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Validity Analysis of Heyzine Assisted Learning Project Based Electronic Modules in Facilitating Students' Creative Thinking Skills on Climate Change Material

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ABSTRACT

Creative thinking is a crucial skill in 21st-century learning, yet field conditions indicate that students' creative thinking abilities remain relatively low. This is due to the use of teaching materials that fail to facilitate the development of student creativity and the suboptimal implementation of project-based learning models in the classroom. To address this issue, this research focuses on the development of a project-based learning electronic modules designed to support and enhance students' creative thinking skills. This research employed a Research and Development (R&D) method with a 4D development model, which includes the definition, design, and development stages. In the definition stage, observations were conducted in several schools. The next stage, the design stage, involved developing a framework for the project-based learning electronic modules. In the development stage, the designed product was tested through validity and practicality tests. Data collection instruments in this study included teacher interviews, student questionnaires, and validity and practicality test sheets. The data obtained were then analyzed using validity analysis techniques with Kappa Moment (k) and product practicality analysis. The results showed that the developed electronic modules had a validity value of 0.86, which is categorized as very valid. It can be concluded that the developed project-based learning electronic modules are valid for improving students' creative thinking skills.

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INTRODUCTION

The government has made various efforts to improve the quality of Indonesian education in the 21st century. These efforts include requiring students to master what is known as the 6Cs: critical thinking, collaboration, communication, creativity, culture, and connectivity (Anugrahwati, 2019; Novitra et al., 2021; Shabrina & Astuti, 2022; Astuti, 2024). Without mastering these skills, students will have difficulty adapting to a changing environment with rapid technological advances, and this will later become a challenge for

Indonesian education in achieving success in 21st-century learning (Asrizal & Festiyed, 2020; Asrizal et al., 2022; Stanikzai, 2023; Cahyandari et al., 2025).

One of the four most important skills for students to master and develop is creative thinking (Affandi et al., 2024; Ilham et al., 2026). Through creative thinking, students are able to analyze concepts in learning, make informed choices in problem solving, and reach logical conclusions (Alfitriyani et al., 2021; Usmeldi & Amini, 2022). Beyond creating new things or products, creative thinking also enhances one's ability to develop, evaluate, and refine ideas to make them more effective and useful in various life and educational contexts (Adnan & Tahraoui, 2022; OECD, 2023).

Although creative abilities play a crucial role in 21st-century learning, various previous studies have shown that mastery of creative thinking skills among high school students, particularly in physics, remains relatively low (Ahzari et al., 2023; Artiwi et al., 2020). Research conducted by Yasni et al., (2025) found that students' overall creative thinking abilities are in the low category. Furthermore, previous research conducted by Afifah & Asrizal, (2025) at SMAN 1 Batuhampu found that students' overall creative thinking skills were in the low category. Likewise, research conducted by Putri & Alberida, (2022) at SMAN 1 Pariaman found that students' overall creative thinking abilities were in the low category.

There are several limitations in previous research, such as research conducted by Yasni et al., (2025), Afifah & Asrizal, (2025), and Putri & Alberida, (2022) which showed that students' creative thinking skills were still relatively low. Furthermore, opportunities to develop creative thinking indicators, including fluency, flexibility, originality, and elaboration, have not been realized because previous research has not yet incorporated project-based learning models into the learning process that has been implemented. Although contextual topics such as climate change are highly relevant to students' lives and can increase their engagement and environmental awareness, previous research has not explicitly linked the development of creative thinking skills to such content.

Students' low levels of critical and creative thinking skills impact their readiness to face the demands of 21st-century learning, which emphasizes higher-order thinking, problem solving, and innovation as core competencies (Suryandari et al., 2021; Soenarko et al., 2022). If this problem is not addressed promptly, students will struggle to adapt to 21st-century learning, which demands their development (Afifah, 2025; Mutohhari et al., 2021). This difficulty can hinder the development of necessary skills, thereby reducing their chances of future success (Asrizal et al., 2022; Thornhill-miller et al., 2025). Therefore, efforts are needed to minimize the potential impacts of 21st-century learning.

Current technological developments have a positive impact, particularly in education, by increasing the effectiveness of the learning process (Dhawan, 2020; Dapat et al., 2023). One form of implementation is teaching materials in the form of printed teaching modules transformed into electronic modules (Sumarmi et al., 2021; Anjarsari et al., 2023). Electronic Modules are electronic-based teaching materials designed by teachers for students to study independently and presented systematically (Herawati et al., 2018; Ayani et al., 2023). Electronic modules have significant potential to increase the effectiveness of the learning process, especially in facilitating students' creative thinking skills (Desnita et al., 2022; Putri Naomi et al., 2023). However, this potential needs to be optimized by implementing appropriate learning models that can stimulate students' creative thinking.

