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Sasirangan v'erse: A digital media innovation based on local wisdom for transforming biology education

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Abstract This study presents the development and evaluation of *Sasirangan Verse*, a culturally responsive digital learning tool that integrates local wisdom into biology education. Drawing on the rich cultural heritage of Sasirangan cloth from South Kalimantan, the tool links traditional motifs and natural dyes with core biological concepts, such as biodiversity, morphology, and classification. This integration aims to foster scientific understanding while cultivating students' appreciation for local culture. The development process followed the ADDIE model (Analyze, Design, Develop, Implement, Evaluate), ensuring a systematic and iterative approach to content creation and refinement. Validation was conducted through expert assessments involving biologists, media designers, and linguists, alongside Likert-scale questionnaires distributed to 50 biology teachers and 100 senior high school students. The tool achieved high validity across content, language, and instructional design, with Content Validity Index (CVI) scores of ≥ 0.90 and Item Objective Congruence (IOC) scores exceeding 0.80. Practicality tests revealed positive reception from both teachers and students, with inclusive usability across gender, age, and academic backgrounds. The effectiveness of *Sasirangan Verse* was measured through pretest and posttest assessments, which showed a significant increase in students' cognitive learning outcomes—from an average pretest score of 41.27 to a posttest score of 68.96. The resulting Cohen's d value of 3.45 indicates a very large effect size, demonstrating the tool's substantial educational impact. Beyond improving academic achievement, *Sasirangan Verse* enhanced student engagement, scientific literacy, and cultural identity through its interactive and contextually meaningful design. The results underscore the transformative potential of integrating digital technologies with indigenous knowledge in science education. Future research should explore expanding the tool's accessibility and incorporating advanced features such as augmented reality to further enrich the learning experience and ensure scalability across diverse educational settings.

Keywords: sasirangan verse, digital media, local wisdom, biology education

1. Introduction

Local wisdom, encompassing traditional knowledge developed from environmental experiences and conditions, is increasingly important in education because of its ability to create a contextual and inclusive understanding of science. Unlike scientific methodologies, the integration of the two can enrich the understanding of environmental issues and increase student participation in learning (Baptista & El-Hani, 2009; Fackler, 2021; Ferguson, 2022; Irzik & Nola, 2007; King & Achiam, 2017; Thiele et al., 2016; Wilson, 2018). Research shows that incorporating elements of local culture can foster environmental awareness and build students' character (Asrial et al., 2021; Citra et al., 2023; Fernando & Yusnan, 2022; Hidayat & Yatminiwati, 2023; Uge et al., 2019; Widana et al., 2023).

Through the motives of Sasirangan, students can learn much about plant morphology, especially that of typical plants in Kalimantan. The motifs not only depict the beauty of the culture but also serve as a medium to introduce students to the biodiversity of the region. The natural dyes used in Sasirangan, which are obtained from various parts of the plant's body, provide a deeper understanding of the relationship between humans and nature. Therefore, Sasirangan is important in the context of local education as one of the superior cultural products that must be maintained. It is hoped that by utilizing Sasirangan in learning, students will be more concerned about the preservation of local culture and their natural diversity.

Indonesia, with its diverse cultural richness, has great potential to integrate local wisdom in education, one of which is through Sasirangan cloth in South Kalimantan. This fabric has high cultural value, but its use in education, especially in connecting its motifs with biology, is still limited. The lack of Sasirangan-based digital learning resources hinders students' understanding of science and preservation of local culture.

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In the digital age, learning technologies such as mobile apps and augmented reality can improve the understanding of biology (Arbuzova et al., 2023; Gould et al., 2019; Metcalf et al., 2023), but they are rarely used to connect science education with cultural literacy. Sasirangan-based learning media can provide dual benefits, enhance scientific understanding and strengthen students' connection with their culture.

Although research on education based on local wisdom has developed (Fernando & Yusnan, 2022; Hidayati et al., 2020; Sudjarwo et al., 2018), the potential of the Sasirangan fabric as a digital learning medium has not been widely explored. The information gap regarding the symbolism of the motive and its relevance to biology limits its educational potential. Sasirangan Verse, as a digital medium, connects Sasirangan motifs with biological concepts, providing a meaningful learning experience that enhances students' cognitive skills and cultural awareness. This approach is in line with global trends emphasizing culture-based pedagogy and digital innovation(Amirseit et al., 2024; Bonorden & Papenbrock, 2022; Koreneva et al., 2023; Labak & Blazetic, 2023; Nebres, 2024).

