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Needs Analysis of Interactive Learning Media Based on Local Biodiversity for Senior High School Science Education in the Kei Islands, Southeast Maluku

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Abstract
Science learning resources that authentically represent local biodiversity remain limited in senior high schools, particularly in the Kei Islands of Southeast Maluku, Indonesia. This study identified students' and teachers' perceived needs for developing interactive learning media based on local biodiversity for senior high school science education. A descriptive survey was conducted with 23 students from one senior high school and 12 biology and science teachers from several senior high schools in the Kei Islands, recruited using purposive sampling. Data were collected using separate 23-item Likert-scale questionnaires with open-ended questions. Two science education experts reviewed the questionnaires, and content validity was assessed using Aiken's V, while internal consistency was examined using Cronbach's alpha for each dimension. The results showed a high overall level of need among students (M = 4.03) and a very high level among teachers (M = 4.23). The need for interactive learning media was rated very highly by students (M = 4.24) and teachers (M = 4.30). Open-ended responses highlighted participants' interest in locally relevant biodiversity content and visual, interactive, contextual, and experiential features. Leatherback turtles (Tabob/penyu belimbing) were mentioned by 3 of 23 students (13.0%) and 2 of 12 teachers (16.7%). These findings provide preliminary, context-specific evidence to guide the design of local-biodiversity-based interactive learning media. However, the study is limited by its small purposive sample, regional context, and reliance on self-reported data, and it does not include prototype validation, practicality testing, or effectiveness testing.

Keywords: Interactive Learning Media; Local Biodiversity; Needs Analysis; Science Education

INTRODUCTION

Science education plays a fundamental role in developing students' scientific literacy, critical thinking, environmental awareness, and problem-solving abilities. However, a persistent challenge in senior high school science learning is the disconnect between abstract classroom concepts and students' immediate natural environments (Turiman et al., 2012; Holbrook & Rannikmae, 2009). This disconnect is especially evident in biology-related topics such as biodiversity, ecosystems, conservation, and environmental sustainability, for which contextual experiences are essential to meaningful understanding (Bybee, 2010). Students may learn biodiversity concepts theoretically without adequate exposure to the rich biological resources in their local communities, potentially limiting environmental awareness and appreciation of biodiversity conservation.

Indonesia is internationally recognized as one of the world's megabiodiverse countries, and is reported to contain substantial proportions of the world's flowering plants (approximately 10%), mammals (12%), and bird species (17%) (Retnowati et al., 2019; Atmoko & Gunawan, 2023). This biodiversity represents a valuable educational resource that can support contextual science learning. Nevertheless, local biodiversity remains insufficiently integrated into science learning in many Indonesian schools. Learning materials frequently emphasize

generalized or global examples rather than species, ecosystems, and environmental issues found in students' local surroundings. Consequently, students may have limited opportunities to recognize the ecological importance of their surroundings and the need for local biodiversity conservation (Margules & Pressey, 2000; Tilman et al., 2014).

Recent international research also emphasizes the importance of local perspectives on biodiversity in environmental education and sustainable development. Dawson et al. (2024) showed that more equitable conservation governance, including meaningful partnerships and greater decision-making authority for Indigenous peoples and local communities, is associated with more favorable ecological outcomes. Similarly, Butler et al. (2025) demonstrated that local communities value biodiversity conservation when it directly relates to their environment, accessibility to nature, and cultural preferences. These findings suggest that local ecological contexts strongly influence environmental awareness and public engagement, with potential implications for students.

Local biodiversity is also relevant in educational and institutional contexts. Schlecht et al. (2026) explained that biodiversity monitoring at local scales provides actionable and meaningful ecological information that can support sustainability education and awareness. Furthermore, Wang et al. (2022) found that traditional beliefs and local culture significantly contribute to biodiversity protection and environmental stewardship. Together, these findings suggest that local ecological knowledge and cultural perspectives are important considerations when designing biodiversity learning media.

In addition, environmental challenges such as habitat degradation, urbanization, agricultural expansion, and climate change increasingly threaten biodiversity at both global and local levels. Research by Ranalli et al. (2025) and Huttunen et al. (2024) demonstrated that landscape management and local ecological practices significantly affect biodiversity conservation outcomes, including pollinator diversity and the sustainability of aquatic ecosystems. Likewise, Issac and Newell (2025) emphasized that community-based approaches and local environmental understanding are essential for developing sustainable ecological systems. These studies highlight the value of educational approaches that connect students with local environmental realities and biodiversity conservation practices.

Integrating technology into science learning offers promising opportunities to address these challenges. Interactive multimedia can support students' motivation, engagement, conceptual understanding, and retention in science education (Mayer, 2009). Technological innovations such as interactive applications, augmented reality (AR), virtual simulations, digital species identification tools, and multimedia learning platforms enable students to visualize abstract concepts and interact directly with contextual biodiversity content (Garg et al., 2025). Moreover, ecoacoustic technologies and biodiversity monitoring approaches, as discussed by Botero-Cañola et al. (2024), demonstrate how digital tools can support biodiversity observation and environmental learning in innovative and engaging ways.