One learning model that can facilitate students' creative thinking skills is project-based learning. Project-based learning is a learning model in which students face real-life problems and are also asked to generate ideas and solutions to a problem (Ningsih et al., 2020; Nurhidayah et al., 2021; Li et al., 2021). Project-based learning also helps students build knowledge through a series of structured projects (Sukaesih et al., 2022; Siringoringo et al., 2023). This learning model aims to require active student participation through collaboration

and engagement in creative and innovative learning (Ningsih et al., 2025; Subiyantoro, 2025). However, in the development of electronic modules, applications are also needed that can make the learning process more interactive (Andriani et al., 2024; Ramdhani, 2025).

One application that can be used to develop effective and more interactive electronic modules is heyzine. Heyzine has features that enable the integration of images, text, and video, making the learning process more engaging and interactive (Pratiwi et al., 2023; Yuni et al., 2025). Heyzine has become an effective alternative digital learning medium to support interactive teaching and learning processes in today's technological era (Ula et al., 2023; Tifani et al., 2024). Therefore, the heyzine application is very supportive in the development of electronic modules because it has features that make learning less boring and can create more active and interactive learning.

This study aims to assess the validity of a project-based learning electronic module in facilitating students' creative thinking skills on climate change material. Furthermore, the novelty of this study, compared to previous studies, lies in the electronic module that facilitates students' creative thinking skills, supported by the Heyzine application, which makes the electronic module more interesting and interactive, especially on climate change material. The question in this study is how valid is the project-based electronic module in facilitating students' creative thinking skills on climate change.

The research question is how valid are project-based learning-based electronic modules for facilitating students' creative thinking skills on climate change. This study also aims to assess the extent to which project-based learning-based electronic modules meet validity criteria covering six aspects: material substance, visual communication display, learning design, software utilization, project-based learning model, and creative thinking skills. The benefit of this study is to provide an innovative solution to address low levels of creative thinking skills in physics learning. Furthermore, this research is expected to support physics education in the digital age by providing more interactive, meaningful learning materials that align with the demands of 21st-century learning.

METHODS

The type of research applied is developmental research, also known as Research and Development (R&D). The research design used in this development is the 4D model (Define, Design, Develop, Disseminate) proposed by (Thiagarajan et al., 1974). This research design is limited to the Develop stage. This model was chosen based on the consideration that the 4D model research design is systematic and based on the theoretical foundation of educational product design, so that the resulting product meets valid criteria. First, in the Define stage, an initial needs analysis is conducted. This assessment is carried out through an analysis of the needs required to develop effective learning. At this stage, problem analysis related to students' creative thinking skills, analysis of student learning outcomes, analysis of material on climate change, and analysis of teaching materials used in learning, specifically at SMAN 1 V Kubung, are conducted.

In the Design phase, the electronic module structure was designed based on project-based learning and can facilitate creative thinking skills. The electronic module was designed to cover issues related to local phenomena such as community environmental management practices, visual illustrations, more contextual learning videos, and problem-solving activities, as well as indicators of creative thinking. Each component of the teaching material was arranged in an orderly manner, starting with an introduction, presentation of the teaching material, student activities, and evaluation. The digital teaching materials developed were not only oriented towards mastering physics concepts but also on developing scientific attitudes and creative thinking skills.

In the Design stage, the electronics modules structure is designed based on project-based learning. The e-modules are structured to cover local phenomena such as community environmental management practices, visual illustrations, more contextual learning videos, and problem-solving activities, as well as indicators of creative thinking (Depdiknas, 2008). Each component of the teaching materials is organized in an orderly manner, starting with the introduction, presentation of the teaching materials, student activities, and evaluation. The developed digital teaching materials are oriented not only towards mastering physics concepts but also towards developing scientific attitudes and creative thinking skills.

The electronic module validation assessment used a Likert scale. The Likert scale used refers to Sugiyono, (2013), which consists of five assessment categories. The "strongly agree" category has the highest score of 5, indicating a very high level of agreement. Furthermore, the "agree" category has a score of 4, "neutral" has a score of 3, indicating respondents are in a position that does not tend to agree or disagree, while the "disagree" and "strongly disagree" categories each have scores of 2 and 1, respectively. The scoring aims to facilitate the process of analyzing validation data objectively and systematically (Sugiyono, 2013).

