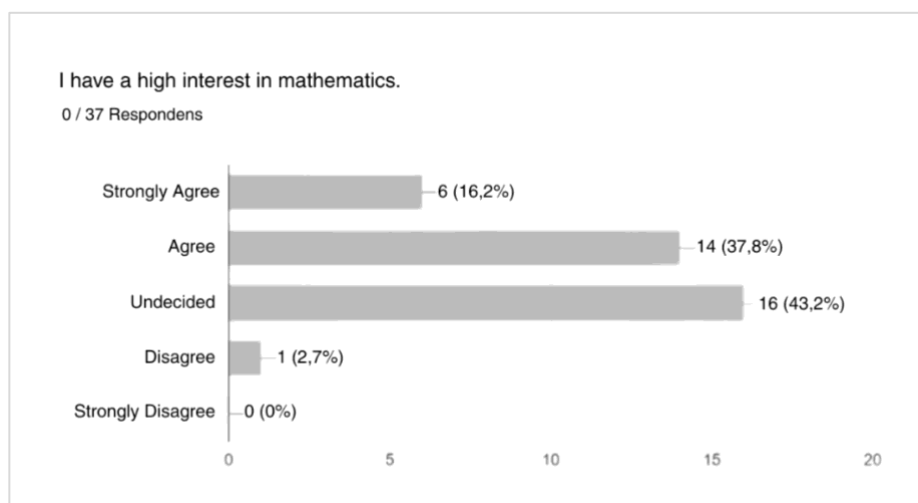
The identified gap in students' mathematical creative thinking ability, characterized by a tendency for rote memorization rather than deep conceptual understanding and a lack of opportunities for idea exploration, aligns with Branch's (2009) ADDIE principle. This principle emphasizes addressing learning problems stemming from a lack of knowledge and skills, in this context, the underdeveloped mathematical creative thinking skills of students (Ismail & Ilyas, 2023). The interview data reveal that despite efforts to leverage digital technology, such as e-books and YouTube learning videos, these have not fully succeeded in nurturing students' mathematical creative thinking. This limitation is exacerbated by students' unfamiliarity with activities requiring higher-order thinking and contextual problem-solving. This finding is consistent with various studies (Wulandari et al., 2025) that show technology can enhance learning outcomes, but its successful integration depends on teacher competence, resource availability, and the pedagogical approach employed. Thus, the integration of digital technology has the potential to foster students' mathematical creative thinking if its presentation provides students with space to explore ideas independently and creatively.

## **Student questionnaire findings**

Information regarding the need for the development of electronic teaching materials based on the "Merdeka" learning pathway was collected through questionnaires distributed to 37 student respondents. The data obtained covered student characteristics analysis, learning needs analysis, student interest preferences for electronic teaching materials, and learning objectives analysis in accordance with the applicable curriculum.

## **Student characteristics analysis**

Student characteristics analysis included students' interest in mathematics, their interest in learning through activities relevant to daily life and real experiences, and their learning style tendencies. Based on the results of the characteristic analysis conducted on 37 student respondents, the following data were obtained.



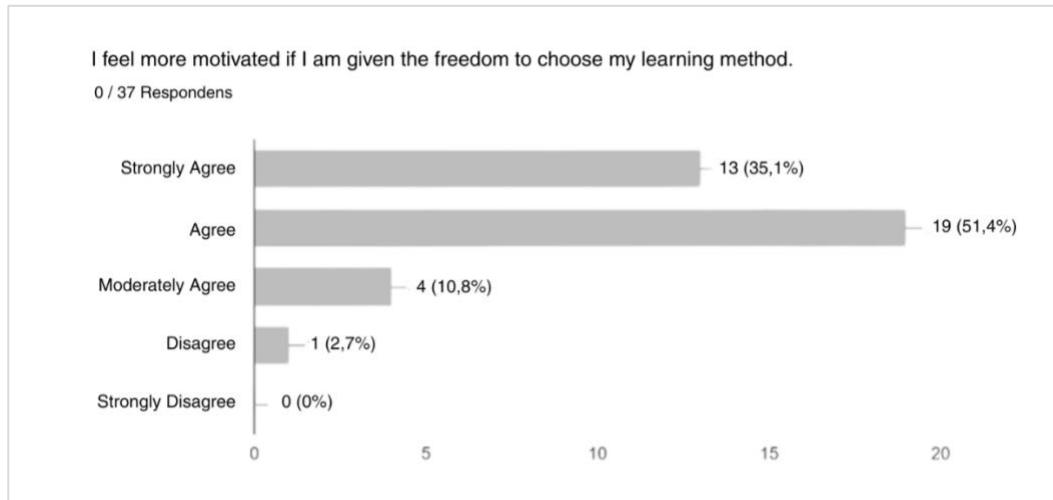
**Figure 1.** Students' interest in mathematics

