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Needs Analysis for the Development of a Guided Inquiry-based E-Module on Biodiversity Material

Mardomo Susanto, Meti Indrowati, Puguh Karyanto

Universitas Sebelas Maret, Surakarta, Indonesia
mardomosusanto@student.uns.ac.id, metiindrowati@staff.uns.ac.id, puguhkaryanto@staff.uns.ac.id
corresponding author: *mardomosusanto@student.uns.ac.id*

ABSTRACT

This paper documents the need for developing a guided inquiry-based e-module on biodiversity material for high school students. The research employs a descriptive exploratory approach involving 41 respondents, consisting of biology teachers and grade X students selected using cluster random sampling. Data were collected through questionnaires focusing on the availability, use, and expectations of learning media. The results showed that current biology learning still relies heavily on teacher-centred methods and printed textbooks and lectures, limiting students' engagement and scientific literacy. Both teachers and students expressed the need for a digital learning media that supports independent learning, encourages active student involvement, and aligns with the guided inquiry approach. The findings support the urgency to develop an interactive e-module that integrates inquiry-based learning steps and can be used flexibly both inside and outside the classroom.

Keywords*: *needs analysis, e-module, guided inquiry, biodiversity, science literacy

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INTRODUCTION

Scientific literacy is the ability to think critically about scientific issues, understand and explain natural phenomena, design and evaluate scientific investigations, and analyze data using a scientific approach (OECD, 2024). Scientific literacy skills play an important role in facing the challenges of the 21st century, because various aspects of life are filled with scientific work. Problems in everyday life are often related to science, so training scientific literacy skills is very important (Basam, 2022). Scientific literacy skills will help individuals to understand and solve problems rationally based on a scientific approach.

Based on the results of PISA 2022, Indonesia scored 415 for scientific literacy, which placed Indonesia in 62nd place out of 81 participating countries. The findings of researchers at the school where they teach, the scientific literacy skills of students are also not satisfactory. One of the factors causing the low scientific literacy scores of Indonesian students is the learning method applied. Most of the learning process only relies on lectures or oral explanations from teachers regarding abstract concepts, so that students have difficulty understanding the material (Basam, 2022).

In the context of biology learning, especially in the material of biodiversity, students are expected to be able to observe, identify, and analyze living things based on their characteristics. However, the reality in the field shows that the learning process is still dominated by conventional methods, such as lectures and assignments, which tend to make students passive and less involved in the scientific thinking process. The low level of student activity in learning has an impact on weak understanding of concepts and science literacy skills.

One alternative approach that can increase student involvement in learning is the guided inquiry method. This method provides opportunities for students to discover concepts through structured scientific

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activities, while still getting direction from the teacher. Guided inquiry can facilitate students in building conceptual understanding, improving science process skills, and fostering students' curiosity.

Learning media plays an important role in supporting the success of the inquiry process. The use of learning media in the teaching and learning process can foster new interests and desires, and empower students' motivation in participating in learning activities (Wahyuningtyas, 2020). Technology-based media, such as interactive e-modules, are a solution that suits the characteristics of today's digital generation. E-modules not only present learning materials in text form, but can also integrate visual, audio, and interactivity elements that can increase learning motivation and enable students to learn independently anytime and anywhere.

Needs analysis is important in developing guided inquiry-based e-modules on biodiversity material. This analysis aims to determine the real conditions of learning, the suitability of the media used, and the expectations of teachers and students for learning media that can support an active, meaningful learning process.

LITERATURE REVIEW

Scientific literacy is the scientific ability and understanding that enables a person to identify questions, acquire new knowledge, explain various scientific phenomena, and draw conclusions based on facts. In addition, scientific literacy includes an understanding of the characteristics of science, an awareness of the role of science and technology in shaping the natural, intellectual, and cultural environment, and concern and involvement in issues related to science (Narut, Y. F., & Supardi, K., 2019).

Learning media is an important component in the teaching and learning process that functions as a tool for teachers in delivering material to students. The use of appropriate media can increase students' interest and attention to the material being taught, so that learning becomes more effective. Success in achieving learning objectives depends not only on the media used, but also on the role of the teacher as a facilitator who guides students in developing their cognitive, affective, and psychomotor aspects (Wulandari, 2023). One form of digital media that is widely developed is e-modules. E-modules are interactive media that refer to products and services in digital computer systems that present various types of content, such as text, images, graphics, animations, videos, audio, and others (UNY, 2017). E-modules are teaching materials developed in digital format with a systematic structure and equipped with interactive features that make it easier for students to understand learning materials. According to Majid (2015), a good module must meet the principles of self-contained, self-instruction, and user friendly. Interactive e-modules provide opportunities for students to learn independently with minimal guidance from teachers. The advantages of e-modules include easy access, can be developed in an interesting way with the help of multimedia technology, and are able to adapt to the needs and characteristics of current students.