The validity of the data obtained was analyzed using a modified categorical assessment (Boslaugh & Watters, 2008). The validator's assessment of each statement was then analyzed using the Cohen Kappa formula, which at the end of the data processing produced a kappa moment that illustrates the level of validity of the electronic modules developed. The Kappa moment formula used is found in equation 1.

$$\text{Kappa Moment } (k) = \frac{P_0 - P_e}{1 - P_e} \quad (1)$$

Based on the first equation, the kappa moment (k) value is used to indicate the level of validity of a product. The P_0 value is obtained by comparing the total score given by the validator with the maximum score. Meanwhile, the P_e value is calculated from the difference between the maximum score and the total score from the validation results. Therefore, the kappa moment value can be used to determine the level of agreement between validators regarding product validity more objectively and systematically.

After obtaining the assessor agreement index that has been filled in by the validator, the index value category is determined. The results of determining the validity category in the electronic module based on the Decision Category Based on Kappa Moment (k) by Boslaugh & Watters, (2008) are shown in Table 1.

Table 1. Decision Categories Based on Kappa Moment (k)

Interval	Category
0.81 – 1.00	Very valid
0.61 – 0.80	Valid
0.41 – 0.60	Quite valid
0.21 – 0.40	Less valid
0.01 – 0.20	Very less valid
0.00	Invalid

Source: (Boslaugh & Watters, 2008)

Validity based on the Kappa Moment index can be classified into six categories: invalid, very less valid, less valid, quite valid, valid, and very valid. Decisions based on kappa (k) values are used to determine the validity level of an instrument based on the validator's performance. The higher the kappa value, the higher the level of validity and quality of the electronic modules are assessed. A kappa value range of 0.81 to 1.00 indicates a very valid category, meaning that the electronic modules are very easy to use without revision. A range of 0.61–0.80 is included in the feasible category, meaning that the electronic modules are

suitable for use with minimal adjustments. A value of 0.41–0.60 is included in the moderately valid category, meaning that the electronic modules can be used but require some revision. Furthermore, a value of 0.21–0.40 is considered somewhat valid, meaning that the electronic modules have not been used and need to be significantly improved. A range of 0.01–0.20 indicates a very low level of validity, meaning that the electronic modules may not meet the requirements. Conversely, a value of 0.00 is classified as invalid because there is no agreement among the validators.

RESULTS AND DISCUSSION

Results

The validation results of the project-based learning electronic module to improve students' creative thinking skills are presented in Figures 1 to 6. This validation stage consists of six assessment components: content substance, visual communication display, learning design, software utilization, project-based learning model, and creative thinking skills. First, the validation test results for the content substance component of the project-based learning electronic module to facilitate students' creative thinking skills consist of four indicators: accuracy (AC), material coverage (MC), currency (CR), and readability (RB). The validation test results for this substance component can be seen in Figure 1.

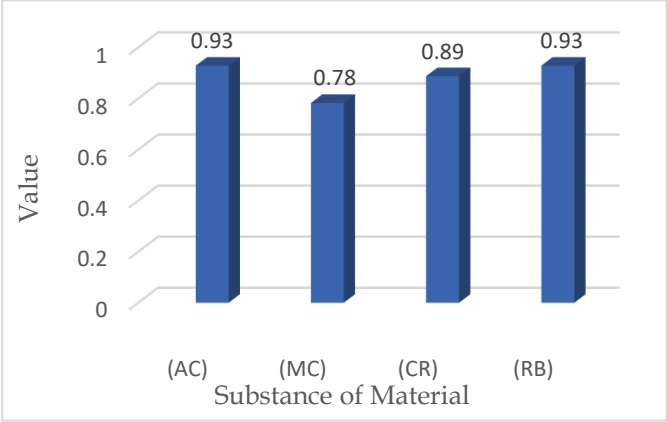

Figure 1. Validation Results of the Material Substance

The data in Figure 1, regarding the validation test results for project-based learning-based electronic modules to facilitate creative thinking skills in the material substance component, fall into the "very valid" category. The analysis results obtained an average validation score for the material substance component of 0.88. Furthermore, the results for each material substance indicator include accuracy (AC) with a score of 0.93, material coverage (MC) with a score of 0.78, currency (CR) with a score of 0.89, and readability (RB) with a score of 0.93. Thus, electronic modules based on project-based learning to facilitate creative thinking skills in the material substance component are considered valid and appropriate to students' current needs.