As illustrated in Figure 1, 16.2% of students strongly agreed, and 37.8% agreed with having a high interest in mathematics. This indicates that 54% of students show a moderate to high potential interest that can be further developed through appropriate learning approaches. However, 43.2% expressed undecided/neutral feelings, and only 2.7% disagreed. Overall, these data suggest a significant potential to enhance student interest in mathematics by introducing more contextual, interactive, and relevant teaching materials.

**Table 2.** Student characteristics analysis

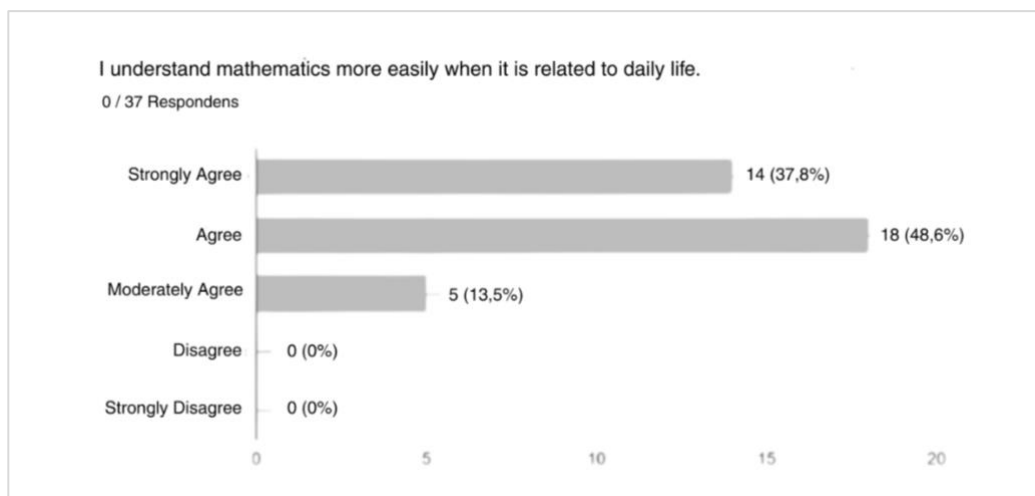
| No | Variable analyzed                          | Learning needs characteristic                                              | Percentage |
|----|--------------------------------------------|----------------------------------------------------------------------------|------------|
| 1  | Visual and Interactive Learning Preference | Students learn more easily using visual and interactive media.             | 73 %       |
| 2  | Auditory or Oral Learning Preference       | Students understand material better through verbal explanations.           | 78.4 %     |
| 3  | Kinesthetic Learning Preference            | Students learn more easily if they can directly try or perform activities. | 78.4 %     |
| 4  | Varied Learning Style (Multi-Modality)     | Students tend to prefer learning methods that involve various modalities.  | 75.7 %     |

The analysis of the data above indicates that students have diverse learning preferences with a strong tendency towards multi-modal learning styles. As many as 73% of students stated they learn more easily with the support of visualization or interactive media in material presentation. Furthermore, 78.4% of students reported better comprehension of material when explained orally or when engaging in direct activities or practice. The majority of students, 75.7%, prefer learning that involves various modalities, including visuals, audio, and direct practice. This finding aligns with the principle of differentiation within the Merdeka Learning curriculum, where students are given freedom and space to choose learning paths and paces that suit their interests, needs, and learning styles (Rohmah & Andriansyah, 2024). This empirical data reinforces the urgency and potential for developing electronic teaching materials based on the Merdeka Learning Pathway that are responsive and adaptive to student characteristics and learning style preferences, are relevant to real-world contexts, and provide flexibility to foster mathematical creative thinking skills.