The guided inquiry approach is a learning approach that requires students to be involved in the scientific investigation process with guidance and direction from teachers. According to Nuraini (2020), the stages or syntax in implementing the guided inquiry model include: (1) presenting questions or problems carried out by the teacher, (2) students formulate hypotheses, (3) designing experimental procedures, (4) conducting experiments according to the specified procedures, (5) collecting and analyzing data, and (6) drawing conclusions. In this learning, the teacher acts as a facilitator who directs students without providing direct answers. Guided inquiry is effective in improving students' science process skills and science literacy because students are actively involved in the process of building knowledge.

Biodiversity is one of the materials in the 10th grade biology curriculum. This material includes the concept of genetic diversity, species, and ecosystems, as well as the importance of preserving biodiversity for the balance of ecosystems and human life. In learning, this material is very relevant to be associated with environmental and conservation issues. However, learning about biodiversity requires media and methods that are able to visualize diverse objects and cannot always be observed directly by students.

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METHOD

This study uses an exploratory descriptive approach that aims to determine the need for the development of learning media in the form of guided inquiry-based e-modules on biodiversity material. The study was conducted in the even semester of the 2024/2025 academic year.

Research Subjects

The subjects in this study were class X students and biology teachers at SMA Negeri 1 Baturetno. The determination of student subjects was carried out using the cluster random sampling technique, namely sampling based on class groups selected randomly from a homogeneous population. The number of respondents in this study was 41 people, consisting of 36 students and 5 biology teachers.

Research Instruments

The instrument used in this study was a needs analysis questionnaire, consisting of two types:
1) Student questionnaire
2) Teacher questionnaire

The research instrument was validated through a content validity test involving 5 experts in the field of education. Validation was carried out on five main aspects, namely: (1) the suitability between the grid and the items on the questionnaire, (2) the clarity of the filling instructions, (3) the clarity of the question items, (4) the use of good and correct Indonesian spelling, and (5) the use of communicative sentences.

The validation results showed that all aspects obtained a percentage value above 75%, which means they are in the "valid" category. The aspect with the highest value was the clarity of the filling instructions (100%), while the aspect with the lowest value was the use of Indonesian spelling (75%). The average percentage of all aspects was 86%, which indicates that the questionnaire instrument is suitable for use.

Data Collection Techniques

Data were collected by distributing questionnaires directly to teachers and students online via Google Form. Respondents filled out the questionnaire independently. Each item on the questionnaire was arranged in the form of closed choices (yes/no).

Data Analysis Techniques

The data obtained were analyzed descriptively quantitatively, by calculating the percentage of each answer choice to identify the tendencies of teacher and student needs. The results of the analysis are used as a basis for designing the initial specifications of the learning media to be developed, namely an e-module based on guided inquiry.

RESULTS AND DISCUSSION

Results of Needs Analysis Questionnaire

a. Teacher Needs Analysis Questionnaire

The purpose of the teacher needs analysis questionnaire is to identify the conditions, challenges, and actual needs of teachers in the learning process, especially to compile or develop an educational product such as teaching materials, learning models, or learning media. In more detail, the purpose of the teacher needs analysis questionnaire includes:
1) Knowing the current learning conditions, including the approaches, methods, and media used by teachers.
2) Identifying obstacles or difficulties faced by teachers in delivering material or assessing students.
3) Knowing teachers' perceptions and readiness for learning innovations, such as the use of e-modules, guided inquiry approaches, or the implementation of the Independent Curriculum.

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4) Exploring teachers' expectations and preferences for the form, features, or content of the product to be developed (for example: the need for e-modules, the type of content desired, etc.).
5) Becoming a logical basis or foundation in the planning stage of developing learning products so that they are in accordance with the real context and user needs (user oriented).

The teacher needs analysis questionnaire that has been prepared contains 10 questions in which respondents choose the answer "Yes" or "No". The complete results of the teacher needs analysis questionnaire can be seen in Table 1.

Table 1 Results of Teacher Needs Analysis

No	Statement	Percentage (%)
1	Teachers have linked biodiversity material to real problems	100
2	Teachers use certain models/approaches in teaching biodiversity	80
3	Biodiversity material is in accordance with students' needs	100
4	Teachers have access to digital teaching materials	80
5	Teachers have difficulty using learning media	20
6	Teachers feel the need for an e-module based on guided inquiry	100
7	Teachers understand the concept of guided inquiry	80
8	Teachers are ready to implement a guided inquiry approach	100
9	Teachers have observed an increase in student participation through guided inquiry	80
10	Teachers have adequate internet access	100

From the data, it can be concluded that all teachers (100%) stated that they have linked biodiversity material with contextual problems in everyday life. This shows that a contextual learning approach has been widely applied.

