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Validity of Heat Teaching Material Integrated Joyful Learning to Promote Student's Creative Thinking Skills

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ABSTRACT

The development of education in the 21st century demands teachers to innovate by integrating technology into the learning process and fostering students' creative thinking skills. However, preliminary studies revealed that students' creative thinking abilities remain low, and the existing teaching materials have not fully supported joyful and engaging learning. This study aims to determine the validity level of a digital learning material on the topic of heat, integrated with the Joyful Learning approach to enhance students' creative thinking skills in senior high school. The research employed a Research and Development (R&D) method using the Hannafin and Peck model, which consists of three stages: need assess, design, and develop/implement. The research instrument used was a validity questionnaire to assess the feasibility of the developed digital material. The results showed that the digital learning material achieved a validity score of 0.95, categorized as highly valid. Therefore, the developed digital material on heat integrated with Joyful Learning is considered valid and feasible for physics learning to foster students' creative thinking skills.

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INTRODUCTION

The development of 21st-century education demands a significant transformation within the educational landscape. The core demand of this shift centers on integrating digital technology with innovative pedagogical approaches (Rahmawati & Dwikoranto, 2022; Sari et al., 2022). In 21st-century learning, educational activities should foster the 4C skills—critical thinking, creativity, communication, and collaboration. In the current curriculum, the integration of 4C has become a priority so that education does not merely focus on theoretical aspects but also on the development of practical competencies (Thornhill-Miller et al., 2023; Mamahit et al., 2018). Teachers are required not only to master the subject matter but also to create enjoyable and meaningful learning experiences that allow students to develop higher-order thinking skills, including creative thinking (Affandi et al., 2024). The integration of 21st-century skills in the learning process has therefore become highly relevant in preparing the younger generation to face future challenges (Mantau & Talango, 2023).

The use of digital technology plays a crucial role in enhancing the effectiveness of learning. In the learning process, the adoption of flexible technological tools serves as an effective strategy to shift students' roles from passive recipients of information to active participants who construct their own knowledge. According to Syahputra (2018), the use of technologies such as digital simulations and interactive applications can help students understand abstract concepts more easily. Technology has now become a key element that enables access to broader and more diverse learning resources, supporting exploration and deeper conceptual understanding of the material being studied. However, preliminary studies in schools indicate that the instructional materials used are still dominated by conventional printed textbooks, which are less interactive and have not integrated elements of joyful learning. This condition affects students' low engagement and limits their creative thinking abilities in understanding physics concepts, particularly the topic of heat (Sari & Prasetyo, 2021; Mustikasari, 2023).

A number of studies on the development of science-based digital learning materials have been conducted. In practice, however, most of them still focus on content feasibility without fully integrating joyful learning models with the development of creative thinking skills (Sukaesih et al., 2022; Usmeldi & Amini, 2022). The validity of digital learning materials on heat topics that integrate learning models such as inquiry and problem based learning (PBL) has shown valid results that support learning effectiveness (Azwar, 2015; Ilahiyah, 2025). Nevertheless, only a limited number of studies have systematically explored the integration of joyful learning with creative thinking skills.

The ideal condition in physics learning is characterized by the creation of an active, enjoyable, and meaningful learning process for students. In such a condition, students understand the material through direct experiences, digital visualization, and contextual problem-solving, which help clarify abstract concepts such as heat (Aldilla & Usmeldi, 2024; Fitriani et al., 2024; Izzah et al., 2024; Nisa et al., 2024). Teachers act as facilitators who create a collaborative, interactive, and pressure free learning environment to maintain motivation and encourage students' active participation (Salirawati, 2018; Affandi et al., 2024). The integration of valid and interactive digital media helps strengthen conceptual understanding while also increasing students' interest in physics content (Hapsari & Nugroho, 2021; Sari & Widodo, 2020). A positive and enjoyable learning atmosphere enables students to feel safe experimenting, asking questions, and expressing ideas without fear. Such ideal conditions not only foster motivation and self-confidence but also build students' creative thinking and communication skills (Arifin et al., 2024; Fitria et al., 2023). This condition supports the achievement of physics learning objectives that align with 21st-century demands.

