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Need Analysis of Ethno-STEM-Based Interactive Learning Media Assisted by Articulate Storyline to Facilitate Students' Creative Thinking Skills on Alternative Energy Material

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ABSTRACT

This research is motivated by the urgent need to integrate ethnoscience and STEM approaches into physics learning to support the development of students' creative thinking skills. Considering observational findings that indicate low levels of student engagement due to use of learning media that are not yet interactive, integrating ethnoscience and STEM is essential. To address this problem, this research utilizes the first phase of the Hannafin & Peck model, specifically conducting a needs assessment to create interactive learning media on alternative energy material. Quantitative data were collected from 109 high school students across two schools. Data were gathered through creative thinking tests, physics learning observations, student characteristics analysis, contextual analysis of learning media, learning environment analysis, and learning objectives analysis. The results revealed significant gaps across all evaluated parameters: (1) students' average creative thinking skills were classified as very low, scoring 43.5% and 42.75%; (2) quality of currently used contextual media was only adequate, scoring 53.72%; (3) ethnoscience integration within existing media was very low at 26%; (4) STEM approach integration was similarly deficient at 32.5%; (5) conversely, student enthusiasm for interactive media was very high at 85% and 81%; and (6) current learning objectives lacked the "affective behavior" aspect, scoring 20%. Developing Ethno-STEM-based interactive learning media assisted by Articulate Storyline represents a strategic solution to close the gap between existing school resources and contemporary pedagogical demands. Ultimately, this research provides a vital contribution by establishing a foundational instructional design that enhances students' creative thinking skills for 21st-century education.

Keywords : Interactive Learning Media, Ethno-STEM, Articulate Storyline, Creative Thinking.

I. INTRODUCTION

The global education system is undergoing rapid transformation in the 21st-century landscape to meet the evolving demands of modern society. A significant changes in this system is the requirement that education be comprehensively directed toward the integration of 21st-century skills [1]. These skills are widely recognized and categorized into six key domains, often abbreviated as the "6Cs". The 6Cs consist of critical thinking, creativity, collaboration, communication, citizenship or culture, and character education or connectivity [2], [1], [3]. Twenty-first-century learning requires students to possess and continuously develop these skills to successfully navigate the complex dynamics of the current era of globalization [4]. Without mastering these skills, students will find it difficult to adapt to rapid technological developments and the constant emergence of global challenges [5], [6]. Among these crucial competencies, creativity or creative thinking stands out as a skill that students must actively cultivate to effectively meet the challenges of the 21st century [7].

Creative thinking skills need to be continuously practiced in every learning activity so that students can generate new ideas and synthesize alternative concepts to solve problems. According to [8] and [9], creative thinking helps students generate new, original, and innovative ideas, make informed choices, reach logical conclusions, and create something new within the context of the problem they face. This is in line with [10]'s opinion, which explains that creative thinking involves providing a variety of possible answers based on the information provided, with an emphasis on diversity, quantity, and appropriateness. Creative thinking in its application allows students to conduct in-depth analyses of emerging ideas and making choices by utilizing essential skills to continuously promote, checking, and adjusting those ideas to be more effective and useful for solving problems in various life and learning contexts [11], [12]. Therefore, creative thinking is a crucial skill that students must master to face the challenges that arise in 21st-century learning.

Despite the importance of these skills, previous empirical studies consistently show that the overall level of creative thinking among high school students remains alarmingly low. Research conducted by [13], found that students' creative thinking skills were categorized as less, with a score of 59.92. Similarly, research conducted by [14], found that creative thinking skills of students at SMAN 1 Kubung was in the very low category, with a score of 34. Furthermore, research conducted by [15], at SMAN 1 Banuhampu corroborated these findings, reporting a very low overall score of 36. If left unaddressed, students will find it increasingly difficult to adapt to 21st-century learning. Targeted and strategic educational efforts are urgently needed to minimize the long-term negative impacts on students' academic journeys. Specifically, an innovative pedagogical approach is required to bridge the gap between abstract theoretical knowledge and students' contextual realities, fostering a more engaging environment for creative development.

This problem can be addressed by implementing a learning approach such as ethno-STEM, which integrates ethnoscience and STEM. The STEM approach provides students with highly relevant, real-world learning experiences by integrating science, technology, engineering, and mathematics across disciplines [16], [17], [18]. In practice, STEM develops creative thinking skills by engaging students with contextual problems that require observation, idea generation, solution formulation, and product creation [19]. Furthermore, the ethnoscience approach connects local culture and wisdom with science education. This connection allows students to learn through the lens of their cultural backgrounds [20], [21], [22]. Integrating local wisdom practices into science learning helps students connect abstract scientific concepts with real life in their surroundings. For example, educators can utilize the Jirah Waterwheel to teach mechanical energy or the malamang process to illustrate heat sources [23]. Ultimately, this integration creates a meaningful and contextual environment that links scientific concepts with students' cultural experiences, thereby encouraging deeper engagement and significantly enhancing both creativity and learning outcomes [24], [25], [26].