Previous studies have explored the use of local biodiversity and ecological contexts in science and biology education. Trautmann and Gilmore (2018) discussed the importance of education that responds to ecological and sustainability challenges. Similarly, Balgopal and Wallace (2010) examined writing-to-learn activities as a means of supporting ecological literacy. These studies suggest the educational value of integrating local biodiversity into science learning. However, much of the cited literature has focused on local ecological contexts to improve students' attitudes, engagement, and conservation awareness, while paying limited attention to developing interactive learning media that specifically integrate local biodiversity into senior high school biology education. In the Indonesian context, this gap is particularly evident in biodiversity learning materials that represent the unique biodiversity of the Kei Islands. Existing studies on biodiversity in the region have largely addressed conservation, environmental management, or ecological aspects rather than designing interactive educational media based on local biodiversity and students' learning needs. Therefore, there is a need to

examine the learning needs that should inform the development of interactive, locally contextualized biodiversity media based on the biodiversity of the Kei Islands for senior high school biology students. This study addresses this gap by identifying students' and teachers' needs to inform the development of interactive biodiversity learning media that connect biological concepts with the local biodiversity of the Kei Islands.

Needs analysis is a crucial phase in instructional design because it identifies the gap between current learning conditions and desired educational outcomes (Dick et al., 2015). Through systematic needs analysis, researchers can identify students' learning difficulties, teachers' instructional challenges, curriculum demands, technological readiness, and user expectations regarding educational media. This process ensures that the resulting media product is relevant, contextually appropriate, and capable of addressing authentic classroom problems. Without proper needs analysis, educational media development risks producing products that do not adequately support meaningful learning or align with students' contextual realities.

Considering the importance of contextual biodiversity learning, technological integration, and environmental awareness, there is a rationale for developing interactive science learning media that integrate local biodiversity content for senior high school students. Such media could connect scientific concepts with students' everyday environments, promote active learning, strengthen environmental literacy, and foster awareness of biodiversity conservation. Therefore, this study aims to conduct a context-specific needs analysis as a preliminary empirical foundation for developing local biodiversity-based interactive media for senior high school science learning. Specifically, this study seeks to answer the following research questions:

1. What are the current perceptions of teachers and students regarding the availability and integration of local biodiversity in senior high school science learning media?
2. What are the perceptions of teachers and students regarding the importance and need for local biodiversity-based interactive learning media?
3. What specific content, features, and design characteristics are needed for the development of local biodiversity-based interactive learning media?

The findings may contribute to research on contextual science learning and biodiversity education. In practice, the results may provide a foundational framework for educators, researchers, and instructional media developers to design innovative, interactive, and environmentally relevant learning media that support science education and biodiversity conservation efforts in Indonesia.

METHODS

Participants, Research Instruments, and Data Analysis

This study employed a descriptive survey design to identify students' and teachers' needs for developing interactive media based on local biodiversity in senior high school science learning. This design was selected because it provides a systematic description of current learning conditions, media usage, and users' needs regarding the instructional media to be developed (Creswell & Creswell, 2018).

The study was conducted during the 2025/2026 academic year at a senior high school in the Kei Islands, Southeast Maluku, Indonesia. Participants included 23 senior high school students from the selected school and 12 biology and science teachers from several senior high schools in the Kei Islands. The student participants were selected using purposive sampling based on the following inclusion criteria: (1) being actively enrolled at the school where the study was conducted, (2) having previously studied biodiversity and environmental topics, and (3) voluntarily agreeing to participate in the study. The teacher participants were also selected purposively based on the following criteria: (1) being an active biology or science teacher at the senior high school level, (2) having at least three years of teaching experience, and (3) having experience teaching topics related to biodiversity or environmental science.

The sample size was determined by the exploratory purpose of obtaining contextual information about students' and teachers' learning needs as a basis for developing interactive learning media based on local biodiversity. Accordingly, the sample was not intended to statistically represent all senior high school students or teachers in Indonesia. Rather, it was intended to provide context-specific insights into learning needs within the selected school and the broader Kei Islands context. Involving teachers from several senior high schools was intended to provide a broader range of perspectives on the conditions, resources, and needs of biology and science learning in the region.