This research focuses on validating and evaluating the effectiveness of *Sasirangan Verse* as a digital learning tool, with the aim of measuring its validity, practicality in the classroom, and impact on students' cognitive understanding. Its contribution is important in integrating local cultural wisdom with modern learning and supporting cultural preservation. Therefore, this study aims to (1) develop a digital learning tool that integrates Sasirangan motifs with biology concepts; (2) validate its content, language, and instructional design through expert review; (3) evaluate its practicality among teachers and students; and (4) examine its effectiveness in improving students' cognitive learning outcomes. Contribution to the literature: This research integrates Sasirangan local wisdom in biology learning, creating an inclusive and contextual education. Sasirangan Verse increases student engagement and science literacy and strengthens their cultural identity.

2. Materials and methods

This research uses the research and development (R&D) method with the ADDIE (Analyze, Design, Develop, Implement, Evaluate) model to design Sasirangan versus digital learning media. This model was chosen because it is systematic, adaptive, and in accordance with local cultural values (Dakhi et al., 2023). The ADDIE model consists of five main stages (Branch, 2009) that have been applied in the development of teaching materials (Drljača et al., 2017) and electronic content that is proven to be valid (Muruganantham, 2015). The iterative process allows for continuous evaluation to improve the quality of learning (Turnbull et al., 2023) and integrate local culture (Maryati et al., 2023). By utilizing Sasirangan motifs in biology learning, this model connects culture with pedagogical standards in education (Arbuzova et al., 2023; Bonorden & Papenbrock, 2022; Nebres, 2024). The flexibility and credibility of this model have been widely recognized (Dhana et al., 2024; Warmi et al., 2024).

2.1. Research Design

This research aims to integrate the Sasirangan fabric as a representation of local wisdom in digital learning media that support biology learning. The focus of this research is to connect Sasirangan motifs with biological concepts, such as biodiversity, morphology, and classification. The ADDIE model provides a structured approach for developing learning media that is not only effective in an academic context but also rich in cultural elements. This design aims to create a more holistic learning experience by linking Sasirangan cultural values with the biological context.

2.2. Development process

The first stage in development is analysis, which aims to identify the needs of students and teachers in learning, especially the limitations of media that connect local wisdom with scientific concepts. This analysis was carried out on the basis of previous studies that highlighted the importance of local wisdom to improve the quality of education (Ferguson, 2022; King & Achiam, 2017). This analysis revealed that there was a gap in the integration of Sasirangan motifs with biology learning, as well as a lack of interactive digital media that was relevant to culture (Ramdiah et al., 2024).

At the design stage, Sasirangan motifs are combined with biological concepts to produce interesting and educational content. The visual design focuses on the relationship between the Sasirangan motif and its biological classification, whereas the app's interface is designed to be user friendly and interactive. Research on educational technology also contributes to the development of this design so that the resulting platform is pedagogically effective and able to increase students' interest in learning (Gould et al., 2019; Koreneva et al., 2023).

In the development stage, the Sasirangan Verse prototype was developed by involving biologists, media designers, and linguists. This collaboration between fields aims to ensure the quality of media and its conformity with educational standards. The development of this media went through a rigorous validation process involving nine experts, including three biologists, three media design experts, and three linguists. These experts evaluate scientific accuracy, curriculum suitability, and design that supports learning objectives. Validation is carried out via the Likert scale to ensure a quantitatively robust evaluation (Fackler, 2021; Thiele et al., 2016). The content developed is based on previous research that examines the relationships among motifs, classifications, natural dyes, and the relationships of local flora and fauna with biological principles (Ramdiah et al.,

2024). This approach offers innovation in integrating local culture with science education (Metcalf et al., 2023; Usmeldi & Amini, 2019).

2.3. Implementation

Sasirangan Verse was piloted on a limited scale in South Kalimantan, involving students and teachers. Teachers act as facilitators who introduce the Sasirangan Verse in classroom activities, whereas students interact with the platform to explore the relationships between Sasirangan motifs and biological concepts. This implementation aims to evaluate the effectiveness of media in supporting the learning process, increasing student engagement, and strengthening students' understanding of scientific and cultural materials (Arbuzova et al., 2023; Wilson, 2018).