Implementing the ethno-STEM approach provides an effective solution to overcome the low level of students' creative thinking skills. In line with the research result by [27] and [28], it has been clearly demonstrates that utilizing ethno-STEM yields a significant increase in student creativity compared to conventional learning methods. Similar findings reported by [29], show that integrating ethno-STEM with project-based learning effectively promotes students' creative thinking skills. However, the optimal success of the ethno-STEM approach heavily depends on robust instructional support. It requires appropriate learning media that can actively facilitate student exploration. This media must also foster high levels of interactivity throughout the learning process. Furthermore, the overall effectiveness of such STEM-based media is strongly influenced by aspects of interactivity and technological accessibility [30].

Interactive learning media leverages digital technology to actively engage students through two-way communication within the learning process. Interactive learning media directly engages students in the learning process through the use of digital technology, thus not only presenting information passively but also enabling students to interact, explore, and learn more actively [31], [32]. The use of interactive learning media can present visualizations, simulations, and interactions that make learning more engaging [33]. Therefore, the meticulous process of designing this sophisticated learning media necessitates the utilization of a robust supporting application, ensuring that the final instructional product developed is not only highly interesting but also continuously engaging for the students.

One software tool that can facilitate the development of interactive learning media is Articulate Storyline. Articulate Storyline combines various media, such as text, pictures, graphs, videos, animations, and audio to deliver presentations in an engaging visual format and provides reciprocal responses for users during the learning process [34], [35]. Its primary function is to create interactive learning media in the form of HTML5 web-based tools or application files [36]. This platform offers several advantages, including a highly interactive display and the flexibility to facilitate learning anywhere and anytime [37]. By integrating elements that stimulate higher-order cognitive processes, Articulate Storyline effectively hones students' creative thinking skills [38]. Therefore, utilizing this software to develop interactive learning media is a highly effective strategy.

Developing interactive learning media that integrates ethnoscience and STEM approaches is a potential solution to enhance students' creative thinking skills. The novelty of this research lies in combining an ethno-

STEM approach, interactive digital technology, and targeted creative thinking indicators into a single, cohesive learning product an integration that has not been widely explored in previous studies. Furthermore, this study focuses specifically on alternative energy material, a crucial context that allows students to explore real-world environmental challenges, renewable resources, and sustainable local practices through physics concepts. To systematically address the identified instructional gaps, this research aims to conduct a comprehensive needs assessment as the first step in the Hannafin & Peck model. Specifically, the explicit objective of this research is to evaluate learning problems, determine learner characteristics, measure learning settings, and analyze instructional objectives to establish a strong foundational design for developing ethno-STEM-based interactive learning media assisted by Articulate Storyline.

II. METHOD

The type of research employed in this study is Research and Development (R&D). In line with [39], R&D is essentially the design and implementation of new product ideas or improvements to existing products. The fundamental objective of R&D activities is producing new products or improvements to existing products that still need improvement. This R&D research utilizes the Hannafin & Peck model. The instructional materials were created using this specific framework, which encompasses three phases: a needs assessment phase, a design phase, and a development and implementation phase [40]. The Hannafin & Peck model provides clear procedures that make it easier for researchers to produce a product.

Subject of this study focuses on developing ethno-STEM-based interactive learning media assisted by Articulate Storyline to facilitate students' creative thinking skills on alternative energy material. The developed media will undergo a rigorous validation process by three expert validators, namely a Physics lecturer from the Faculty of Mathematics and Natural Sciences at Universitas Negeri Padang. Validation criteria will assess content feasibility, language appropriateness, media design, and ethno-STEM integration. Revisions will be made based on input from the validators to improve the quality of the learning media before implementation. If the final product is deemed valid, the next step is to implement the interactive learning media, which will be tested in a real classroom setting. The results of the validation and practicality tests will provide evidence of the quality and feasibility of the interactive learning media. This ensures that the media is appropriate, practical, and capable of supporting meaningful learning while fostering students' creative thinking skills.

This research was conducted over a four-month timeframe (April to Juli 2026) at two distinct locations, namely SMAN 1 Suliki and SMAN 1 Kec. Guguak. The research subjects comprised 109 Grade XI students (57 students from SMAN 1 Suliki and 52 students from SMAN 1 Kec. Guguak), selected using a purposive sampling technique based on their ongoing study of alternative energy topics and recommendations from their physics teachers. Data were collected through tests of creative thinking skills, observations of physics learning, analysis of student characteristics, contextual analysis of learning media, analysis of the learning setting, and analysis of learning objectives. Data triangulation was ensured by combining test results, self-reported questionnaires, and direct classroom observations to validate the findings from multiple perspectives.

In the creative thinking skill test, the instrument used was a descriptive essay test. The questions were tested on students at SMAN 1 Suliki and students at SMAN 1 Kec. Guguak which aimed to determine the extent to which students have mastered one of the skills required in learning the 21st-century. The test given will assess students' creative thinking skills, with questions follow on creative thinking indicators according to [10]. These data collection procedures served as a crucial foundation for the needs assessment phase to identify existing instructional gaps and guide the development of innovative learning media.