Data were collected using two separate questionnaires, one for students and one for teachers, with each questionnaire consisting of 23 items. The questionnaires were developed based on indicators relevant to developing local-biodiversity-based interactive learning media, including the relevance and adequacy of learning content, the availability and accessibility of learning resources, the integration of local environmental contexts, technology readiness and digital literacy, and expectations regarding media features, appearance, and interactivity. The student questionnaire comprised five dimensions: (1) the need for local biodiversity materials, (2) the need for interactive learning media, (3) the involvement/integration of local biodiversity in learning, (4) technology readiness and digital literacy, and (5) expectations toward the developed media. The teacher questionnaire comprised five dimensions: (1) the need for local biodiversity materials in learning, (2) the need for interactive learning media, (3) the involvement of local biodiversity in teaching practice, (4) infrastructure readiness and institutional support, and (5) expectations toward interactive media specifications.

All questionnaire items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Before administration, two science education experts reviewed the questionnaires. Each validator rated every item for relevance, clarity, and language simplicity on a five-point scale. Content validity was assessed using Aiken's V (Aiken, 1985), calculated at the item level based on the two validators' ratings. Aiken's V was calculated using the formula $V = \Sigma s/[n(c - 1)]$, where $s = r - l_0$, r is the rating assigned by a validator, l_0 is the lowest rating category, n is the number of validators, and c is the number of response categories. We used the validation results to identify items requiring revision. Revisions focused on improving wording clarity, simplifying language, and ensuring each item aligned with its intended dimension. The finalized questionnaires were administered after expert review and revision.

We assessed internal consistency using Cronbach's alpha separately for each dimension of the student and teacher questionnaires. Negatively worded items were reverse-scored before the reliability analysis so higher scores consistently represented greater perceived need, readiness, or expectation. For the five-point response scale, the reverse-scoring transformation was $X_r = 6 - X$; thus, an original score of 1 was recoded as 5, 2 as 4, 3 remained 3, 4 as 2, and 5 as 1. Cronbach's alpha was then calculated for each dimension rather than for the questionnaire as a whole. Because the questionnaires were developed primarily for needs analysis and each dimension contained only four or five items, we interpreted the reliability coefficients cautiously. The relatively small number of teacher participants (n = 12) also influenced how we interpreted the reliability estimates.

The quantitative data were analyzed descriptively using frequencies, percentages, and mean scores. For each dimension, the mean score was calculated by summing the item scores obtained by all respondents within the dimension and dividing the total by the number of respondents and the number of items in that dimension. The resulting mean scores were interpreted using five equal intervals based on the five-point Likert scale: 1.00–1.80 = very low, 1.81–2.60 = low, 2.61–3.40 = moderate, 3.41–4.20 = high, and 4.21–5.00 = very high. The same interpretive criteria were applied to both student and teacher responses.

The reliability analysis showed varying levels of internal consistency across the questionnaire dimensions. For the student questionnaire, Cronbach's alpha coefficients ranged from 0.473 to 0.810. The highest coefficient was obtained for the local biodiversity

involvement/integration dimension (α = 0.810), followed by expectations toward the developed media (α = 0.736), the need for local biodiversity materials (α = 0.655), technology readiness and digital literacy (α = 0.562), and the need for interactive learning media (α = 0.473). For the teacher questionnaire, Cronbach's alpha coefficients ranged from −0.401 to 0.850. Acceptable to good internal consistency was observed for the involvement of local biodiversity in teaching practice (α = 0.752), infrastructure readiness and institutional support (α = 0.783), and expectations toward interactive media specifications (α = 0.850). In contrast, the need for interactive learning media showed a marginal coefficient (α = 0.644). The first teacher dimension, concerning the need for local biodiversity materials in learning, yielded a negative alpha coefficient (α = −0.401). Item-level analysis showed negative corrected item-total correlations for most items in this dimension, indicating limited internal consistency among the five items. This result was retained and reported transparently rather than removing items solely to increase the reliability coefficient, as the items were intended to capture several related aspects of teachers' needs regarding local biodiversity materials. Thus, we treated the reliability coefficients as diagnostic evidence of internal consistency rather than the sole criterion for determining the usefulness of the needs-analysis instrument.

In addition to the Likert-scale items, the questionnaires included open-ended questions designed to obtain contextual information about participants' perceived learning challenges, preferred media characteristics, and locally relevant biodiversity content. We analyzed the open-ended responses descriptively using category-based coding. Responses were first reviewed to identify recurring topics, including learning difficulties, desired media features, and biodiversity species or categories relevant to local learning. Responses referring to the same species using different local or common names were grouped into a single category; for example, "Tabob" and "penyu belimbing" were coded as leatherback turtle. The frequency and percentage of participants mentioning each category were then calculated. Coding was checked by rereading the original responses and comparing the assigned categories with participants' original statements to minimize coding inconsistencies. Because the open-ended analysis aimed to provide contextual information rather than develop a formal qualitative theory, the results were interpreted descriptively and used to complement the quantitative needs-analysis findings.