2.4. Evaluation

The evaluation of the ADDIE model aims to maintain regularity and ensure the efficiency of the development process with quality results. Evaluations are carried out at each stage to ensure smoothness and continuity. At the analysis stage, the evaluation includes a curriculum that contains material on biodiversity, morphology, and classification of living things, as well as the availability of digital-based learning resources and students' conservation attitudes (Ramdiah et al., 2024). At the design stage, the evaluation includes the integration of Sasirangan motifs in Sasirangan Verse, including motifs, natural dyes, morphology, and classification. The development stage involves evaluating media suitability on the basis of expert assessment, student response, and teacher response. At the implementation stage, the evaluation measures the validity, practicality, and effectiveness of the application of Sasirangan Verse in biology learning. The overall evaluation serves to assess the feasibility of Sasirangan Verse on the basis of its validity (expert assessment), practicality (student and teacher responses), and effectiveness (effect size (Eta Squared)).

2.5. Participant

The study involved a wide range of participants, including experts, students, and teachers. Three subject matter experts (biologists, educational practitioners, and cultural experts), three media design experts, and three linguists were involved in the validation of the Sasirangan Verse design. Fifty biology teachers from the Banjarmasin Teacher Commitee (MGMP) gave responses regarding the practicality of this media in the trial. A teacher is responsible for the implementation of the product in a pilot study, teaching biodiversity material via Sasirangan Verse. The other participants were 100 students from State Senior High School (SMAN) 1 Banjarbaru, who gave feedback regarding the practicality and effectiveness of this media. The following is the age distribution of the students: 14 years = 3 (3%), 15 years = 84 (84%), and 16 years = 13 (13%). There were 34 males (34%) and 66 females (66%). Furthermore, with respect to the favorite subject, the percentage of science students was 39%, and the percentage of social studies was 61%.

2.6. Instruments and Data Collection

The research instruments include Sasirangan Verse, guidebooks, motif cards, and validation assessment sheets for material, media, and language experts. Practice test questionnaires for teachers (23 items) and students (21 items), LKS-integrated teaching modules, and test questions for effectiveness tests were used to collect data related to accessibility, ease of use, and relevance of content to biological materials. Effectiveness testing was carried out with a pretest and posttest to evaluate the development of cognitive learning outcomes in 100 students of SMAN 1 Banjarbaru after using Sasirangan Verse.

2.7. Data analysis

Data collected during validation, practicality tests, and effectiveness tests were analyzed to assess the quality and impact of Sasirangan Verse. Descriptive statistics are used to interpret feedback from teachers and students. Effectiveness tests via pretest and posttest were analyzed with one-way ANOVA to measure the significance of cognitive improvement, with a significance level of $p < 0.05$. Effect size (Eta Squared) is used to measure the impact of learning, where a high score indicates substantial educational benefits (Arbuzova et al., 2023; Gould et al., 2019; Labak & Blazetic, 2023; Permatasari et al., 2021).

3. Results

The implementation and evaluation of Sasirangan Verse were carried out through a series of validation, practicality, and effectiveness tests. This evaluation assesses the feasibility of the tool as a digital learning medium that integrates cultural heritage with biology education. The results of the evaluation revealed important findings related to their validity, practicality, and impact on cognitive learning outcomes.

3.1. Validation

The results of the validation of the learning media products are shown in Table 1.

Table 1 Results of the Validation of Sasirangan Verse.

No	Description	CVI	IOC	Cut of value
1	The results of validation of Sasirangan verse by media experts: Aspects of feasibility as learning media Practical aspects Media aspects	0.9	0.81	CVI = ≥0.9 (Valid) IOC = ≥0.8 (Valid)
2	Language expert validation results: Language clarity and simplicity Cultural and contextual appropriateness Language proficiency alignment Scientific accuracy	1.0	1.0	
3	Validation results on teaching modules: Aspects of suitability with the teaching module Aspects of support for learning objectives Material aspects Aspects of caring for local wisdom	0.95	0.95	