Observation of physics learning involved direct observation of the learning media used by physics teachers in the classroom. The observation sheet was developed based on a standard instructional evaluation rubric and underwent peer review prior to use. This instrument aims to measure the integration of information and communication technology (ICT) in instruction, the alignment of instructional media with the teaching approach, and the capacity of the media to facilitate activities that foster creative thinking. Additionally, a structured questionnaire was administered to students to analyze their characteristics. This questionnaire utilized a 5-point Likert scale (ranging from "Strongly Agree" to "Strongly Disagree") to identify specific issues, technology preferences, and learning needs within the classroom learning process.

Subsequently, a contextual analysis of the instructional media employed by the physics teacher was conducted. The examined aspects included the interactivity of the media and the integration of ethnoscience and STEM components; an observation guide served as the primary instrument for this assessment. The learning objectives were analyzed using a standardized observation guide to evaluate their alignment with the ABCD framework and national curriculum standards stipulated in the Regulation of the Permendikbud No. 22 of 2016. Finally, an analysis of the learning setting was carried out using an observation guide to evaluate the physical and communicative effectiveness of classroom physics instruction.

This study employs a quantitative approach utilizing descriptive statistics to evaluate various components, including the outcomes of creative thinking tests, physics classroom observations, student characteristics, instructional media contexts, learning environments, and educational objectives. For enhanced clarity, the resulting quantitative data are visualized through tables and graphs. Ultimately, this descriptive method facilitated a comprehensive and profound interpretation of the collected data. The analysis category for the test of creative thinking skills was determined based on the calculated scores for each respondent. Scoring was applied according to established rubrics, assigning a score between 0-4 for each creative thinking indicator. The method for calculating the obtained scores according to [41] is done with the following Equation 1:

$$NP = \frac{R}{SM} \times 100 \qquad (1)$$

Within this mathematical formulation, the principal variable denoted as NP specifically designates the sought or expected final percentage value reflecting the student's overall cognitive mastery. The core of this calculation fundamentally relies on the variable R, which meticulously represents the actual cumulative raw score directly obtained by the student. To determine the exact success proportion, this cumulative raw score is then divided by the parameter SM, a determining variable that indicates the ideal maximum score achievable for the test. Finally, to transform this derived fractional ratio into a percentage format and easy to interpret, the quotient is systematically multiplied by a fixed constant of 100.

Quantitative analysis used descriptive statistics to assess students' creative thinking test results. To clarify these quantitative findings, the processed data were presented systematically using tables and graphs. This descriptive statistical analysis aimed to provide an in-depth interpretation of the data obtained from the research subjects. Furthermore, interpretation categories for evaluating students' creative thinking skills were determined based on the percentage scores calculated for each respondent. The detailed interpretation categories used to evaluate the results of this creative thinking ability analysis are presented in Table 1 below.

Table 1. Criteria of Creative Thinking Skills

Intervals	Category
86 - 100	Very High
76 - 85	High
60 - 75	Enough
55 - 59	Low
≤ 54	Very Low

(Source: Ref [41])

III. RESULTS AND DISCUSSION

Results

Analysis of Students' Creative Thinking Skills

The results of the analysis of students' creative thinking skills at SMAN 1 Suliki and SMAN 1 Kec. Guguak were based on tests administered to 57 and 52 students, respectively. The data was obtained through essay question sheets that had been filled in by students. The test question sheets were in the form of descriptive questions containing indicators of creative thinking according to [10]. Each student's response was systematically evaluated to accurately determine their current level of creative proficiency in solving physics problems. The analysis of the results obtained regarding students' creative thinking skills is presented in Table 2.

Table 2. Score for Each Creative Thinking Skill Indicator

Indicator Creative Thinking	Score (%)		Category
	SMAN 1 Suliki	SMAN 1 Kec. Guguak	
Fluency	45%	48%	Very Low
Flexibility	43%	40%	Very Low
Originality	36%	36%	Very Low
Elaboration	50%	47%	Very Low
Average	43.5%	42.75%	Very Low

Based on the data presented in Table 2, the average creative thinking ability of students at SMAN 1 Suliki and SMAN 1 Kec. Guguak was 43.5% and 42.75%, respectively. Furthermore, a closer examination reveals that all individual indicators—fluency, flexibility, originality, and elaboration—are uniformly deficient across both institutions, with originality scoring the lowest at merely 36%. This may be attributed to several factors, including the pattern of knowledge transfer that relies heavily on rote memorization and does not actively stimulate students' creative problem-solving capabilities. The persistent deficiency in these cognitive domains highlights a pressing need for pedagogical intervention to better prepare students for contemporary challenges. Therefore, teachers need to apply learning approaches based on the exploratory needs and cognitive levels of students [42]. One robust approach that can stimulate student creativity is the ethno-STEM approach.

Analysis of Physics Learning Observations

The results of the physics learning observations revealed that physics teachers predominantly presented material directly using lectures and class discussions. The learning media used were limited to non-interactive PowerPoint presentation slides, which did not encourage active student participation or exploration in the learning process. As a result, the classroom environment became monotonous. This approach positioned students merely as passive recipients of information rather than active constructors of their own knowledge. The data underscores a critical instructional gap characterized by a shortage of interactive media that can effectively contextualize concepts and foster creative problem-solving. The detailed analysis of the physics learning observations is presented in Figure 1 below.