**Figure 2.** Learning motivation with freedom to choose learning methods

Based on data from 37 students, 35.1% strongly agreed and 51.4% agreed that they felt more motivated when given the opportunity and freedom to choose their learning methods. Only 10.8% expressed moderate agreement, and a mere 2.7% disagreed with the statement. This indicates that the vast majority of students, 86.5%, feel more motivated by and support the importance of flexible learning pathways in electronic teaching materials based on the Merdeka Learning Pathway. This statistic suggests that student interest can be significantly enhanced through adaptive and personalized learning strategies, which not only increase intrinsic motivation but also strengthen independent learning and personal responsibility.



**Figure 3.** Learning motivation with freedom to choose learning methods (related to daily life)

The data presented indicate that 86.4% of students agreed to strongly agreed that they understand and are more interested if the material taught is linked to daily life or their surrounding environment. Only 13.5% expressed moderate agreement with this statement.

## Learning needs analysis

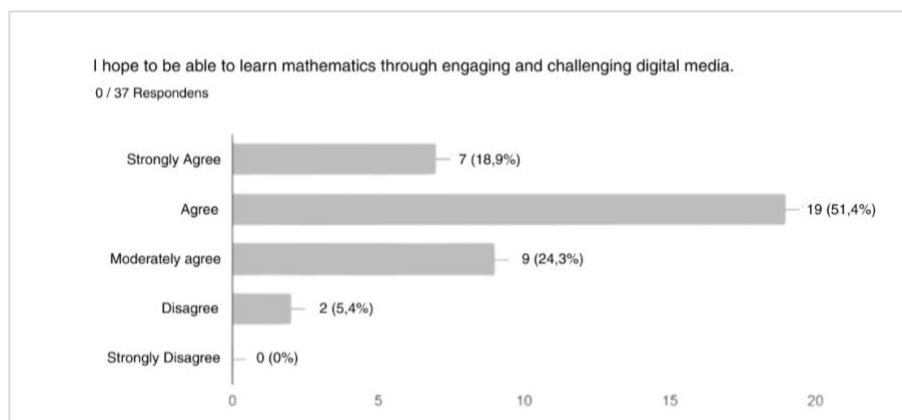
The learning needs analysis covered the effectiveness of current teaching methods in helping students understand the material, the relevance of existing teaching materials to students' learning needs, and the availability of systematic and structured teaching materials to support independent learning. The detailed results of students' learning needs are presented in the [Table 3](#).

**Table 3.** Learning needs analysis

| No | Variable analyzed                                                | Learning needs characteristic                                                                    | Percentage |
|----|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------|
| 1  | Difficulty understanding material with current methods.          | Students do not experience difficulty understanding material with the currently applied methods. | 62.2 %     |
| 2  | Relevance of teaching materials.                                 | Students feel that the teaching materials currently used meet their needs.                       | 54.1 %     |
| 3  | Need for systematic teaching materials for independent learning. | Students experience difficulty learning independently without systematic teaching materials.     | 78.3 %     |
| 4  | Interest in electronic teaching materials.                       | Students show interest or attraction towards interactive electronic teaching materials.          | 86.4 %     |

Based on the data from 37 student respondents, a significant finding is that only a small proportion of students (10.8%) agreed or strongly agreed that they experienced difficulty understanding the material taught with the currently applied learning methods. Conversely, the majority of students (62.2%) disagreed, indicating that most students feel relatively comfortable with the existing methods. A majority of students (54.1%) felt that the teaching materials currently used were relevant to their needs.