The second validation assessment concerns the visual communication display, which focuses on how information is presented in electronic modules to support the learning process. This assessment consists of six indicators: navigation (NG), fonts (FT), colour (CL), and layout (LY). These indicators are designed to make it easier for students to operate the electronic module and create an engaging display. Validation of the visual communication display components is presented in Figure 2.

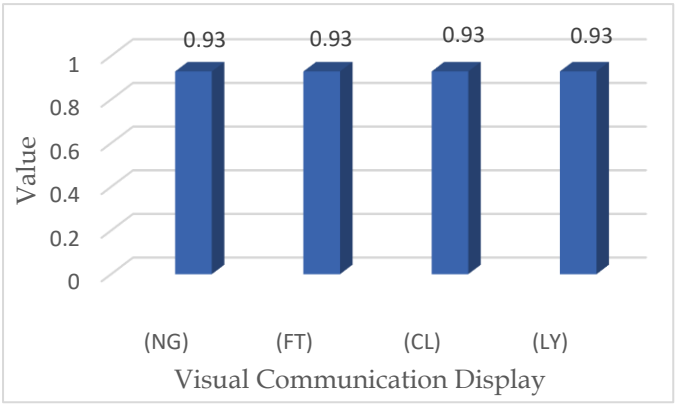

Figure 2. Visual Communication Display Validation Results

Based on Figure 2, the validation results for the Visual Communication Display component are included in the "very valid" category, with an average score of 0.93. Then the validation results for each indicator in the Visual Communication Display component which includes navigation (NG) obtained a validation value of 0.93 in the very valid category, font (FT) obtained a validation value of 0.93 in the very valid category, colour (CL) obtained a validation value of 0.93 in the very valid category, and layout (LY) obtained the same validation value, namely 0.93. Therefore, the project-based electronic learning module to facilitate students' creative thinking abilities is considered valid and appropriate for use by students in the learning process.

The third validation results are for the learning design component. This component includes seven indicators: title (TL), learning outcomes and learning objectives (LO), learning objectives (LO), materials (MT), exercises or simulations (ES), compiler (CP), and references (RF). These indicators are systematically structured, aligned, and relevant to learning objectives. The results of the validation assessment for the learning design component are presented in Figure 3.

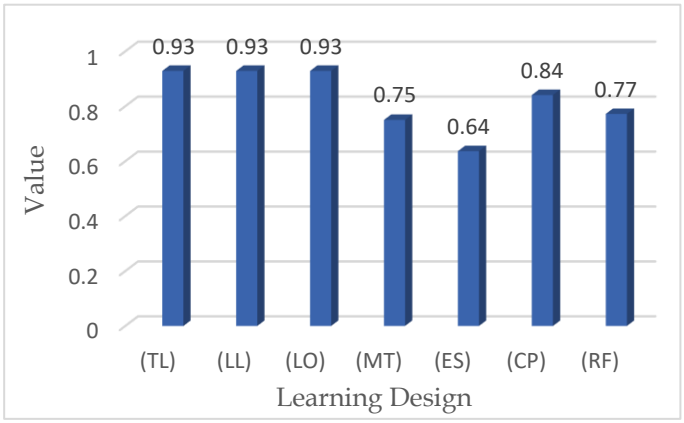

Figure 3. Learning Design Validation Results

From the data in Figure 3, the validation results for the project-based e-learning module to facilitate creative thinking skills fall into the "very valid" category, with an average score of 0.83. There are two assessment categories for each indicator: very valid and valid. The title (TL), learning outcomes and learning objectives (LO), learning objectives (LO), compiler (CP), and references (RF) indicators were in the very valid category, while the materials (MT) and exercises or simulations (ES) indicators were in the valid category. Therefore, the project-based electronic learning modules, designed to facilitate creative thinking skills in the learning design component, is considered valid and appropriate for current student needs.

The fourth component concerns the utilization of software used to design effective and

interactive electronic modules in learning. The indicators in this component include: interactivity (IT), supporting software (SS), and originality (OR). This indicator is crucial because it ensures the novelty of the developed product. The validation results for the software utilization component are presented in Figure 4.