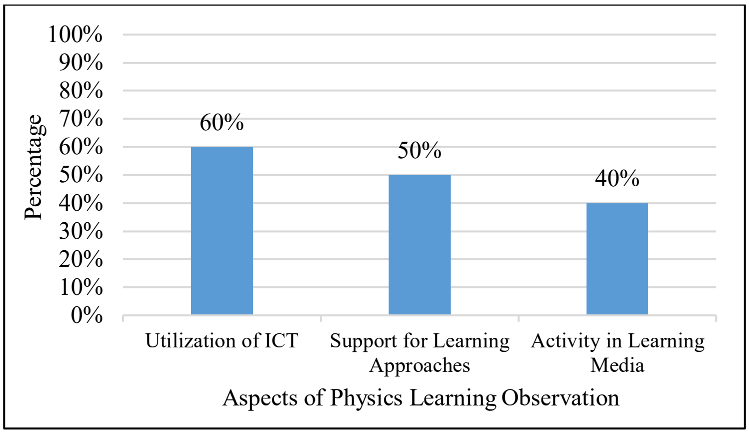

Fig. 1. Results of the Analysis of Physics Learning Observation

Based on the observational data presented in Figure 1, it is evident that 60% of physics teachers have utilized ICT in their classrooms. In terms of activity in learning media, only 40% of the currently employed learning media incorporate open-ended tasks or complex questions designed to actively challenge and stimulate students' creative thinking skills. Consequently, this limitation significantly impacts classroom dynamics; students tend to remain passive consumers of information, exhibit a reluctance to ask exploratory questions, and rarely demonstrate unique, divergent, or novel ideas when responding to physics problems presented by the teachers. Furthermore, an analysis of the pedagogical frameworks reveals that merely 50% of these existing learning media explicitly support or align with specific, student-centered learning approaches. Synthesizing these observational results, a critical gap is apparent: there is a substantial lack of highly interactive learning media that not only engages students but also systematically integrates a holistic pedagogy, such as the ethno-STEM approach, to contextualize physics concepts and cultivate creative problem-solving.

Analysis of Student Characteristics

The results of the student characteristics analysis provide critical insights into the learners' profiles. A questionnaire was administered to 44 students at SMAN 1 Kec. Guguak and 52 students at SMAN 1 Suliki. The questionnaire analysis consisted of four aspects including student learning styles (SLS), use of learning media (ULM), project-based learning (PjBL), and alternative energy material (AEM). Understanding these specific characteristics is crucial for designing an interactive learning media that is highly tailored to the students' actual needs and learning preferences. Furthermore, the findings reveal that students possess a strong audio-visual learning preference, exhibit high enthusiasm for interactive digital technology, demonstrate readiness for project-based tasks, and require targeted facilitation to master alternative energy concepts. The results of the analysis of determining student characteristics can be seen in Figure 2.

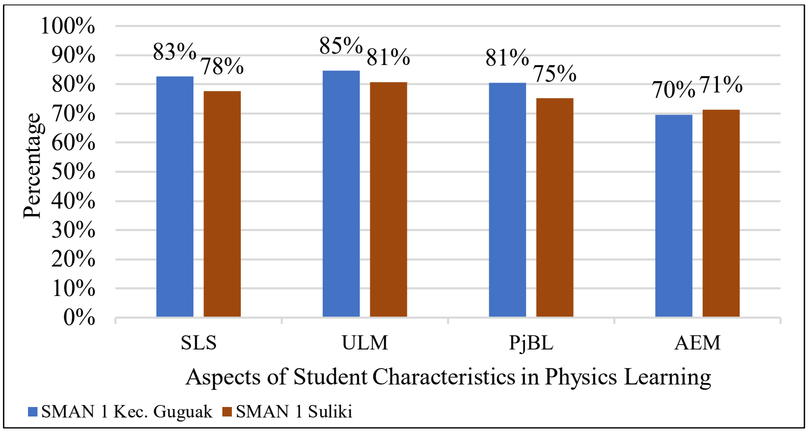

Fig. 2. Results of Questionnaire Analysis at SMAN 1 Kec. Guguak and SMAN 1 Suliki

Based on data presented in Figure 2 above, the results of the questionnaire analysis at SMAN 1 Kec. Guguak and SMAN 1 Suliki show a consistent trend in student characteristics. In the aspect of student learning styles, both schools respectively obtained a percentage of 83% in the very high category and 78% in the high category, indicating that students have a strong learning style tendency towards the use of audio-visual and digital media in the learning process. In the aspect of the use of learning media, both schools respectively obtained a percentage of 85% and 81% in the very high category, indicating that there is a very high enthusiasm and need from students for the use of technology interactively in the classroom. In the aspect of project-based learning, both schools respectively obtained a percentage of 81% in the very high category and 75% in the high category, indicating high readiness and strong interest from students to solve problems and design real work. In the aspect of alternative energy material, the score obtained was 71% and 70% in the high category, confirming that although students have a basic understanding of alternative energy material, some of the students still experience difficulties in mastering the concept as a whole, so that the presence of more effective learning facilitation is needed.