RESULT AND DISCUSSION

The needs-analysis findings suggest that both students and teachers perceived a substantial need for local biodiversity-based interactive learning media. Students reported an overall mean score of 4.03, categorized as high, while teachers reported a higher overall mean score of 4.23, categorized as very high. Interactive learning media received a very high mean score in both groups, indicating that these resources were a shared priority for supporting local biodiversity-based science learning.

Results of Student Needs Analysis

The needs analysis from 23 senior high school students covered five dimensions measured using a Likert-scale questionnaire. The overall mean score was 4.03 (SD = 0.36), classified as high. Table 1 summarizes results by dimension.

Table 1. Student Needs Analysis Results per Dimension

No.	Dimension	Items	Mean	Category
1	Need for Local Biodiversity Learning Materials	5	3.83	High
2	Need for Interactive Learning Media	5	4.24	Very high
3	Integration of Local Biodiversity in Learning	4	4.24	Very high
4	Technology Readiness and Digital Literacy	4	3.87	High
5	Expectations Toward the Developed Media	5	3.96	High
	Overall Total	23	4.03	High

**Negatively worded items (reverse-scored)*

As shown in Table 1, the Need for Interactive Learning Media and Involvement of Local Biodiversity in Learning dimensions shared the highest mean score of 4.24 (Very High). This suggests strong student interest in interactive media and reports of local biodiversity being incorporated into learning. The Need for Local Biodiversity Learning Materials dimension yielded a mean of 3.83 (High), reflecting students' awareness of the importance of studying biodiversity in their immediate environment. The Technology Readiness & Digital Literacy (M = 3.87) and Expectations Toward the Developed Media (M = 3.96) dimensions were both classified as high, suggesting perceived technological readiness and expectations for the interactive media to be developed. Table 2 presents detailed item-level results for the student questionnaire.

Table 2. Student Needs Analysis Results per Item

Code	Statement	Mean	Category
A1	Recognition of local plant species	4.04	High
A2	Difficulty finding local organism examples in textbooks*	2.74	Moderate
A3	Biodiversity materials use mostly out-of-region examples*	3.22	Moderate
A4	Desire to study local biodiversity in greater depth	4.65	Very high
A5	Local biodiversity knowledge is important for environmental awareness	4.52	Very high
A6	Interactive media facilitates science comprehension	4.48	Very high
A7	Current school science media is adequate*	4.00	High
A8	Prior use of digital/interactive media for science learning	3.87	High
A9	Need for learning media accessible anytime and anywhere	4.61	Very high
A10	Interactive media increases motivation in science learning	4.26	Very high
A11	The teacher connects biodiversity to the local environment	4.35	Very high
A12	Has conducted organism observation around the school	4.30	Very high
A13	Familiar with local endemic plant/animal species	4.04	High
A14	Interested in learning biology through local biodiversity exploration	4.26	Very high
A15	Has access to a smartphone/tablet/computer for learning	4.09	High
A16	Internet connectivity at school/home is adequate	3.91	High
A17	Able to operate digital applications independently for learning	3.96	High
A18	School supports digital technology use in learning	3.52	High
A19	Media should include real photos/images of local species	3.78	High
A20	Desire for an interactive quiz/exercise feature	3.87	High
A21	Media must be easy to use without complex instructions	3.87	High
A22	The media should include the ecological functions of local organisms	3.96	High
A23	Desire for offline-capable media	4.30	Very high

**Negatively worded items (reverse-scored)*

In Table 2, items A4 (M = 4.65) and A9 (M = 4.61) recorded the highest mean scores. Item A4 measures students' desire to study local biodiversity in greater depth, while item A9 measures the need for learning media accessible anytime and anywhere, suggesting particularly strong stated preferences. Item A2 (M = 2.74), concerning difficulty finding local organism examples in textbooks, received the lowest mean. Because this item was reverse-scored, its interpretation should be checked against the original response distribution. Item A3 (M = 3.22) suggests that some students perceive instructional materials as relying on examples from outside their region.

Results of Science Teacher Needs Analysis

The needs analysis of 12 senior high school science teachers yielded an overall mean score of 4.23 (SD = 0.53), classified as very high. Table 3 summarizes results by dimension.

Table 3. Teacher Needs Analysis Results per Dimension

No.	Dimension	Items	Mean	Category
1	Need for Local Biodiversity Learning Materials	5	4.12	High
2	Need for Interactive Learning Media	5	4.30	Very high
3	Integration of Local Biodiversity in Teaching	4	3.98	High

No.	Dimension	Items	Mean	Category
	Practice			
4	Infrastructure Readiness and Institutional Support	4	4.48	Very high
5	Expectations Toward Interactive Media Specifications	5	4.27	Very high
	Overall Total	23	4.23	Very high

As shown in Table 3, the Infrastructure Readiness and Institutional Support dimension received the highest mean score (M = 4.48; Very High), suggesting that teachers perceived relatively favorable technological infrastructure and institutional support for digital media implementation. The Expectations Toward Interactive Media Specifications (M = 4.27) and Need for Interactive Learning Media (M = 4.30) dimensions were both Very High, suggesting strong perceived demand for media development. The Need for Local Biodiversity Materials (M = 4.12) and Integration of Local Biodiversity in Teaching Practice (M = 3.98) dimensions were High, suggesting that teachers recognize the importance of integrating local content, though certain implementation challenges remain. Table 4 presents item-level results for the teacher questionnaire.