The validation results revealed that the teaching materials had excellent validity, with high content validity index (CVI) and item objective congruence (IOC) values. In terms of the media aspect, which includes feasibility, practicality, and media elements, the CVI value of 0.90 and IOC of 0.81 indicate that these learning media are effective and relevant, although there is still room for improvement. Language validation revealed perfect results, with CVI and IOC values of 1.0 each, indicating that clarity, simplicity, cultural appropriateness, and scientific accuracy were met without revision. Teaching modules that include curriculum conformity, learning objectives, and strengthening local wisdom obtained CVI and IOC scores of 0.95, which is highly relevant for supporting learning and local cultural integration. Overall, this teaching material provides a solid foundation for application in learning, improving students' understanding of the local cultural context, especially Sasirangan.

The Sasirangan Verse validation shows a high level of validity in the content, language, and teaching modules. This validation process confirms that Sasirangan Verse is effective as a learning medium despite the opportunity for improvement in its practicality. These findings are in line with previous research that emphasized the importance of the relevance of learning media in determining its success (Iryani et al., 2023; Kamilah et al., 2023; Lumowa & Kurniawati, 2020). Sasirangan's universal design supports the active participation of all parties, as evidenced by impeccable language validation results, encompassing clarity, simplicity, cultural relevance, and scientific compatibility. In conclusion, Sasirangan Verse is effective as a tool for teaching biology and preserving local culture. The use of engaging and interactive media has the potential to increase student motivation and create an inclusive learning environment (Fadhilah et al., 2023; Herlinda et al., 2020; Rahmat et al., 2019; Turchyn et al., 2023).

With strong validation, Sasirangan Verse has the potential to become a culture-based digital learning model, making a significant contribution to the development of more adaptive and contextual local education. This medium, which integrates local wisdom, provides culturally relevant educational experiences and enhances students' appreciation of cultural heritage, creating meaningful learning. According to Yeni & Dilfa (2022), culture-based media can increase motivation and enrich students' learning experience. Moreover, Mishra et al. (2020) stated that integrating local cultural and contextual elements in learning materials makes content more relevant and engaging and increases inclusivity. The results of this media development can be seen in Figure 1.

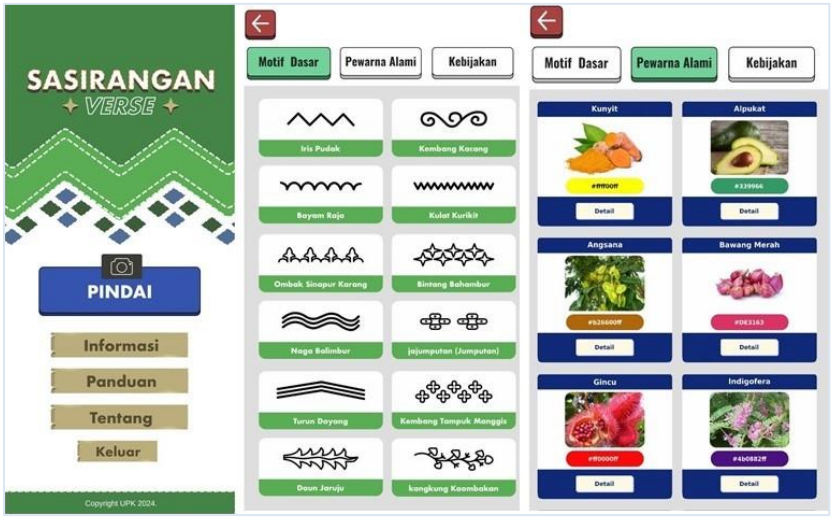

Figure 1 Sasirangan versus digital media display.

3.2. Practicality test

The practical test of the learning model involved teachers and students as respondents. The assessment for teachers uses a rubric consisting of 23 items, whereas the assessment for students uses a rubric with 21 items. Data analysis was conducted to assess the difference in scores based on gender and age group for teachers, as well as gender and majors (science and social studies) for students. The purpose of this analysis was to evaluate how the learning model is applied by users with different backgrounds, providing an overview of the model's flexibility and usefulness in a variety of contexts. The results of the practicality test for teachers are shown in Figure 2.