Analysis of Contextual of Learning Media

The results of the contextual analysis of the learning media currently used by Physics teachers. From the contextual analysis, it was revealed that the learning media currently used by Physics teachers in school is quite adequate, achieving an average a score of 53.72%. This evaluation was follows the ideal standards for interactive learning media, which include six main aspects. These aspects include, visual and multimedia display (VMD), language and narrative quality (LNQ), interactivity and engagement (IE), learning structure and independence (LSI), ease of access (EOA), contextual appropriateness (CA). The detailed results of the contextual analysis of learning media are presented visually in Figure 3 below.

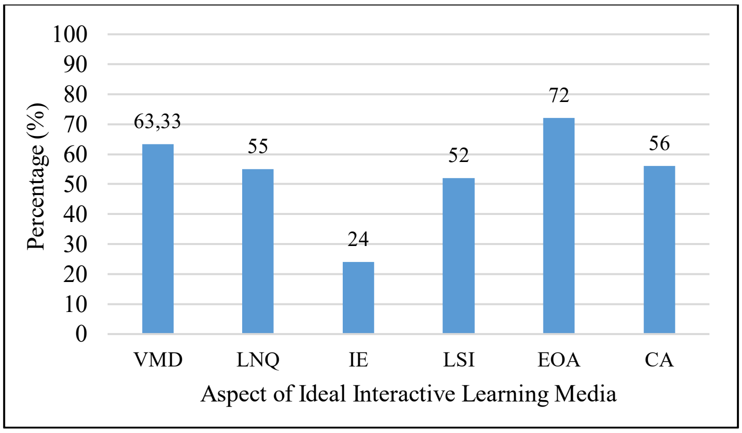

Fig. 3. Results of Contextual Analysis of Learning Media Used in School

Based on the data presented in Figure 3, it is revealed that the learning media currently used by Physics teachers still have several weaknesses and do not meet the ideal standards of interactive learning media. The ease of access aspect received the highest score of 72%, indicating that the media is relatively accessible to students but can still be optimized. The visual and multimedia display aspect received a score of 63.33%, which falls into the sufficient criteria. The contextual appropriateness and language and narrative quality aspects each received a score of 56% and 55%, which are included in the sufficient category, indicating a need for better contextual integration and narrative clarity. The learning structure and independence aspect received a score of 52%, meaning the media still lacks optimal support for self-directed learning. Finally, interactivity and engagement received a score of 24%, which is the lowest aspect and falls into the very low category, because the current media is highly passive and lacks interactive features or elements that stimulate active student participation. To overcome these critical limitations, particularly the profound deficit in interactivity and contextual relevance, a substantial pedagogical and technological intervention is required.

Analysis of Integration of Ethnoscience in Learning Media

The results of the integration of ethnoscience in learning media provide crucial insight into the contextual relevance of current teaching practices. The data were obtained from questionnaires filled out by the researchers themselves based on observations and assessments of learning media used in schools. The questionnaire analysis consisted of five aspects including science concepts relevant to local culture (SCRLC), science process skills integrated with local knowledge (SPSILK), scientific attitudes instilled through local wisdom (SAITLW), application of physics concepts based on local wisdom (APCBLW), and representation and visualization of physics in local knowledge (RVPLK). The detailed results of the analysis of ethnoscience integration in learning media presented visually in Figure 4 below.

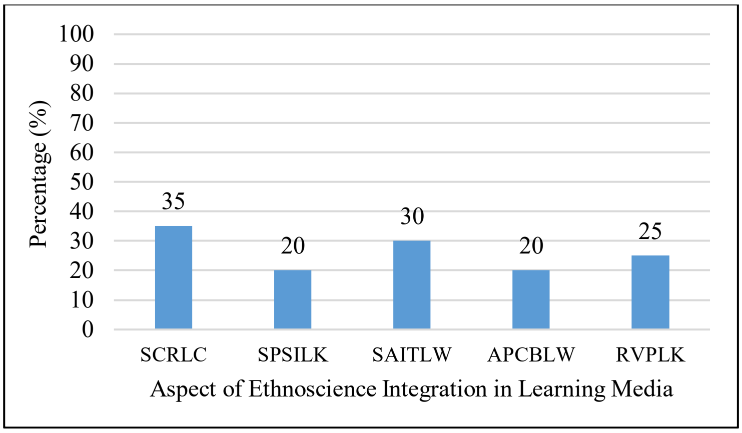

Fig. 4. Results of Ethnoscience Integration Analysis in Learning Media Used in School

Based on the data presented in Figure 4, the integration of ethnoscience in the learning media currently used in schools remains low. Analysis presented that the integration of ethnoscience in learning media used in school with a score of 26%. The science concepts relevant to local culture aspect achieved the highest score at 35%, indicating a very basic inclusion of general local contexts. The scientific attitudes instilled through local wisdom aspect received a score of 30%, while the representation and visualization of physics in local knowledge aspect scored 25%. Furthermore, the science process skills integrated with local knowledge and the application of physics concepts based on local wisdom aspects each received the lowest scores of 20%, demonstrating that the existing teaching materials completely lack experimental guidance, process skills, and the mathematical or conceptual application of physics related to local wisdom.