However, a highly significant finding is that 78.3% of students (43.2% agreed, 35.1% strongly agreed) still experience difficulty learning independently without systematic teaching materials. This emphasizes the urgent need for structured electronic resources to facilitate self-study and learning. Student responses further indicate that the majority (86.4%) are more attracted to learning materials equipped with animations, videos, or simulations. This highlights the necessity of integrating multimedia elements into teaching materials to enhance student appeal and engagement. The presentation of material through a combination of text, visuals, and audio is proven to support more effective information processing, aligning with Mayer's (2009) theory of multimedia learning, which asserts that using various information channels simultaneously can help students organize and integrate knowledge more meaningfully (Fathoni et al., 2023).



**Figure 4.** Students' expectations for digital media

Additionally, the data above show that 70.3% of students expressed their desire to learn mathematics through engaging and challenging digital media. This serves as a strong signal that students generally seek more innovative learning experiences relevant to current technological advancements.

### Learning objectives analysis

The analysis of learning objectives examines the alignment of learning outcomes and how designed learning activities can foster students' mathematical creative thinking skills while remaining relevant to the curriculum framework. The results of this analysis, based on data from 37 student respondents, are presented in the [Table 4](#).

**Table 4.** Learning objectives analysis

| No | Variable Analyzed                                                  | Learning Needs Characteristic                                                                                    | Percentage |
|----|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|------------|
| 1  | Clarity of learning objectives.                                    | Students understand the direction and learning outcomes of mathematics conveyed by the teacher.                  | 73 %       |
| 2  | Learning objectives support mathematical creative thinking skills. | Learning objectives encourage students to think creatively, solving problems with various methods or approaches. | 81%        |
| 3  | Contextualization of objectives.                                   | Learning objectives help students connect learned material with daily life.                                      | 64.8 %     |
| 4  | Independent learning and reflection.                               | Learning objectives facilitate students in assessing their learning achievements.                                | 86.5 %     |

Based on the data presented in [Table 4](#), the analysis of learning objectives reveals that the majority of students (73%) indicated they understand the learning objectives conveyed by the teacher. This suggests that teachers have been reasonably successful in communicating the learning direction in accordance with the curriculum. A significant proportion of students, 81%, felt that the formulated learning objectives encouraged them to think creatively. Furthermore, 64.8% of students stated that learning objectives could help them connect mathematical concepts with their daily lives. Finally, a substantial 86.5% of students felt that the learning objectives supported their independent learning. These findings are crucial foundations for developing

teaching materials that not only focus on drill and practice but also facilitate activities involving contextual problem-solving, exploration of new ideas, and metacognitive reflection.

Teaching materials designed based on the Merdeka Learning Pathway should include open-ended, contextual mathematical challenges that allow for various alternative strategies in solving mathematical problems. Exploratory activities such as project-based tasks, problem-based simulations, and interactive visualizations can stimulate the indicators of creative thinking—namely fluency, flexibility, originality, and elaboration—as key components of creative thought (Ginanto et al., 2024).

## Synthesis of findings and discussion

From the comprehensive analysis of teacher interviews and student questionnaire data, a significant and pressing need for appropriate instructional intervention to enhance students' mathematical creative thinking abilities is evident.

Teacher perspectives highlight that conventional and static digital teaching materials are a primary contributing factor to this gap. These materials inherently limit opportunities for fluency, flexibility, originality, and elaboration—key indicators of creative thinking as theorized by Torrance (Siswono, 2010). Teachers' reports of students' tendency to "just watch and imitate" or inability to "find various solutions or new ideas" directly reflect deficiencies in these creative thinking dimensions. Furthermore, practical challenges like internet connectivity and digital distractions necessitate materials that are not only pedagogically sound but also robust and engaging enough to maintain student focus.