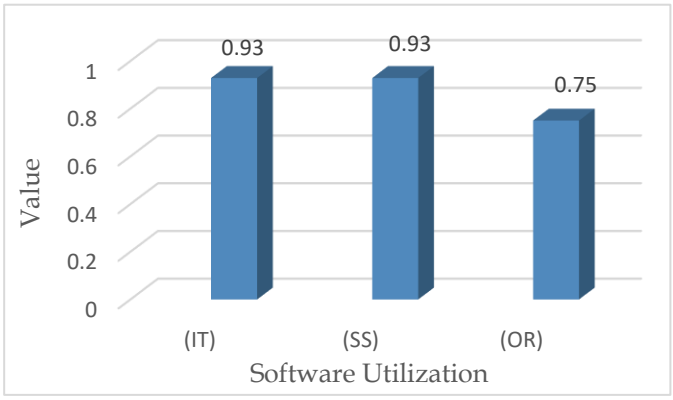

Figure 4. Software Utilization Validation Results

The data in Figure 4 shows that the software utilization component falls into the "very valid" category with an average score of 0.87. Analysis of each indicator yields a score of 0.93 for interactivity (IT), 0.93 for supporting software (SS), and 0.75 for originality (OR). Therefore, the validation results on the software components of the project-based e-learning module, designed to facilitate creative thinking skills in software utilization components such as the heyzine application, are considered valid and appropriate to the needs of today's students.

Furthermore, the fifth component concerns the project-based learning model. Indicators in the project based learning model include: fundamental questions (FQ), creating a project plan (CP), developing a project schedule (DS), monitoring and project progress (PM), testing results (TR), and evaluating results (ER). The validation results for the project based learning components can be seen in Figure 5.

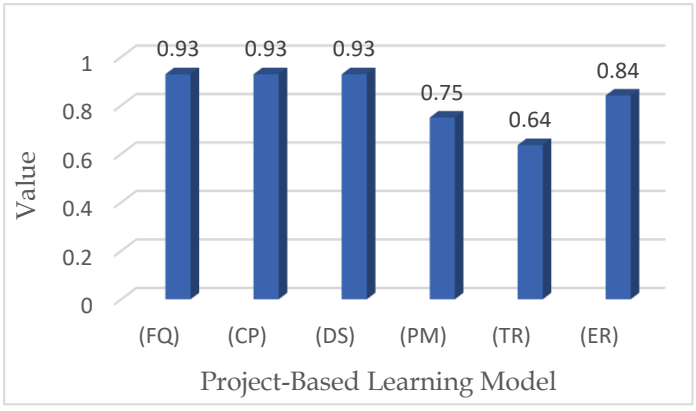

Figure 5. Project-Based Learning Model Validation Results

The data obtained in Figure 5, for the project-based learning component, obtained validation results in the "very valid" category with an average score of 0.84. With scores from each of the indicators on: fundamental questions (FQ) with a score of 0.93, creating a project plan (CP) with a score of 0.93, developing a project schedule (DS) with a score of 0.93, monitoring and project progress (PM) with a score of 0.75, testing results (TR) with a score of 0.64, and evaluating results (ER) with a score of 0.84. Thus, electronic modules based on project-based learning to facilitate creative thinking skills have been declared valid and suitable for use in learning processes.

Finally, the sixth component concerns creative thinking skills. Indicators for this

component include: ability to provide ideas (AI), ability to solve problems (PS), ability to provide answers (AN), and ability to provide detailed answers (DT). Furthermore, the validation results for the creative thinking skills component can be seen in Figure 6.

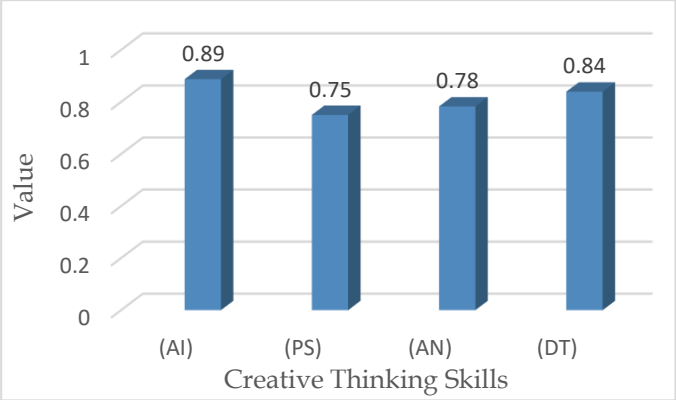

Figure 6. Creative Thinking Skills Validation Results

The data in Figure 6 illustrates that the creative thinking skills component received validation data in the "very valid" category with an average score of 0.81. The validation results for each indicator include: ability to provide ideas (AI) with a score of 0.89, ability to solve problems (PS) with a score of 0.75, ability to provide answers (AN) with a score of 0.78, and ability to provide detailed answers (DT) with a score of 0.84. Therefore, the project-based electronic learning module, which is designed to facilitate creative thinking skills in the creative thinking ability component, is considered valid and appropriate to the needs of today's students.