Analysis of Integration of STEM in Learning Media

The results of the integration of STEM approach in learning media provides significant insight into the instructional design of current classroom practices. Data were collected through questionnaires completed by the researchers themselves based on observations and assessments of the learning media used in schools. The analysis revealed that the level of STEM integration in the learning media was classified as low. The questionnaire analysis covered four main aspects: science, technology, engineering, and mathematics. Detailed results of analysis of the STEM approach integration in learning media are presented in Figure 5 below.

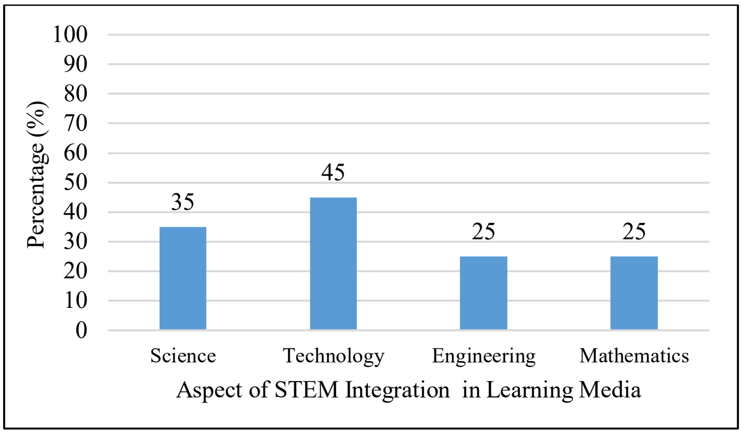

Fig. 5. Results of STEM Integration Analysis in Learning Media Used in School

Based on the data presented in Figure 5, the integration of the STEM approach in the learning media currently used in schools remains low, achieving an overall average score of 32.5%. Among the four key aspects evaluated, the technology aspect received the highest score at 45%, indicating that visual tools or digital presentations are moderately present in current learning media. The science aspect followed with a score of 35%. Meanwhile, the engineering and mathematics aspects received the lowest scores, each at 25%, demonstrating a significant lack of engineering design processes, project-based construction, and mathematical calculations or modeling within the existing instructional media. This condition aligns with the findings of previous studies which highlight that conventional and teacher-centered media fail to provide comprehensive, multidisciplinary real-world experiences, thereby hindering the development of students' higher-order thinking skills.

Analysis of Learning Setting

The results of the analysis regarding classroom learning setting during the lesson on alternative energy are presented here. This analysis was conducted to evaluate the effectiveness of the learning setting across six aspects includes classroom spatial arrangement (CSA), student engagement (SE), positive communication (PC), learning component interaction (LCI), variety of learning media (VLMD), and variety of learning methods (VLMT). Effective learning setting are a key factor in supporting meaningful learning and facilitating the successful implementation of the ethno-STEM approach. The results shown in Figure 6 provide an overview of the strengths and the aspects requiring improvement.

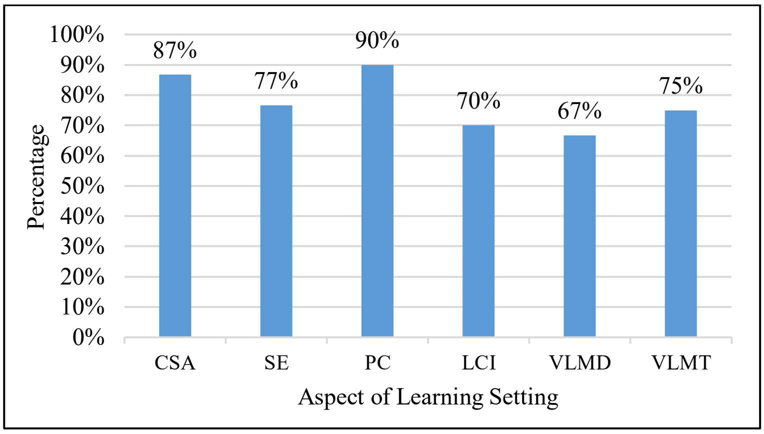

Fig. 6. Results of Learning Setting Analysis

Based on the analysis of the learning setting graph for alternative energy material, the evaluation of six main aspects indicates that classroom spatial arrangement and positive communication achieved the highest percentages, each scoring 90, demonstrating that the physical learning environment is well-conditioned and positive interactions are successfully built during the instructional process. Furthermore, learning component interaction obtained a score of 80, followed by student engagement with a score of 73.3, indicating that while instructional components interact adequately, students' active participation in the classroom still requires optimization. Conversely, the lowest scores were recorded for variety of learning media at 70 and variety of learning methods at 65, confirming that the current teaching approach still relies on conventional, less varied methods and media that fail to fully facilitate students' exploratory learning needs.

Analysis of Learning Objectives

The results of the analysis of learning objectives for the topic of alternative energy based on the audience, behavior, condition, and degree (ABCD) framework. This analysis was conducted to evaluate the extent to which the existing learning objectives meet the characteristics of well-formulated instructional objectives. Each indicator was evaluated across three instructional materials to identify strengths and areas for improvement. The findings presented in Figure 7 serve as the basis for revising the learning objectives.