Student data strongly corroborate these needs. A substantial majority of students expressed a high interest in learning through activities relevant to daily life (86.4%) and are more motivated when given freedom to choose learning methods (86.5%). Critically, 78.3% of students struggle with independent learning without systematic materials, and a striking 86.4% are attracted to interactive electronic materials with multimedia elements. This preference aligns with Mayer's theory of multimedia learning, which asserts that using various information channels simultaneously can help students organize and integrate knowledge more meaningfully (Fathoni et al., 2023). The finding that 81% of students feel learning objectives encourage creative thinking points to a receptive student body, but the *actual materials* need to align with this objective. These student preferences, particularly for multi-modal (75.7%) and challenging digital media (70.3%), directly support the development of dynamic and interactive resources that can facilitate creative thought. The challenges identified by teachers regarding internet and distractions further underscore the need for adaptable and engaging electronic materials.

The current pedagogical approaches, even with existing digital integration, often fail to create an environment conducive to generating diverse ideas or adapting strategies, which are crucial for developing creative problem-solving skills (Branch, 2009).

## Theoretical correlation: Merdeka learning pathway and creative thinking indicators

Given the identified gaps in students' mathematical creative thinking from both teacher interviews and student questionnaires, and the strong student preference for adaptable, interactive, and contextual learning, the development of electronic teaching materials based on the Merdeka Learning Pathway emerges as a highly relevant and strategic alternative solution. This approach is deemed capable of meeting students' pedagogical and technological needs and

aligns with current national curriculum policies (Kemendikbudristek, 2022). To further support this rationale, it is crucial to establish the theoretical correlation between the stages of the Merdeka Learning Pathway and the cultivation of mathematical creative thinking indicators. The Merdeka Learning Pathway, with its emphasis on student-centered and flexible learning experiences, inherently provides a conducive framework for nurturing divergent thinking, originality, and comprehensive problem-solving. This theoretical alignment serves as a strong logical basis for why Merdeka-based materials can effectively stimulate creative thinking.

This theoretical mapping demonstrates how each stage of the Merdeka Learning Pathway provides specific opportunities for students to engage in activities that directly foster indicators of creative thinking. For instance, the "Starting from Self" stage promotes fluency by allowing uninhibited initial idea generation, directly addressing the problem of students' limited idea exploration. "Concept Exploration" facilitates flexibility through diverse conceptual approaches, countering the tendency for rote memorization. The "Collaboration Space" enhances both originality and flexibility through group idea exchange, addressing the suboptimal student interaction. "Contextual Demonstration" directly links to originality by requiring creative solutions in real-world scenarios, which existing materials often fail to stimulate. "Elaboration of Understanding" naturally develops elaboration through deep idea development, tackling the lack of conceptual understanding. "Inter-Material Connection" further strengthens fluency and elaboration by connecting various concepts, promoting broader thinking. Finally, the "Real Action" stage synergistically cultivates originality, flexibility, and fluency by requiring the application of creative insights into tangible outcomes, addressing the need for independence and practical application. This conceptual coherence provides a powerful justification for prioritizing the Merdeka Learning Pathway as the foundation for developing electronic teaching materials aimed at improving students' mathematical creative thinking skills.

**Table 5.** Relationship between merdeka learning pathway and creative thinking indicators

| Merdeka learning pathway     | Developed creative thinking indicators | Descriptions                                                               |
|------------------------------|----------------------------------------|----------------------------------------------------------------------------|
| Starting from Self           | Fluency                                | Encourages students to express initial ideas freely and spontaneously.     |
| Concept Exploration          | Flexibility                            | Opens opportunities to see various perspectives and conceptual approaches. |
| Collaboration Space          | Originality, Flexibility               | Encourages the exchange of unique and flexible ideas in groups.            |
| Contextual Demonstration     | Originality                            | Presents creative solutions in relevant real-world situations.             |
| Elaboration of Understanding | Elaboration                            | Develops ideas deeply and structured.                                      |
| Inter-Material Connection    | Fluency, Elaboration                   | Connects various concepts to broaden and deepen understanding.             |
| Real Action                  | Originality, Flexibility, Fluency      | Realizes ideas in concrete actions that reflect applied creativity.        |

Source: Adapted from Kemdikbudristek (2022); Siswono (2010).