Table 4. Teacher Needs Analysis Results per Item

Code	Statement	Mean	Category
B1	Textbooks adequately include local species examples*	3.92	High
B2	Difficulty finding local species references for teaching*	3.25	Moderate
B3	Students are more enthusiastic about local environment examples	4.25	Very high
B4	Integrating local biodiversity is important for environmental appreciation	4.75	Very high
B5	The current curriculum allows room for local biodiversity integration	4.42	Very high
B6	Need for interactive media to support biodiversity instruction	4.50	Very high
B7	Available media is already adequate for biodiversity teaching*	4.33	Very high
B8	Digital interactive media enhances students' conceptual understanding	4.42	Very high
B9	Ready to integrate local biodiversity-based interactive media if available	4.25	Very high
B10	Needs a tutorial when using new digital media	4.00	High
B11	Routinely connects biodiversity material to local species	3.92	High
B12	Has conducted direct biodiversity observation with students	4.08	High
B13	Local species data is easy to find as teaching materials*	3.58	High
B14	Local biodiversity potential is rich enough as a meaningful learning resource	4.33	Very high
B15	The school has adequate facilities for digital media use	4.25	Very high
B16	Students generally own devices for digital learning	4.67	Very high
B17	School administration supports digital media innovation	4.67	Very high
B18	Possesses sufficient technical skills to operate digital media	4.33	Very high
B19	Media should align with learning outcomes/competencies in the curriculum	4.33	Very high
B20	The media should include a teacher's guide for classroom implementation	4.50	Very high
B21	Media should support independent student learning outside the classroom	3.75	High
B22	Media must contain accurate scientific information on local species	4.33	Very high
B23	Interactive media has the potential to improve student learning outcomes	4.42	Very high

**Negatively worded items (reverse-scored)*

Item B4 (M = 4.75), which states that integrating local biodiversity into science learning is important for fostering students' appreciation of the environment, obtained the highest mean score among the teacher items. This was followed by items B16 and B17 (M = 4.67 each), measuring student device ownership and principal support for digital innovation. Item B2 (M = 3.25), assessing teachers' difficulty in finding local species references, recorded the lowest mean score, suggesting that access to local biodiversity references warrants further investigation, a gap that media development should address. Item B13 (M = 3.58) also warrants closer examination of access to local species information as teaching materials.