As many as 80% of teachers use a particular model or approach in teaching the material, and all respondents stated that the biodiversity material is in accordance with the needs of students. This shows that in terms of content, teachers feel that the existing material is relevant. However, only 80% of teachers have access to digital teaching materials, which indicates that there are still some teachers who need support facilities. Interestingly, only 20% of teachers have difficulty using learning media, which means that the majority are quite comfortable using the media.

All teachers (100%) agree that there is a need for the development of e-modules based on guided inquiry. However, only 80% stated that they understand the concept, although all stated that they are ready to implement it. This can indicate enthusiasm even though it is not fully accompanied by a deep theoretical understanding. In addition, 80% of teachers observed that the implementation of guided inquiry can increase student participation, and 100% stated that they have adequate internet access. This is an important capital in the use of e-modules in the future. These results strengthen the urgency of the need to provide systematic, interactive, and curriculum-based guided inquiry e-modules. In addition, teacher training on the inquiry approach is also needed to support the effectiveness of its implementation.

b. Student Needs Analysis Questionnaire

The purpose of the student needs analysis questionnaire is to explore information about students' learning experiences, difficulties, interests, and expectations of the learning process, especially so that the development of teaching materials or learning media is in accordance with real conditions and their needs. More specifically, the objectives include:

1) Identifying students' learning difficulties, both in understanding the material, using learning media, and in the learning process in the classroom.
2) Knowing students' perceptions of the learning they have undergone so far, such as teacher teaching methods, use of media, and their level of involvement.

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3) Exploring students' interests and motivations towards certain forms of learning, such as the use of e-modules or guided inquiry approaches.
4) Knowing students' access to and abilities towards technology, which is important if product development is digital or online.
5) Getting direct input from students as end users of teaching materials, so that the products developed are truly in accordance with their learning needs.

The student needs analysis questionnaire consists of 10 questions and respondents choose the answer "Yes" or "No". Respondents in filling out this questionnaire were 36 grade X students selected by cluster random sampling. The complete results of the student needs questionnaire can be seen in Table 2.

Table 2. Results of Student Needs Analysis

No	Statement	Percentage (%)
1	The teacher relates the biodiversity material to environmental problems in everyday life	100
2	The teacher's teaching method in this material is interesting and different from usual	80.56
3	I have difficulty understanding the biodiversity material when it is explained in class	19.44
4	I find it difficult to understand the differences between living things around me and those explained in the material	19.44
5	The material presented by the teacher is in accordance with my abilities and learning needs	94.44
6	The teacher has helped me understand this material in an easy and enjoyable way	91.67
7	I have conducted direct observations or simple experiments with the teacher (guided inquiry)	94.44
8	I have used digital teaching materials (eg e-modules) in biology learning	52.78
9	I am interested if e-modules are used in biology learning, especially biodiversity material	94.44
10	I feel that activities such as observing, investigating, and drawing my own conclusions help me understand biodiversity material	97.22

Based on the results of the questionnaire, it can be seen that the majority of students (100%) stated that the teacher had linked the biodiversity material to environmental problems in real life. This shows the implementation of a good contextual approach in learning. Most students (80.56%) also felt that the way the teacher delivered the material was quite interesting and different from usual. However, around 19.44% of students still had difficulty understanding the material, both conceptually and in comparing living things around them with the material being taught. This shows that some students need a more visual, concrete, and applicable learning approach. Most students (94.44%) felt that the material delivered was in accordance with their abilities, and the teacher had helped them understand the material in a fun way. As many as 94.44% of students also stated that they had conducted simple observation or experiment activities with the teacher, which indicates that a guided inquiry approach has been implemented in the learning process. However, only 52.78% of students have ever used digital teaching materials such as e-modules. However, interest in the use of e-modules is very high: 94.44% of students are interested if e-modules are used in learning, especially on biodiversity material. Interestingly, as many as 97.22% of students feel that activities such as observing, investigating, and drawing their own conclusions help them understand the material. This shows that the inquiry approach is very suitable for strengthening students' understanding of the concept of biodiversity.

c. Conclusion of Teacher and Student Needs Analysis

Based on the results of the needs analysis for teachers and students, several important conclusions were obtained as a basis for developing e-modules based on guided inquiry on biodiversity material:

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1) Teachers have generally linked biodiversity material to real-life contexts, used an interesting approach, and realized the importance of inquiry-based learning. As many as 100% of teachers stated the need to develop e-modules based on guided inquiry, and 80% stated that they understood the concept.
2) Although teachers' understanding of the inquiry approach is quite high, only a few stated that they are ready to implement it directly in the classroom. This indicates the need for training or technical assistance so that teachers can apply the approach optimally.
3) Regarding access to technology, the majority of teachers have adequate internet connections, but there are still teachers who have difficulty using learning media or do not have access to appropriate digital teaching materials.
4) From the student perspective, enthusiasm for the use of e-modules is very high (94.44% stated that they are interested). However, only 52.78% have ever used digital teaching materials, and around 19.44% still have difficulty understanding biodiversity material in the classroom.
5) Most students stated that inquiry-based activities such as observation and investigation were very helpful in understanding the material, and they had experience conducting observations with teachers.
6) These results indicate that both teachers and students need learning media that can accommodate a guided inquiry approach and are able to answer the challenges of understanding abstract concepts in biodiversity material.
7) Overall, these findings reinforce the need to develop guided inquiry-based e-modules that are not only adaptive to student needs but also support teachers in implementing the Independent Curriculum meaningfully.