Discussion

The material's substance component achieved a very valid validation result with an average score of 0.88. These results indicate that the depth and delivery of concepts are effective and aligned with students' daily lives in physics learning. This aligns with previous research by Suryawati & Osman, (2018); Paudi & Ngaito, (2026), on the importance of learning that is directly related to students' daily lives. Furthermore, the validation results for the visual communication display and learning design components were 0.93 and 0.83, these results indicate that fun, effective and interactive learning will make students more active in learning, so that the desired learning objectives are achieved (Sumarmi et al., 2021; Yasni et al., 2025). The software utilization component obtained a validation score of 0.88, indicating that heyzine provides ease of access and use in learning and is appropriate for current student characteristics. This is in line with findings by Pratiwi et al., (2023); Yuliana et al., (2023), that appropriate software utilization can improve learning effectiveness.

Furthermore, the components of the project-based learning model and creative thinking skills each obtained an average validation result with a score of 0.84 and 0.81 in the very valid category, this data shows that the project-based learning model can improve students' creative thinking skills. This finding supports the previous one by Sukaesih et al., (2022); Siringoringo et al., (2023), Project based learning is a learning model in which students face real life problems and are asked to generate ideas and solutions, the project based learning model can also be applied in an effort to improve students' creative thinking skills. Furthermore, project-based learning does not make students only depend on the teacher, but students are presented with a problem that makes students think creatively in solving the problem (Desnita et al., 2022; Putri Naomi et al., 2023).

The findings of this study confirm that the project-based learning electronic module,

designed to facilitate students' creative thinking skills, shows a very valid level of validity. This digital teaching material is very suitable for use in teaching high school physics, especially about climate change, this is also in line with previous research Ula et al., (2023) if the teaching material is valid and has met all the standards and what is needed in today's education, it can increase motivation, creativity, and more conceptual learning. This electronic module has obtained validation value results on the visual communication display component in a very valid category, meaning it is relevant to current technological advances in creating active and more interactive learning. It also shows that based on previous findings by Pratiwi et al., (2023); Yuliana et al., (2023) the use of software such as heyzine has also been shown to increase effectiveness and make the learning process more interactive.

However, this study has several limitations that require further development. These electronic modules were only developed for climate change, specifically for Grade 10, Phase E, in the second semester due to time and cost constraints. This suggests the need for material expansion to broaden the product's coverage. Furthermore, this research phase was also limited to validity, without assessing its practicality and effectiveness. This means that future studies should include direct student trials and teacher assessments to assess the practicality and effectiveness of these electronic modules after use. Furthermore, these electronic modules only facilitate students' creative thinking skills without facilitating other abilities or skills. This suggests the need to develop electronic modules capable of facilitating the other 6Cs to make the product more comprehensive. The learning model used in this electronic module is project-based learning, which also suggests the need to develop other learning models capable of facilitating students' creative thinking skills. This aligns with previous research by Fajri et al., (2025); Yasni et al., (2025) that found that fun learning and Ethno-PBL can facilitate students' creative thinking skills, making learning more effective and conceptual. This should be done with broader trials across various student groups. The researchers also hope that this research will soon continue to the practicality and effectiveness phases, so that these electronic modules can be validated by three expert validators. Thus, project-based learning-based electronic modules designed to facilitate students' creative thinking skills can be considered relevant and suitable for implementation, particularly in high schools, as an alternative, engaging, and interactive learning resource, particularly for climate change.

CONCLUSION

Based on the research objectives explained previously, it can be concluded that the validity of the project-based learning model-based electronic modules to facilitate students' creative thinking skills is valid and meets students' needs in the current learning process. This is evident in the material substance component, with a very valid validity result. The visual communication display component shows a very valid validity result. The learning design component also shows a very valid validity result. Furthermore, the software utilization component is in the very valid category. The project-based learning model component is also in the very valid category. Finally, the creative thinking ability component also received validation results in the very high category. Therefore, the validity results of the project-based learning-based electronic modules to facilitate students' creative thinking abilities obtained an average score of 0.86 for each component, which is categorized as very valid. These results indicate that project-based learning-based electronic modules to facilitate students' creative thinking abilities are considered feasible and can be implemented in schools, so that they can be continued to the practical phase for students.

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