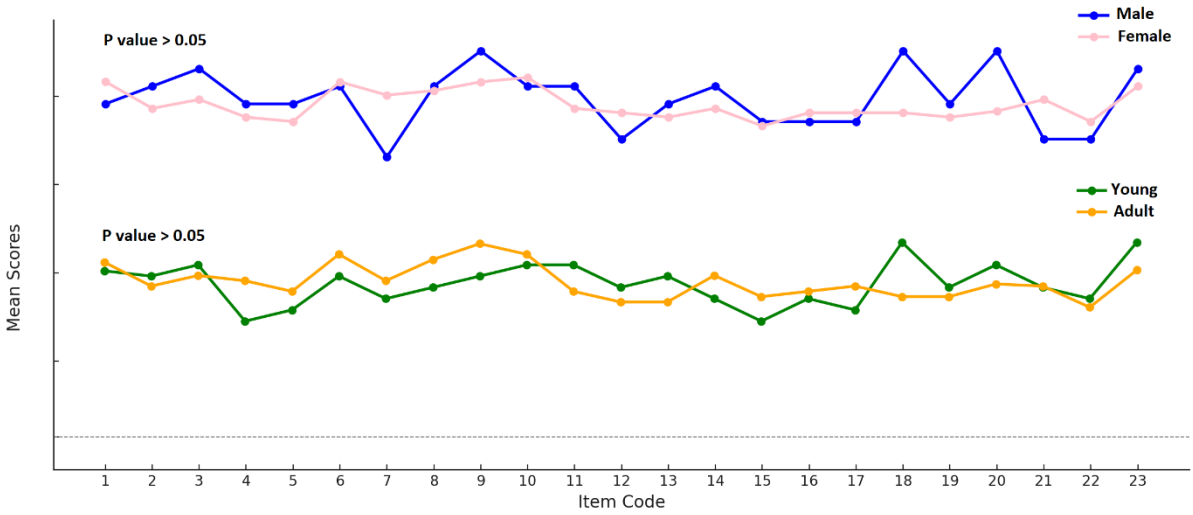

Figure 2 Model practicality test results for teachers.

The results of the analysis shown in Figure 2 reveal no significant differences between men and women in their responses to all statements. Although there was variation in the average response between men and women on some items, the t test revealed that the difference was not statistically significant ($p > 0.05$). This suggests that male and female perceptions of this model tend to be uniform, without gender bias. Therefore, this model is equally acceptable for both genders, ensuring its relevance in the context of gender diversity. In addition, there was no significant difference between the young (young) and adult (adult) age groups in their responses to the given statements ($p > 0.05$), suggesting that both groups had similar perceptions of this model. These findings indicate that this model is well accepted by both age groups in the absence of significant bias. A practicality test was also carried out on the students, the results of which are shown in Figure 3.