Comparison of Student and Teacher Needs Analysis Results

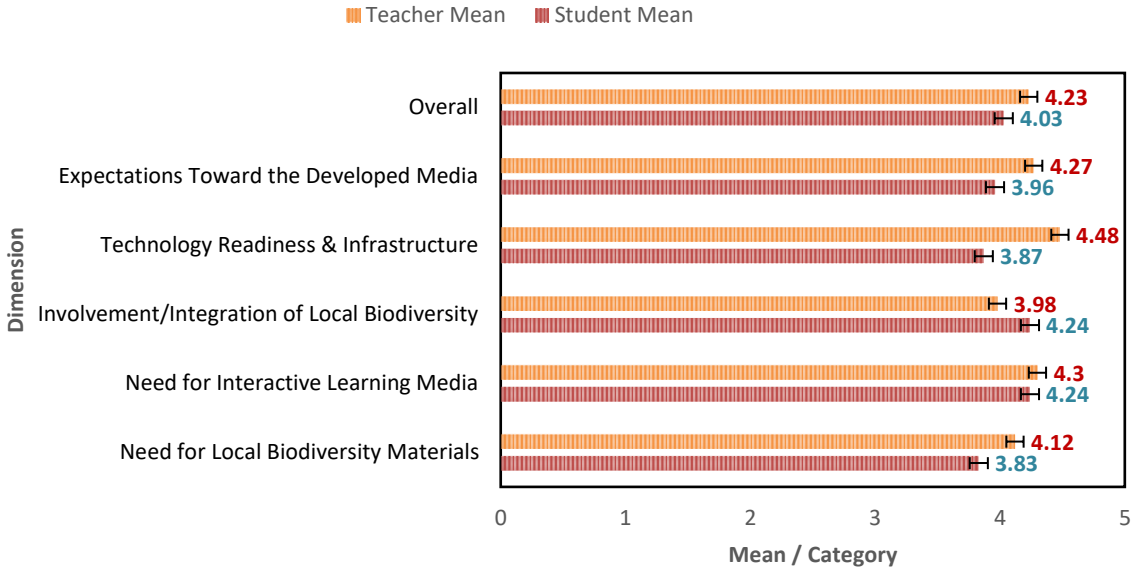


Figure 1. Comparison of Student and Teacher Needs Analysis Results

As illustrated in Figure 1, students and teachers reported high to very high levels of perceived need for local-biodiversity-based interactive learning media. Overall, teachers' mean score (M = 4.23) exceeded that of students (M = 4.03), indicating higher average ratings among the surveyed teachers than among the students. The Need for Interactive Learning Media dimension received very high ratings in both groups (students: 4.24; teachers: 4.30), suggesting a shared preference. A notable divergence emerged in the Technology/Infrastructure Readiness dimension, where teachers (M = 4.48) rated institutional preparedness considerably higher than students' personal technology readiness (M = 3.87).

Results of Open-Ended Questions Analysis

The open-ended responses provided additional evidence regarding participants' learning preferences, perceived challenges, locally relevant biodiversity content, and expectations for the proposed interactive learning media. Responses were grouped into descriptive categories based on recurring ideas in the participants' answers. Because individual responses could include more than one idea, category frequencies are not mutually exclusive.

Students' Responses

Five recurring categories were identified in the student responses. The most frequently identified category concerned visualization, interactivity, and ease of understanding, which appeared in 20 of the 23 student responses (87.0%). Students frequently described effective science-learning media as visual, interactive, simple, and able to transform abstract concepts into concrete representations. One student described effective media as able to "turn complex things into something fun and easy to imagine." At the same time, another emphasized that visual

materials helped them understand scientific concepts more easily.

Interest in local biodiversity content was evident across all 23 student responses (100%). Students identified a wide range of organisms and biodiversity categories that they would like to learn about. Three students (13.0%) mentioned leatherback turtles (Tabob/penyu belimbing), while two students each mentioned Cendrawasih and orangutans (8.7%). Other responses referred to cuscus, capung, black orchid, octopus, coconut trees, local fish, wild animals, endemic flora and fauna, and traditional medicinal plants. The diversity of responses suggests students were interested not only in a single species but in biodiversity they perceived as distinctive, unfamiliar, locally relevant, or ecologically meaningful.

Contextual and experiential learning appeared in 12 student responses (52.2%). Students suggested that biodiversity learning should be connected to their immediate surroundings and, where possible, involve direct observation. Several students proposed outdoor activities and student-worksheet-based observation tasks. One student suggested that the media should encourage students to "go outside the classroom, see trees, or observe insects around the school or home," indicating a preference for learning experiences that connect scientific concepts with the surrounding environment.

A further theme concerned environmental awareness and conservation, which appeared in 11 responses (47.8%). Students expected the proposed media not only to improve academic understanding but also to foster appreciation, concern, and responsibility toward local biodiversity. A smaller number of responses (3 students; 13.0%) explicitly emphasized local cultural knowledge and wisdom, suggesting that scientific biodiversity knowledge could be connected with local knowledge and practices.

Teachers' Responses

Teacher responses yielded several complementary categories. Eight of the 12 teachers (66.7%) mentioned limited availability of relevant learning media and resources. Teachers described difficulties finding learning resources that represent local biodiversity and connecting biodiversity concepts to students' immediate environments. One teacher noted that a major challenge was the "limited availability of learning media and opportunities for field observation." At the same time, another emphasized difficulties associated with unstable internet connectivity in some areas.

Eight teachers (66.7%) also identified a need for visual and interactive learning media. Teachers proposed authentic photographs and videos, interactive quizzes, simulations or animations, observation activities, and teacher guidance. One teacher suggested using "real images and videos of plants and animals in the surrounding environment, complete with descriptions of their characteristics and roles." These responses are consistent with the quantitative finding that interactive learning media represented one of the strongest areas of need.

All 12 teachers (100%) referred to the importance of locally relevant biodiversity content, although the specific organisms varied. Two teachers (16.7%) mentioned Tabob, while other responses included Butut Kai (Centropus sp.), cuscus, enbal, coconut trees, medicinal plants, local birds and insects, tuna, shellfish, and endemic fish. Teachers tended to emphasize species that were locally distinctive, ecologically important, culturally meaningful, or threatened.

Teachers identified contextual and experiential learning in 7 responses (58.3%). Teachers recommended giving students opportunities to observe organisms directly and to connect biodiversity concepts with their local environment. Some teachers also suggested linking biodiversity with local cultural practices and the traditional use of biological resources, particularly medicinal plants and local food resources.

Issues related to technology accessibility and infrastructure appeared in 5 teacher responses (41.7%). Teachers emphasized the need for media that could be accessed using commonly available devices such as smartphones and computers and that could accommodate schools experiencing unstable internet connectivity. This finding is particularly relevant to

developing an offline-capable or low-connectivity version of the proposed media.