This study aims to assess the validity of digital learning materials on heat integrated with joyful learning and creative thinking skills for 11th-grade senior high school students. The novelty of this research lies in the synergy between digital technology and the integration of joyful learning to facilitate students' creative thinking skills, addressing the needs of 21st-century education (Mustikasari, 2023; Affandi et al., 2024). The results are expected to make a significant contribution to the development of innovative, interactive physics learning materials that are relevant to the characteristics of the digital generation.

The research question in this study is how valid the digital learning material on heat, integrated with Joyful Learning and creative thinking skills, is for Grade XI senior high school students. This study aims to assess the extent to which the learning material meets the criteria of content feasibility, presentation, language, and graphics, thereby ensuring its effective use in the learning process. The benefit of this study is to provide an innovative solution to address the low levels of student engagement and creativity in physics learning. In addition, this research is expected to support physics education in the digital era by providing learning materials that are more interactive, meaningful, and aligned with the demands of 21st-century learning.

METHODS

The type of research used in this study is Research and Development (R&D) employing the Hannafin and Peck development model. This model is one of the instructional design approaches used to produce learning products such as digital learning media, including instructional videos, digital teaching materials, or interactive modules. The Hannafin and Peck development model consists of three main stages: needs assessment, design, and the development and implementation stages. This approach was chosen because it enables the production of systematically tested learning products.

The object of this research is a digital learning material on heat integrated with Joyful Learning. This material is designed to facilitate students' creative thinking skills. The learning material will be validated by three experts who are lecturers from the Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, to ensure its feasibility and appropriateness for instructional use. Following the validity testing, the Joyful Learning–integrated digital material will be revised based on the feedback provided by the validators. If the data analysis from the product validity test indicates that the material is valid, the process will continue with a practicality test of the digital learning material integrated with Joyful Learning. The practicality test will be conducted with Grade XI students (Phase F) at SMA Negeri 7 Padang through a limited trial.

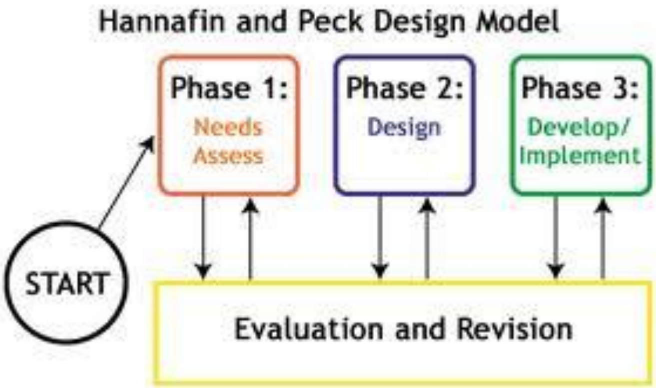

Figure 1. Hannafin and Peck Design Model

Figure 1. illustrates the Hannafin and Peck development model, which consists of three sequential phases. The process begins with the Needs Assessment stage, which includes analyzing learning problems, student characteristics, learning objectives, and the learning setting (Slamet, 2022). After the needs are identified, the research proceeds to the Design stage, which involves designing the digital learning material that integrates the concept of Joyful Learning with the heat topic for Grade XI students. This design stage includes creating storyboards, developing content, and determining the format of the digital learning material. The final stage is Development/Implementation, in which the design is developed into an actual product and then validated by experts. All stages are accompanied by continuous Evaluation and Revision processes to ensure that the resulting product truly meets the required feasibility standards.