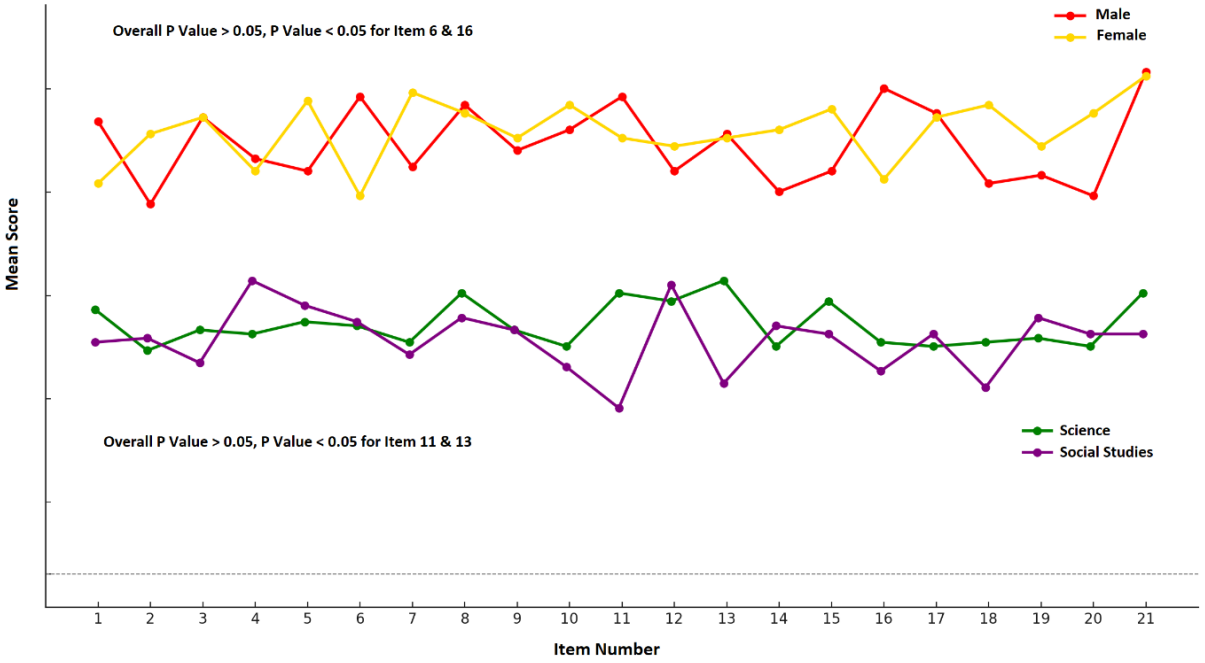

Figure 3 Practicality test results for students.

Figure 3 shows that the developed model is well received by various groups on the basis of gender and academic major. For male and female students, most of the items showed no significant differences, which suggests that the perceptions of these models are similar, allowing for their inclusive use without gender bias. However, two items (Item 6 and Item 16) showed significant differences, with male students feeling more motivated to be actively involved in learning and better understanding the morphology of the objects represented by Sasirangan motifs. Similar findings were also observed in students from science and social studies majors, where the majority of the items had similar perceptions. Nonetheless, Item 11 and Item 13 differ significantly, with science students giving higher ratings to elements of local wisdom, scientific classification, and involvement in biological projects. These differences provide insights for model development, especially in increasing the involvement of female students and social studies groups. Overall, the model remains relevant, inclusive, and flexible, which validates its success in supporting learning, which includes gender diversity and diverse academic backgrounds.

3.3. Effectiveness Test

The model is applied in the classroom to assess the effectiveness of the developed learning model, with success indicators measured through pretest and posttest. This test aims to evaluate the impact of the model on student learning outcomes. Learning outcome data were analyzed via descriptive analysis to determine the distribution, shift, and increase in student scores from pretest to posttest, as presented in Figure 4.