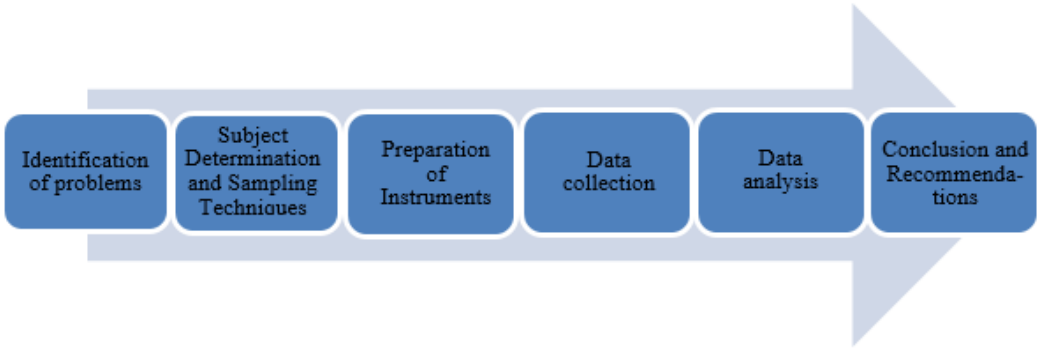

Figure 1. Research stages

CONCLUSIONS AND RECOMMENDATION

Based on the results of the needs analysis conducted on teachers and students in class X biology learning, especially biodiversity material, it can be concluded that:

1) The learning media currently used are still conventional, dominated by lectures and textbooks, and have not been fully able to facilitate active involvement of students in the learning process.
2) Students show a high need for digital learning media that are interactive, interesting, and allow them to learn independently anytime and anywhere.
3) Teachers state the need for teaching media that can foster scientific literacy skills, and are in accordance with the syntax of guided inquiry learning.
4) The development of e-modules based on guided inquiry is very much needed as an alternative learning media that can increase student activity, support 21st century learning, and bridge the needs of teachers and students in understanding the concept of biodiversity more deeply and meaningfully.

Based on the research results, the researcher provides several recommendations as follows:

1) For developers of learning media, it is recommended to develop guided inquiry-based e-modules that are in accordance with the characteristics of students and competencies in biodiversity material, by paying attention to the integration of interactive elements such as images, videos, animations, and exploratory activities.
2) For biology teachers, the results of this needs analysis can be used as a basis for selecting or compiling more contextual learning media and encouraging student activity, especially in developing scientific literacy skills.
3) For schools or education policy makers, it is necessary to support the procurement and training of the use of digital media, including e-modules, to support the implementation of inquiry-based learning in order to improve the quality of 21st century learning.
4) For further researchers, it is recommended to continue this research to the design and development stage of e-modules, and to test the effectiveness and practicality of the media so that it can be implemented more widely in various educational units.

Limitation

This study has several limitations that need to be considered, including:

1) Limited scope of respondents, which only involved 41 respondents from SMA Negeri 1 Baturetno residents. The results of this needs analysis cannot be generalized to all schools nationally without further research.
2) The instrument used was only a closed questionnaire, so there is a possibility that there is important information that is not explored in depth due to the absence of qualitative data such as interviews or in-depth observation studies.
3) The analysis only reaches the needs stage, does not include the design and development stages of the e-module in real terms, so the effectiveness of the media needed cannot be known directly.
4) Focus on one subject matter, namely biodiversity. The results of the study do not yet reflect the need for media for other biology materials that may have different learning characteristics.

Credit authorship contribution statement

First author: Responsible for the entire research process, from problem identification, instrument development, data collection and analysis, to writing the draft article. Second author: Provides conceptual and methodological direction in conducting the research, including revision of theoretical substance and discussion, and checking the suitability of the data to the research objectives. Last author: Provides guidance in instrument development and data analysis, and performs final editing of the article manuscript to comply with scientific writing rules.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethical Declaration

All participants provided informed consent prior to their involvement in the study. They were informed about the study's purpose, procedures, and their right to withdraw at any time without consequence.

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2) School and biology teachers, who have given permission, support, and participation in data collection;
3) Grade X students, who have agreed to be respondents and provide the required data;
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