The product validation aims to determine the feasibility of the developed digital learning material. The instrument used is a validity questionnaire that has been validated by the supervisor. The validity questionnaire is constructed based on the components outlined in the *Guidelines for the Development of Digital-Based Teaching Materials*. There are five components included in the validity questionnaire, namely content substance, instructional design, visual communication display, software utilization, and the integration of joyful learning. The Joyful

Learning–integrated digital learning material is considered valid if it meets the criteria for each component assessed.

The instrument used in this study consists of validation sheets completed by the experts involved. The validation sheet includes assessment indicators aligned with the feasibility aspects of the digital learning material. The instrument is arranged using a Likert scale to facilitate quantitative analysis. It is also equipped with a comment section that allows experts to provide qualitative feedback for improving the product.

The validation data were analyzed using a quantitative descriptive analysis technique. Each assessment item score was calculated to obtain an average score. The average score was then used to determine the validity category of the developed learning material. The assessment employed a 1–5 Likert scale, with categories presented in Table 1.

Tabel 1. Likert Scale

Likert scale	Category
1	Strongly disagree
2	Disagree
3	Undecided
4	Agree
5	Strongly agree

Source: (Sugiyono, 2017)

The collected data were analyzed using Aiken's validity index. The validity assessment focused on content validity and construct validity. Aiken's V formula was used to determine the content validity coefficient based on the evaluations of n experts for each item. The Aiken formula applied is shown in Equation 1.

$$V = \frac{\sum s}{n(c-1)}$$

Description:
V = rater agreement index
s = score given by each rater minus the lowest score in the category
c = number of rating categories
After obtaining the rater agreement index, the category of the index value is determined. The decision results based on Aiken's V Index are presented in Table 2.

Tabel 2. Decision Based on Aiken's V Index

Interval	Category
≥ 0,4	Invalid
0,4< V≤ 0,8	Valid
V> 0.8	Highly valid

Source: (Retnaawati, 2016)

Item validity based on Aiken's V index can be classified into three categories: invalid, valid, and highly valid. If the Aiken's V value is at or below 0.4, the item falls into the invalid category, meaning its validity is low and it is not suitable for use, thus requiring a thorough revision. If the Aiken's V value is between 0.4 and 0.8, the item is categorized as valid. In this category, the item can still be used but should be revised to improve its clarity and quality.

Meanwhile, if the Aiken's V value exceeds 0.8, the item is considered highly valid and suitable for use in assessment without the need for major revisions. Items in the high validity category can also proceed directly to the practicality testing stage. The final stage is the field trial, which aims to determine the feasibility of the product after being validated by experts. During this trial, assessments are conducted on content construct validity, reliability, discriminating power, and difficulty level.

RESULTS AND DISCUSSION

The findings of the learning material validation were obtained through analysis using a validity instrument. This instrument consists of five assessment components: content substance, visual communication display, instructional design, software utilization, and Joyful Learning integration. First the validity test results of the Joyful Learning integrated digital learning material for the content substance component consist of four indicators, namely correctness (CR), depth (DP), up to dateness (DT), and readability (RB). The results of the validity test for the content substance component are presented in Figure 2.