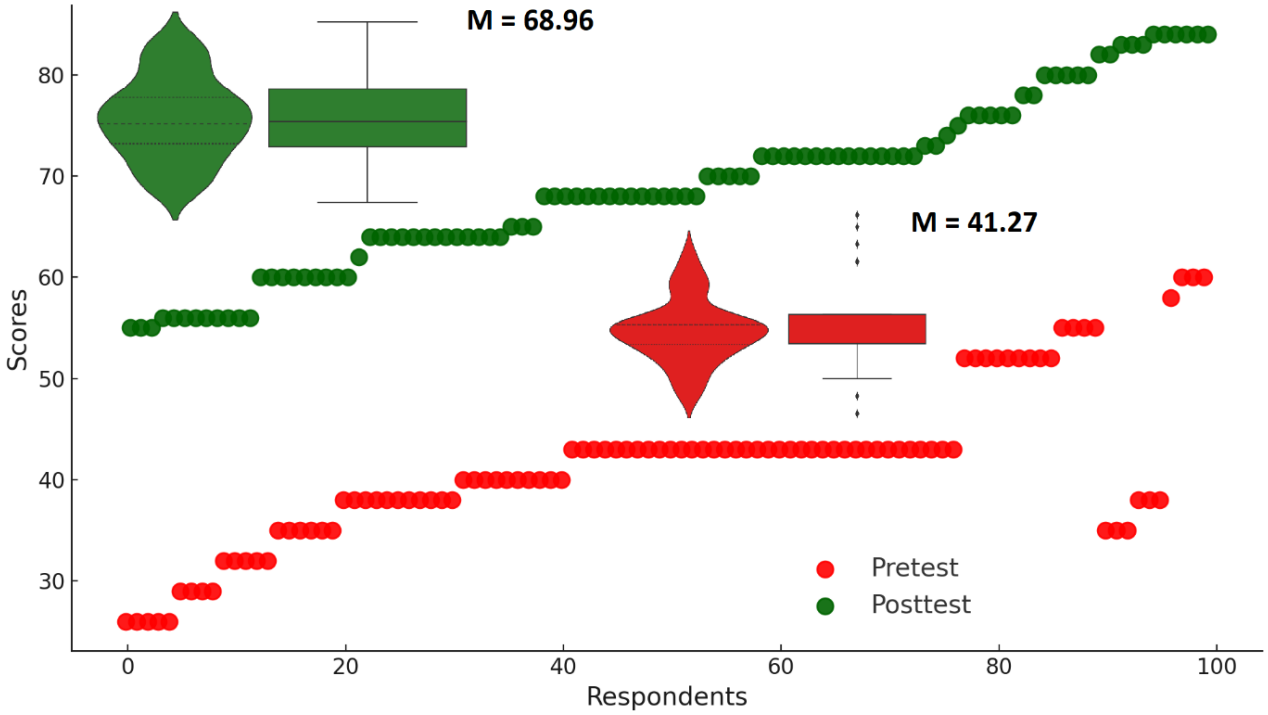

Figure 4 Descriptive Analysis of Student Learning Outcomes.

Figure 4 shows a significant improvement in learning outcome scores after the intervention, which is illustrated through three visualizations: a dot plot, a violin plot, and a box plot. In the dot plots, the posttest scores are consistently higher than the pretest scores are, with a wider spread indicating improvement variations. The violin plot shows a wider distribution on the posttest, with a higher median, signifying an improvement in overall student performance. The box plot reinforces these findings, showing significant shifts in the upper, median, and lower quartiles between the pretest and posttest, reflecting significant improvements in the student group. The average pretest score increased from 41.27 to 68.96 on the posttest, confirming the positive impact of the intervention on learning outcomes. The results of further analysis confirmed that this treatment was effective in improving student learning outcomes, which was supported by the one-way ANOVA test and Cohen's d value used to measure the magnitude of the effects of the treatment. The results of the statistical test can be seen in Table 2.

Table 2 Results of one-way ANOVA.

	Sum of Squares	Df	Mean Square	F	Sig.	Cohen's d
Between Groups	38336.805	1	38336.805	595.64	0.000	3.45
Within Groups	12743.55	198	64.3614			
Total	51080.355	199				

The one-way ANOVA results presented in Table 2 revealed significant differences between the pretest and posttest groups ($p < 0.001$). The effect of the intervention on further improvement in learning outcomes was supported by Cohen's d value of 3.45, which was significant on the basis of the interpretation of standard effect measures. Thus, these findings suggest that the intervention significantly improved student learning outcomes and that the differences between the pretest and posttest groups have a substantial practical impact. These data reflect the strong effectiveness of the treatment in the student group.

4. Discussion

Figure 2 shows significant differences in teacher responses by gender and age, which may be influenced by several factors. The design of this learning model focuses on inclusivity and adaptability, allowing for good acceptance by teachers from diverse backgrounds. This shows that the product is well designed to meet the needs of educators, resulting in a uniform response. These findings are in line with research by Ahmed & Hina Hussain Kazmi (2020), Black et al. (2016), Danyaro et al. (2024), Parvin et al. (2024), and Sartinah & Murtadlo (2021), which suggests that teachers with uniform knowledge and skills regarding the application of the model tend to have aligned perceptions, reducing differences by gender or age.

The results of the practicality test revealed that Sasirangan Verse was well received by both men and women, although male students showed a higher level of involvement in active learning. This is supported by previous research showing that boys often prefer project-based learning that involves hands-on experience (Amatullah & Komariah, 2021; Lone et al., 2018). Social and cultural factors can also influence male students to adopt more competitive learning behaviors so that they are superior in understanding complex material such as biological morphology (Varatharajoo et al., 2014). Nisa et al. (2020), which also explains why male students are more proficient in understanding certain concepts.

This research also revealed that students majoring in science give higher assessments of elements of local wisdom and science-based projects. This is due to the increased relevance of scientific concepts that are connected to the cultural background and experiences of students. Hadisaputra et al. (2020), Muhammad et al. (2019), and Quy et al. (2022) state that the integration of scientific knowledge with local wisdom can increase appreciation of local science and traditions. Local wisdom often includes ecological knowledge that is important in understanding biodiversity and conservation. Science students who interact with local wisdom can develop a more holistic understanding of ecosystems and the importance of preserving cultural heritage along with scientific progress (Hien & Nhan, 2022). Integrating local wisdom in the curriculum aims to make learning more relevant and acceptable to all students, as well as bridging the gap between academic disciplines (Asaad et al., 2022; Shofiyah et al., 2019).