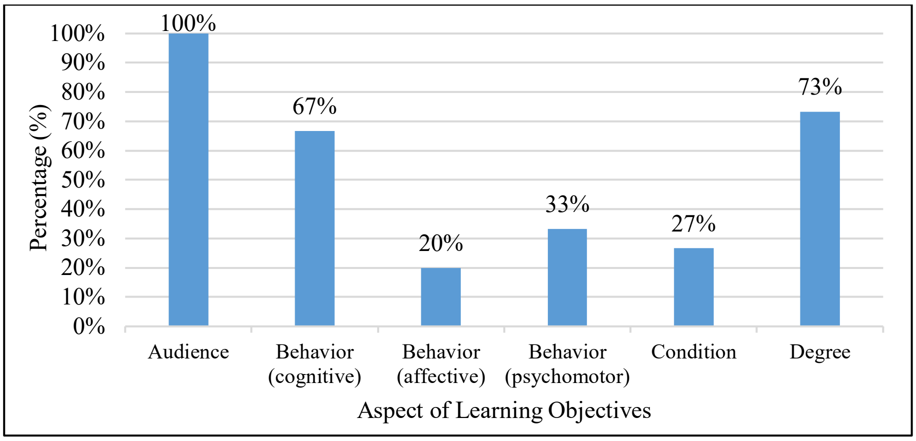

Fig. 7. Result of Learning Objectives Analysis

The analysis results indicate that the current learning objectives do not yet fully satisfy the comprehensive ABCD criteria. The Audience aspect achieved the maximum score of 100%, demonstrating that the target learners have been clearly and accurately defined. Furthermore, the Degree and Behavior (cognitive) aspects obtained relatively high scores of 73% and 67%, respectively, suggesting that the achievement criteria and knowledge competencies are adequately formulated but could still benefit from minor refinements. In contrast, the Behavior (psychomotor), Condition, and Behavior (affective) aspects received significantly lower scores of 33%, 27%, and 20%, respectively. These low percentages highlight that the skill competencies, expected learning conditions, and attitude formations are inadequately defined and require substantial strengthening. Consequently, subsequent revisions to the learning objectives must prioritize the precise formulation of psychomotor and affective behaviors, alongside clearly defined learning conditions.

Discussion

Based on the results of the initial data research conducted, seven main findings from the needs analysis were obtained. First study, showed that students' creative thinking skills at SMAN 1 Suliki and SMAN 1 Kec. Guguak were in the very low category. The results of this study align with research conducted by [43], who stated that conducive learning, which includes physical and non-physical aspects, can improve students' creative thinking skills. Furthermore, to implement active, creative, and effective learning and achieve learning objectives, teachers are expected to implement learning approaches and learning media that can facilitate students' creative thinking skills [44]. According to [45], the learning approach that can be used to develop students' potential in terms of creative thinking skills is the ethno-STEM approach, designed to focus on solving real-world problems and developing creative thinking skills. In line with [46] findings, the use of digital media in interactive learning can be enhanced, resulting in students becoming more creative, innovative, and optimal. Therefore, the implementation of innovative approaches such as ethno-STEM which are synergistically integrated with interactive learning media is a crucial strategic step to facilitate and develop students' creative thinking skills optimally.

Second study, regarding observations of physics learning, showed that physics teachers delivered material directly using lecture methods accompanied by class discussions. The learning media used by physics teachers were still non-interactive PowerPoint presentation slides, which did not encourage active student participation and exploration in the learning process. Consistent with [47] opinion, this resulted in students feeling less interested in physics learning, ultimately leading to difficulties in physics lessons and a poor understanding of the physics concepts. Regarding the utilization of ICT in learning media, showed a significant need for further improvement to make learning more interactive. In terms of activity in learning media, the learning media used by Physics teachers is still limited to containing open-ended tasks that challenge students' creative thinking skills. These results align with previous research [48], which indicates that instructional approaches relying on teacher-center methods and rote memorization generally hinder the development of creative thinking skills. In terms of support for learning approaches, the learning media used by Physics teachers is still limited to support learning approaches.

According to [49], these findings reveal a disconnect between theoretical concepts and practical application. Therefore, teachers must use interactive learning media that integrates the ethno-STEM approach.

The results of the third study relate to the characteristics of students at SMAN 1 Suliki and SMAN 1 Kec. Guguak. A questionnaire found that students were more interested in learning through visual or animated media. This finding aligns with research conducted by [50], who explained that visual media is crucial for the learning process, especially in terms of eliminating difficulties in the student experience. Similarly, [51] argues that animated media creates a more effective learning environment, encouraging students to be more active, and creativel. Furthermore, students preferred learning using learning media that can be clicked or explored independently. This indicates that the learning process must be designed in such a way as to attract attention and arouse students' enthusiasm for learning [52]. Furthermore, students felt more focused when learning through audio media. These results indicate that learning through audio media can improve student focus [53]. Students enjoy learning using interactive technology. This shows that students strongly agree with learning by utilizing technology to make learning more interactive [54], [55]. Students find it easier to understand material through learning media accompanied by illustrations or visual graphics. These results indicate that learning accompanied by clear, well-illustrated materials is much more preferred by students than conventional learning.