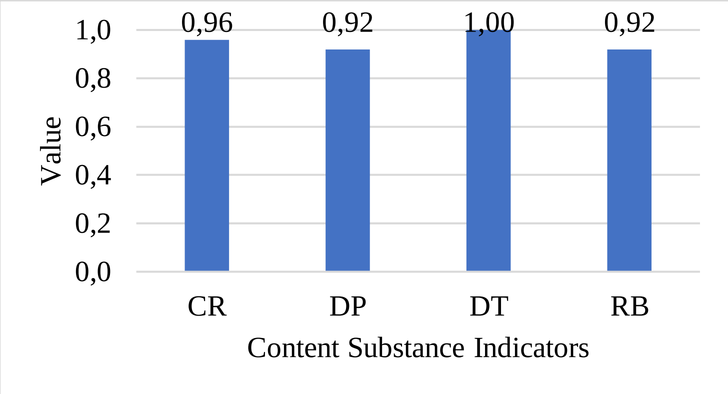

Figure 2. Content Substance Component

Based on Figure 2, it can be seen that the validity test results of the Joyful Learning–integrated digital learning material on the content substance component show score variations ranging from 0.92 to 1. The validity scores given by the validators for each indicator in the content substance component fall into the "very valid" category. From the analysis of each indicator, the average validity score for the Joyful Learning–integrated digital learning material on the content substance component is 0.95, categorized as very valid. The "up-to-dateness" indicator obtained the highest score, which is 1, categorized as very valid. The indicators of accuracy, depth, and readability each obtained a score of 0.96, also categorized as very valid. Thus, the Joyful Learning–integrated digital learning material on the content substance component is considered valid and suitable for use in the learning process.

The second component is the visual communication display, which focuses on how information is presented visually to support learning. This component consists of several indicators, including navigation (NG), font (FT), media (MD), color (CL), animation (AN), and layout (LY). These indicators are designed to ensure clarity, attractiveness, and ease of use in the learning materials. The validity results of the visual communication display component are presented in Figure 3.

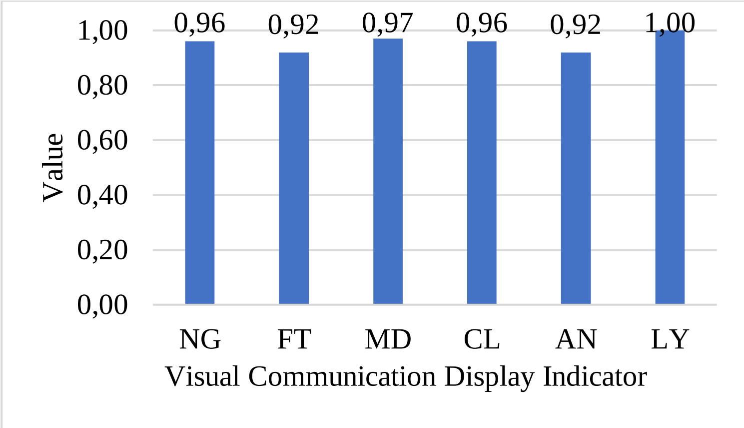

Figure 3. Visual Communication Display Component

Based on Figure 3, the validity test results of the Joyful Learning–integrated digital learning material on the visual communication display component show score variations ranging from 0.92 to 1. The validity scores given by the validators for each indicator of the visual communication display component fall into the "very valid" category. From the analysis of each indicator, the average validity score for the Joyful Learning–integrated digital learning material on this component is 0.96, which is categorized as very valid. The layout indicator obtained the highest score, namely 1, categorized as very valid. The lowest score, 0.92, was obtained by the font indicator, which is also categorized as very valid. Therefore, the Joyful Learning–integrated digital learning material on the visual communication display component is considered valid and suitable for use in the learning process.

The third component is the learning design, which focuses on the structure and organization of the learning process. This component includes several indicators, namely title (NT), introduction (IT), media (MD), learning material identity (LM), learning objectives (LO), learning content (LC), worksheets (WS), exercises (EX), competency tests (RF), and references (DP). These indicators ensure that the learning materials are systematically arranged and aligned with learning objectives. The validity results of the learning design component are presented in Figure 4.