Integrating the Sasirangan Verse application in biology education significantly improved students' learning outcomes and academic performance (Table 2). This increase can be explained by factors such as greater student engagement, learning experiences that fit learning styles, and access to resources that enrich the material through a variety of information and media. Digital apps increase student engagement by providing an interactive and immersive learning experience (Serpagli & Mensah, 2021; Situmorang et al., 2024; Stymne, 2020). Digital tools also allow for a personalized learning experience, according to the needs of each student. Access to a wide range of digital resources encourages research and self-paced learning skills, which are essential in modern education (Sumatokhin et al., 2020; Wang et al., 2024). Nair & Yunus (2022) added that integrating digital and multimedia tools can improve the understanding and retention of complex biological concepts, making them more accessible to all students, regardless of their socioeconomic background. Research by Aumann et al. (2024) and Owen (2023) shows that teachers who are skilled in technology-based pedagogy tend to be more effective in using digital tools, which in turn improves the quality of teaching and student learning outcomes.

The integration of local wisdom with digital learning applications has a positive effect on students' understanding of biological concepts. This approach enriches the educational experience and contextualizes learning, making it more relevant and engaging for students. Susanti et al. (2022) This finding shows that the integration of local wisdom into digital learning platforms can strengthen students' relationships with materials, improving their understanding. According to Susanti et al. (2022) and Akhyar et al. (2021), digital biology education that contextualizes biological concepts within the framework of local wisdom makes students more likely to understand and internalize the information presented. These findings are supported by Arbuzova et al. (2023), who highlighted the effectiveness of augmented reality (AR) in biology teaching. These technologies create a motivating learning environment that is aligned with students' experiences and cultural backgrounds, which helps preserve biological concepts and encourages exploration of the surrounding environment, building a sense of responsibility and relevance to their studies.

One of the main ways in which digital apps increase student engagement is by integrating local cultural knowledge into the curriculum. Research shows that the relevance of learning materials to students' lives and cultures can significantly increase their motivation and engagement. For example, mobile augmented reality (MAR) applications in biology education have had a positive effect on student attitudes, providing immersive experiences that are relevant to the local context. This technology not only interests students but also helps them visualize complex biological processes, improving their understanding (Çakır et al., 2020). In addition, with increasing digital skills, students become better equipped to interact with complex biology content

and collaborate effectively (Amin et al., 2023). Mehrvarz et al. (2021) also state that it improves student understanding and retention.

On the basis of the above discussion, Sasirangan Verse plays an important role in increasing students' mastery of biological content, especially biodiversity. By providing an interactive, personalized, and immersive learning experience, Sasirangan Verse encourages greater engagement and a better understanding of complex biological concepts.

The results of the study show that Sasirangan Verse is a valid, practical, and effective digital learning tool. Its cultural integration and interactive design can engage students as well as enhance their understanding of biological concepts. These findings highlight the potential of combining cultural heritage with modern digital tools to create meaningful educational experiences. Sasirangan Verse's development should address technical accessibility issues and explore advanced features such as AR to further improve student engagement and cognitive outcomes.

5. Conclusions

The results of media development show that this product has high validity in content, language, and learning modules. The effectiveness test revealed a significant improvement in student learning outcomes, with the average posttest score increasing from 41.27 to 68.96 and the effect measure (Cohen's d) of 3.45, indicating a significant educational impact. Teachers and students rated the medium as practical, with an inclusive design that was relevant to different user groups without gender or age bias. The integration of Sasirangan motifs with biological concepts, such as biodiversity and morphology, through interactive digital platforms enhances scientific understanding and strengthens appreciation for local culture. This research highlights the potential of combining digital technology with local wisdom as an innovative strategy to create meaningful and contextual learning experiences.

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Ethical considerations

This is mandatory because it involves the application of a questionnaire in the methodology

Conflict of interest

The authors declare that they have no conflicts of interest that could influence or influence the research and its outcomes.

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