Overall, the qualitative findings reinforce the quantitative results by demonstrating that both students and teachers want learning resources that are interactive, visually engaging, locally relevant, and connected to real environmental contexts. Students particularly emphasized understandable visual representations, engagement, and direct environmental experiences, whereas teachers placed greater emphasis on the availability of authentic local content, instructional guidance, accessibility, and implementation conditions. These findings support prioritizing core features such as authentic local biodiversity content, photographs and videos, interactive quizzes, scientifically accurate species information, contextual observation activities, and teacher guidance. Some teachers mentioned more advanced features, such as AI-assisted species identification. However, these should be treated as optional features requiring separate technical feasibility and accuracy testing rather than as essential requirements identified in this needs analysis.

Discussion

Need for Local Biodiversity-Based Learning Materials

The findings of this study provide several insights when compared with previous research. The needs analysis results indicate that both students (M = 3.83) and teachers (M = 4.12) rated the need for local biodiversity-based learning materials as High. This finding aligns with prior research showing that locally contextualized learning can support student motivation and conceptual understanding (Katili et al., 2021; Gehlbach, 2022). The high scores on items A4 ("desire to study local biodiversity in greater depth," M = 4.65) and A5 ("local biodiversity knowledge is important for environmental awareness," M = 4.52) suggest that students not only possess intrinsic interest but also recognize the ecological relevance of contextual learning about local biodiversity.

However, reverse-scored items A2 and A3 suggest possible gaps: students still struggle to find local organism examples in their textbooks (A2, M = 2.74) and perceive that instructional materials predominantly use out-of-region examples (A3, M = 3.22). Teachers also have difficulty finding local species references (B2, M = 3.25) and agree that textbooks do not adequately represent local species (B1, reverse-scored). This pattern reflects a broader disconnect between the demand for contextual learning and the supply of locally representative learning resources, a gap documented by researchers who noted that formal curriculum materials tend to underrepresent endemic flora and fauna. This disparity provides a compelling empirical rationale for developing local biodiversity-based learning media.

Need for Interactive Learning Media

The Need for Interactive Learning Media dimension received very high scores in both respondent groups (students: M = 4.24; teachers: M = 4.30). Both respondent groups rated this dimension as very high. These findings suggest that interactive digital media may be a valuable resource in modern science education (Rangel-de Lázaro & Duart, 2023; Garzón et al., 2025).

Item A9, measuring the need for media that is accessible anytime and anywhere, recorded the second-highest score among all student items (M = 4.61), suggesting interest in flexible, technology-supported independent learning. Teachers similarly expressed strong readiness to integrate local biodiversity-based interactive media once available (B9, M = 4.25) and a firm belief that such media would enhance student understanding (B8, M = 4.42). Meanwhile, the reverse-scored item B7 "available media is already adequate for biodiversity teaching" still yielded a relatively high reversed score (M = 4.33), indicating that existing media do not sufficiently support locally contextualized biodiversity learning. These findings collectively support developing purposefully designed interactive media tailored to address this specific educational need.

Involvement of Local Biodiversity in Learning and Teaching Practice

The local biodiversity involvement dimension received a Very High rating from students (M = 4.24) and a High rating from teachers (M = 3.98). From the students' perspective, high scores on items A11 ("teacher connects biodiversity content to the local environment," M = 4.35) and A12 ("has conducted organism observations around the school," M = 4.30) suggest that observation-based local learning is already occurring at a reasonably good level. This is consistent with the principles of Contextual Teaching and Learning (CTL), which emphasize connecting instructional content to students' real-life contexts (Johnson, 2002).

For teachers, reverse-scored item B13 ("local species information is easy to find as teaching material," M = 3.58) requires cautious interpretation and does not independently establish the extent of a resource-access barrier. Open-ended responses nevertheless indicate that some teachers experienced difficulty accessing relevant information about local biodiversity in the Kei Islands. This contrasts with item B14 ("local biodiversity potential is rich enough as a learning resource," M = 4.33), revealing a contrast between the acknowledged richness of local natural resources and the scarcity of documented, accessible information. This underscores the need for media that not only deliver local content but also serve as a repository of regional biodiversity knowledge.

Technology Readiness and Infrastructure

Students' technology readiness dimension was classified as high (M = 3.87), with item A15 (device ownership, M = 4.09) scoring higher than item A18 (school support for digital technology, M = 3.52). This pattern indicates that individual device access surpasses institutional support—a common finding in Indonesian educational technology research (Kemendikbud, 2021). Item A16, measuring internet connectivity adequacy (M = 3.91), reflects relatively favorable conditions at the individual level. However, teacher responses in the open-ended section indicated that connectivity in certain areas remains a challenge.