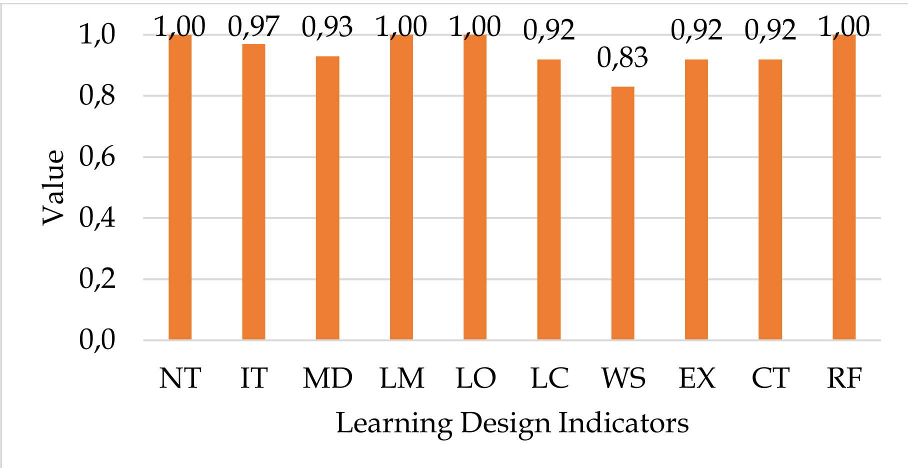

Figure 4. Learning Design Component

Based on Figure 4, the validity test results of the Joyful Learning–integrated digital learning material on the instructional design component show score variations ranging from

0.83 to 1. The validity scores given by the validators for each indicator of the instructional design component fall into the "very valid" category. From the analysis of each indicator, the average validity score for the Joyful Learning–integrated digital learning material on this component is 0.95, categorized as very valid. The indicators of learning outcomes, title, and teaching material identity obtained the highest score, namely 1, categorized as very valid. The lowest score, 0.83, was obtained by the worksheet indicator, which is also categorized as very valid. Therefore, the Joyful Learning–integrated digital learning material on the instructional design component is considered valid and suitable for use in the learning process.

The fourth component is software utilization, which focuses on the effective use of digital tools in the learning materials. This component includes several indicators, namely interactivity (IT), Canva software (CS), Heyzine software (HS), and originality (O). These indicators are intended to support user engagement and ensure the uniqueness of the developed product. The validity results of the software utilization component are presented in Figure 5.

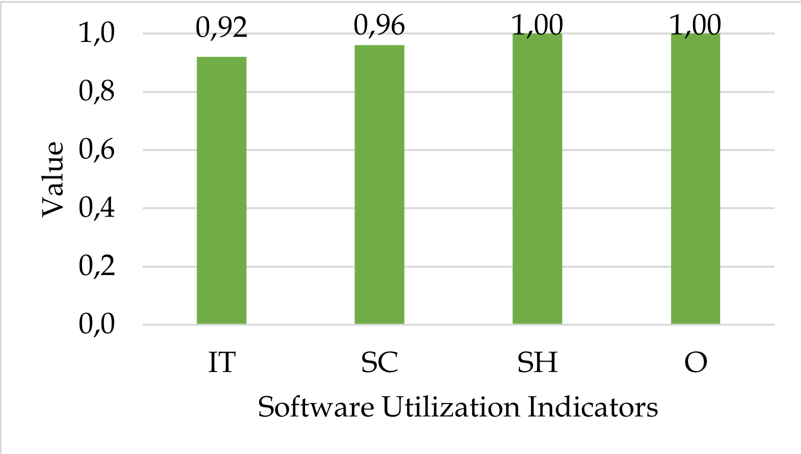

Figure 5. Software Utilization

Based on Figure 5, the validity test results of the Joyful Learning–integrated digital learning material on the software utilization component show score variations ranging from 0.83 to 1. The validity scores given by the validators for each indicator of the software utilization component fall into the "very valid" category. From the analysis of each indicator, the average validity score for the Joyful Learning–integrated digital learning material on this component is 0.95, categorized as very valid. The indicators of Heyzine software and originality obtained the highest score, namely 1, categorized as very valid. The lowest score, 0.92, was obtained by the interactivity indicator, which is also categorized as very valid. Therefore, the Joyful Learning–integrated digital learning material on the software utilization component is considered valid and suitable for use in the learning process.