Based on the identified gaps in students' mathematical creative thinking abilities from teacher interviews, the additional insights from student questionnaires, and the strong theoretical alignment with the Merdeka Learning Pathway, a clear design plan for the electronic teaching materials emerges. This section outlines the essential characteristics these materials must possess to effectively address the identified needs and foster mathematical creative thinking. This design plan will serve as a foundational blueprint for the subsequent development stage of this research (following the ADDIE model).

The electronic teaching materials based on the Merdeka Learning Pathway should embody the following characteristics:

1. **Open-Ended Tasks and Non-Routine Problems:** Feature tasks with multiple possible solutions or approaches, explicitly encouraging divergent thinking and flexibility in problem-solving, which are currently lacking in traditional materials.
2. **Contextual and Relevant Content:** Present mathematical concepts embedded within real-world scenarios, case studies, or everyday problems that resonate with students' experiences. This will stimulate originality by requiring students to apply mathematical principles in novel contexts, moving beyond rote practice problems.
3. **Adaptive and Differentiated Learning Paths:** Offer customizable learning paths or supplementary resources (e.g., additional explanations, remedial exercises, challenge problems) to cater to diverse learning paces and styles. This directly supports the Merdeka Learning Pathway's emphasis on student-centered learning and helps overcome issues like device limitations by allowing content to be consumed flexibly; Provide opportunities for students to choose their preferred mode of learning (e.g., visual, auditory, kinesthetic) within the material.
4. **Facilitating Collaboration and Independent Exploration:** Design activities that encourage peer interaction and collaborative problem-solving, even in a digital format (e.g., shared virtual whiteboards, group project spaces). This nurtures originality and flexibility through shared idea generation and discussion; Ensure content is easily accessible via mobile devices to support flexible learning environments, addressing teachers' desire for learning beyond the classroom, while acknowledging and planning strategies for internet connectivity challenges.

By incorporating these characteristics, the electronic teaching materials will not only provide a more engaging and flexible learning environment but, crucially, will serve as a powerful tool to bridge the identified gap in students' mathematical creative thinking skills, aligning perfectly with the pedagogical goals of the Merdeka Learning Pathway. This structured design approach ensures that the development phase will be directly informed by the needs analysis, leading to a highly effective and targeted educational resource.

## **Conclusion**

This needs analysis study aimed to identify the necessity of developing electronic teaching materials based on the "Merdeka" learning pathway to enhance students' mathematical creative thinking skills. The findings reveal a significant gap between current mathematics learning conditions and the ideal state, primarily concerning the suboptimal development of students' mathematical creative thinking. Despite a general comfort with existing teaching methods, students strongly desire flexible, interactive, and multimedia-rich electronic learning resources that allow them freedom in choosing learning approaches and connect mathematics to real-life

contexts. While teachers have integrated some technology, the available electronic materials remain limited in their capacity to foster creative thinking, independence, and active student participation. Crucially, a substantial majority of students experience difficulty with independent learning without systematically structured materials. Therefore, the development of adaptive electronic teaching materials, integrated with interactive elements like animations and simulations, is essential to bridge this gap, support differentiated learning, and stimulate mathematical creative thinking by providing contextual and exploratory activities.

These findings carry several practical implications. For educators, the study underscores the importance of innovating teaching material design beyond conceptual content to truly cultivate creativity and independence. Developers of teaching materials must prioritize interactivity, flexibility, and real-world relevance, ensuring materials accommodate diverse learning styles and facilitate exploratory, reflective, and contextual learning activities. For educational policymakers, systemic support is crucial, including teacher training, provision of robust digital infrastructure, and policies that encourage effective integration of learning technology. Thus, the development of "Merdeka" pathway-based electronic teaching materials not only addresses current learning needs but also aligns with 21st-century educational demands emphasizing creativity, flexibility, and student learning independence.

Limitations of this study include its focus solely on the needs analysis stage within the ADDIE model, meaning the design, development, implementation, and evaluation of the actual electronic teaching materials were beyond its scope. Furthermore, the findings are specific to the context of SMA Negeri 7 Makassar and its 11th-grade students and mathematics teachers, which may limit the direct generalizability to other educational settings without further contextual validation.

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