From the teacher's perspective, the Infrastructure Readiness & Institutional Support dimension obtained the highest mean score across all dimensions (M = 4.48; Very High). Items B16 (students possess digital devices, M = 4.67) and B17 (school principal supports digital innovation, M = 4.67) recorded the highest scores in the entire teacher questionnaire. This conducive institutional environment may be an enabling factor for the successful implementation of interactive media. Nevertheless, item B10 (need for a tutorial when using new digital media, M = 4.00) indicates that user guidance remains necessary, particularly to optimize teachers' use of these media.

Expectations Toward Media Specifications

The media expectations dimension scored High among students (M = 3.96) and Very High among teachers (M = 4.27). The convergence of quantitative and qualitative findings provides a preliminary media specification profile. In terms of content, both students and teachers expect the media to feature authentic photographs and videos of local species, accompanied by accurate scientific information including scientific names, habitats, and conservation status (A19, M = 3.78; B22, M = 4.33). Item A23, measuring the need for offline functionality, recorded a notably high score (M = 4.30), which is particularly relevant given limited internet connectivity in certain areas.

From a pedagogical standpoint, interactive quiz features (A20, M = 3.87), ease of use (A21, M = 3.87), and suitability for independent student learning outside the classroom (B21, M = 3.75) were identified as preferred specifications. Teachers specifically emphasized the need for an integrated teacher guide (B20, M = 4.50) and alignment with current curriculum learning outcomes (B19, M = 4.33). These findings align with instructional design principles stating that effective media must integrate relevant content, a user-friendly interface, and curriculum coherence (Dick, Carey & Carey, 2015).

Open-ended responses further revealed deeper aspirations: students envisaged media

that would not merely provide information but also promote direct field-based learning experiences (experiential learning). Several students described their ideal media as a "field guide" that invites real outdoor exploration. Teachers, meanwhile, emphasized the importance of a contextual approach that integrates local biodiversity with local community wisdom, such as traditional medicinal plant knowledge and culturally embedded ecological knowledge (traditional ecological knowledge).

Implications for Instructional Design and Further Development

The findings provide a preliminary instructional-design basis for developing interactive learning media based on local biodiversity. Rather than representing evidence of media effectiveness, the identified needs can inform specific design requirements for the next development stage. The high demand for interactive, visual, contextual, and locally relevant learning resources suggests that the initial prototype should prioritize authentic biodiversity content from the Kei Islands, scientifically accurate species information, images and videos, interactive quizzes, contextual observation activities, teacher guidance, and accessibility through commonly available digital devices. Given reported connectivity constraints in some areas, prototype design should also consider offline or low-connectivity access.

The subsequent development process should proceed through several stages. First, translate the needs identified in this study into a prototype design aligned with the applicable science curriculum and relevant principles of contextual and inquiry-oriented science learning. Second, relevant experts in biology/science education and instructional media should validate the prototype to assess content accuracy, curriculum alignment, pedagogical appropriateness, usability, language, and technical quality. Third, the revised prototype should undergo limited usability testing with students and teachers to identify difficulties in navigation, comprehension, accessibility, and interaction. Finally, classroom trials should examine implementation feasibility and, in a subsequent study, the media's potential effectiveness in supporting biodiversity learning, biodiversity literacy, and environmental awareness.

Advanced features such as AI-assisted species identification may be considered in later development stages, but they should remain optional until their technical feasibility, identification accuracy, and usability are established. The present study should therefore be viewed as the needs-analysis stage of a broader instructional-development process, providing evidence for design decisions rather than evidence of the proposed media's effectiveness.

CONCLUSION

This study provides preliminary evidence of the need for local-biodiversity-based interactive learning media in senior high school science education in the Kei Islands, Southeast Maluku. The findings indicate a high overall level of need among students (M = 4.03) and a very high level of need among teachers (M = 4.23), with the Need for Interactive Learning Media dimension receiving very high ratings in both groups. Open-ended responses also indicated that participants valued learning resources that present locally relevant biodiversity through visual, interactive, contextual, and experiential learning features.

These findings provide context-specific information to inform the design requirements of future local-biodiversity-based interactive learning media. However, the findings should be interpreted cautiously because the study involved a relatively small purposive sample of 23 students and 12 teachers, was conducted in the Kei Islands context, and relied on participants' self-reported perceptions. Therefore, the findings should not be generalized to all senior high schools or science teachers in Indonesia. Furthermore, this study was limited to needs analysis and did not include prototype validation, practicality testing, or effectiveness testing. Future research should develop and validate the proposed media and examine its practicality and effectiveness using larger and more diverse samples.

ETHICS STATEMENT

All participants voluntarily participated in the study after receiving adequate information about the research and providing their consent to participate. The school granted permission to conduct the study before data collection. To maintain confidentiality, we did not disclose participants' identities or the school's name in the research report. We analyzed and reported all data in aggregate form.

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