Fourth finding relates to the contextual analysis of learning media currently used in schools, which revealed significant deficiencies in facilitating 21st-century skills. Results of a contextual analysis of the learning media currently used by physics teachers in schools indicate that the quality of the media does not meet the ideal standards for interactive learning media in the fairly adequate category. Based on the detailed evaluation of six main aspects, the interactivity and engagement aspect received the lowest score, placing it in the very low category. This low rating indicates that the current media is still very passive, relying on linear presentations and lacking elements that stimulate active student participation. This finding is in line with [56] who emphasized that the use of conventional teacher-centered media makes the learning process passive, thus failing to accommodate the needs of students' exploration and creative thinking. In fact, the availability of technology-based interactive learning media has been theoretically proven to be able to present visualizations, simulations, and interactions that make learning more engaging [44], as well as making the quality of the student learning process more meaningful [57].

Fifth finding addresses the integration of ethnoscience and STEM approaches in the learning media used in schools is currently still relatively low. In the aspect of ethnoscience integration, the biggest weakness is seen in the lack of science process skills and the application of physics concepts based on local wisdom, where both only received the lowest score, indicating the absence of experimental guidance and practical conceptual applications. In line with this, the analysis of the integration of the STEM approach also revealed that elements of engineering design and mathematical calculations are not well accommodated, as indicated by the lowest score. The lack of these important multidisciplinary elements proves that the media used by teachers fail to provide comprehensive real-world experiences, thus hampering the development of students' higher-order thinking skills. This situation is unfortunate because the availability of learning media that ideally integrate STEM has been proven to facilitate students with hands-on experience, train them in simple technological designs, and significantly improve their learning outcomes and science process skills [57]. Furthermore, the incorporation of local wisdom elements into STEM is a culturally responsive approach that has been empirically proven to be very powerful in increasing student learning engagement, strengthening cultural relevance, and ultimately being a key mediator in developing 21st-century skills, especially creativity and critical thinking [58].

Sixth finding addresses the analysis of the learning setting during alternative energy lessons. While the classroom spatial arrangement and positive communication achieved commendable scores, the variety of learning media and variety of learning methods recorded the lowest percentages. This indicates that although the physical and communicative environment is well-conditioned, the instructional approach still relies on conventional methods that do not fully facilitate students' exploratory learning needs. Effective learning settings are crucial for supporting meaningful education and the successful implementation of the ethno-STEM approach. Consequently, introducing innovative and interactive teaching tools is essential to create a student-centered environment. Seventh finding concerns the analysis of the existing learning objectives evaluated through the ABCD framework. The evaluation demonstrated that while the Audience aspect is perfectly defined, critical components such as behavior for psychomotor and affective, as well as the learning condition, remain inadequately formulated. Clear and comprehensive learning objectives are fundamental to guiding the instructional process, especially when aiming to develop creative thinking skills. These low percentages necessitate a substantial revision of the learning objectives to explicitly include expected learning conditions alongside psychomotor and affective behaviors.

Based on the results of this needs analysis, a clear gap exists between the pedagogical demands of 21st-century education and classroom learning practices. The dominance of teacher-centered learning and passive media has proven unable to accommodate students' audio-visual learning styles and their need for interactive learning contexts. To bridge this instructional gap, the development of interactive Ethno-STEM-based learning media presents a very urgent and strategic solution. By focusing on alternative energy materials, this digital instrument is designed to synergistically integrate local wisdom with multidisciplinary STEM components, thereby creating a dynamic and student-centered learning environment. Ultimately, this development innovation is highly expected to not only facilitate the diversity of student learning characteristics and stimulate their active involvement, but also effectively optimize students' creative thinking skills in physics learning.

IV. CONCLUSION

Based on the needs assessment data analysis, seven main findings emerged. First, students' creative thinking skills are categorized as very low at the two observed schools. Second, observations of physics learning revealed a significant lack of interactive media that hindered active student participation. Third, the analysis of student characteristics indicated a strong preference for audio-visual and interactive learning. Fourth, the contextual analysis of current learning media showed it to be merely adequate overall. Fifth, the integration of both ethnoscience and STEM approaches within the existing instructional media was found to be very low. Sixth, while the classroom spatial arrangement and positive communication were commendable, the variety of learning media and teaching methods used is still limited. Seventh, the evaluation of learning objectives highlighted that the expected learning conditions, affective, and psychomotor behaviors are inadequately formulated. These findings indicate a clear gap between current classroom learning practices and the pedagogical demands of 21st-century education. It can be concluded that developing Ethno-STEM-based interactive learning media using Articulate Storyline for alternative energy materials is urgently needed.

By synergizing local wisdom and STEM, this digital innovation is expected to create a dynamic, student-centered learning environment that accommodates diverse learning styles and characteristics and enhances students' creative thinking skills. The expected impact of implementing this media is the successful transformation of a passive learning environments into an active and exploratory spaces. As a practical implication, teachers and policymakers are encouraged to support the adoption of culturally responsive, technology-integrated instructional tools to modernize physics education. However, a limitation of this current study is its exclusive focus on the initial needs assessment phase of the Hannafin & Peck model. Therefore, future research must proceed to the subsequent design, development, and implementation phases to empirically evaluate the validity, practicality, and overall effectiveness of the media.

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