The fifth component is the Joyful Learning integration indicators, which include: a stress-free or relaxed learning environment (LE), connecting the material to daily life or contextual relevance (CR), creating positive emotions during learning (CPE), consciously engaging all senses (CES), activating both right and left brain functions (ARB), utilizing advanced technology (UAT), and concluding learning in an impressive or curiosity inducing manner (CL). The validation results for the Joyful Learning integration component can be seen in Figure 6.

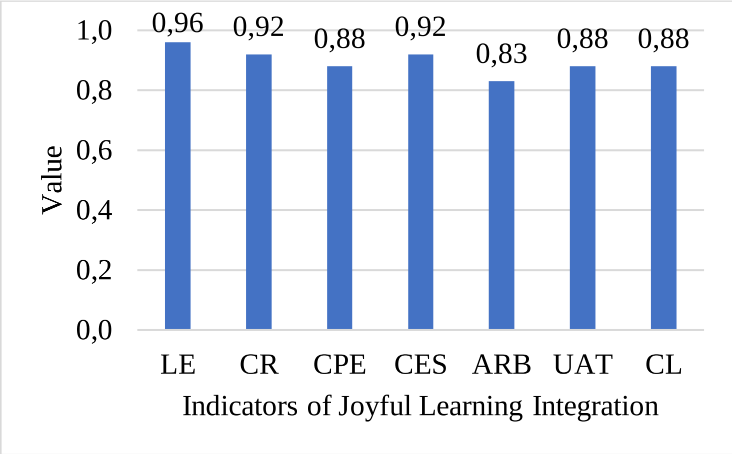

Figure 6. Joyful Learning Component

Based on Figure 6, the validity test results of the Joyful Learning–integrated digital learning material on the Joyful Learning integration component show score variations ranging from 0.83 to 0.96. The validity scores given by the validators for each indicator of this component fall into the "very valid" category. From the analysis of each indicator, the average validity score for the Joyful Learning–integrated digital learning material on this component is 0.97, categorized as very valid. The indicator of creating a relaxed learning environment obtained the highest score, namely 0.96, categorized as very valid. The lowest score, 0.83, was obtained by the indicator of activating both the right and left brain, which is also categorized as very valid. Therefore, the Joyful Learning–integrated digital learning material on this component is considered valid and appropriate for use in the learning process.

The overall validity of the digital learning material was determined based on the average percentage of each assessment component. These components include content substance (CS), visual communication display (VC), instructional design (ID), software utilization (SU), and Joyful Learning integration (JL). The results reflect a combined evaluation of all assessed components. The analysis of the overall validity of the digital learning material is presented in Figure 7.

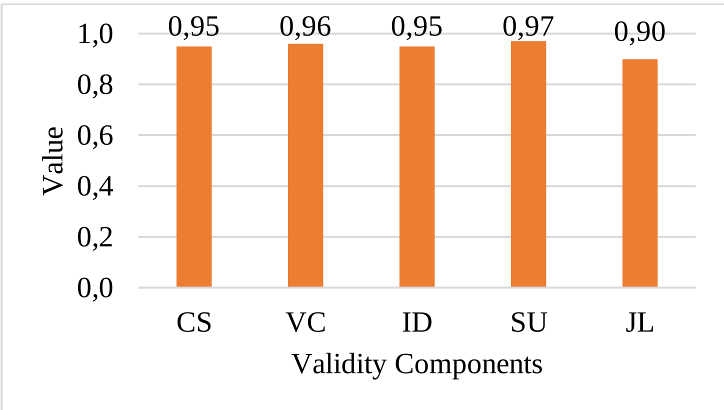

Figure 7. Average Percentage of Validity Components

Based on Figure 7, it can be stated that the average validity scores of each component of the Joyful Learning–integrated digital learning material range from 0.90 to 0.97. The component with the highest validity score is the software utilization component, with a score of 0.97. Meanwhile, the component with the lowest validity score is the Joyful Learning integration component, which obtained a score of 0.90. Overall, the average validity score across all components is 0.95. Based on this average value, the validity test results of the Joyful Learning–integrated digital learning material fall into the "very valid" category. This indicates that the developed Joyful Learning–integrated digital learning material has been proven to be feasible for use.

Discussion

The substance of the material demonstrates a high level of validity with an average score of 0.95, indicating that the content delivery is effective and supports a deeper understanding of physics concepts, aligning with Kusuma's (2020) view on the importance of conceptual clarity in education. The validity of the visual presentation and instructional design, which scored 0.96 and 0.95 respectively, shows that the material offers an engaging and interactive learning experience consistent with joyful learning principles, which emphasize enjoyable and actively involving learning environments (Kusuma et al., 2016). The software utilization component obtained the highest score of 0.97, indicating that Canva and Heyzine provide flexibility and easy access for students, aligning with the findings of Yuliana et al. (2023) and Hasan et al. (2024) regarding the effectiveness of interactive digital media. The integration of joyful learning principles, which reached a score of 0.90, demonstrates that the activities within the learning material are designed to stimulate curiosity, active engagement, and student creativity, supporting Wardani's (2024) findings on interactive multimedia-based learning. These results also align with research by Anggreni and Yohandri (2022) as well as Sinaga and Abubakar (2024), which show that well-designed digital learning materials can improve motivation, creativity, and higher-order thinking skills in physics. Compared to preliminary studies conducted at SMAN 7 Padang, there is a notable improvement over traditional learning materials, which tend to be less effective in stimulating students' creativity and critical thinking (Hufri, 2022; Meilova & Asrizal, 2024). Overall, these findings strengthen the argument that digital learning materials integrated with joyful learning have excellent validity and are highly relevant for developing creative thinking skills among high school students.

The findings of this study confirm that the digital learning material based on Joyful Learning demonstrates a very high level of validity. This digital resource is suitable for use in high school physics learning, particularly on the topic of heat, as it meets all required standards. All validity aspects scored above 0.90, indicating that the material fulfills feasibility criteria in terms of content quality, visual presentation, and learning activity design. The material is easy to follow, supported by informative visuals, and utilizes relevant technology to create a more interactive learning experience. The use of software such as Canva and Heyzine has been proven to enhance both accessibility and the attractiveness of the material. Overall, these findings show that the developed digital learning material has strong potential to improve students' motivation, creativity, and conceptual understanding of physics.

This study has several limitations that should be considered for future development. The scope of the learning material is limited to the heat topic for Grade XI in the second semester due to time constraints, indicating the need to expand the content to cover all physics topics for a more comprehensive product. The research phase was also restricted to practicality testing without assessing effectiveness, meaning that subsequent studies should conduct broader trials across different groups of students. The sample, which involved only one class in a single school, prevents the findings from being generalized to wider contexts, highlighting the need for more diverse participants to obtain more representative results. The short research duration also limited the development process, preventing multiple revision cycles typically required in ideal development studies. Therefore, future research is expected to extend both duration and testing coverage to allow more thorough refinement of the product.

CONCLUSION

The digital teaching materials developed with the integration of Joyful Learning for the heat (calor) topic for 11th-grade high school students have undergone needs analysis, design, and expert validation stages. These materials include an interactive instructional design, visually appealing presentation, utilization of software such as Canva and Heyzine, and the application of Joyful Learning principles in every learning activity. Expert validation results show that all components of the teaching materials—content substance, visual communication design, instructional design, software utilization, and Joyful Learning integration—achieved high validity scores, with an overall average categorized as very valid. This indicates that the developed digital teaching materials are suitable for use in high school physics learning. Therefore, the Joyful Learning-integrated digital teaching materials have the potential to enhance students' learning interest and creative thinking skills. Further research can focus on testing the practicality and effectiveness of these materials in improving student learning outcomes. In addition, the concept of developing digital teaching materials can be extended to other physics topics.

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