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STUDENT RESPONSE TOWARD THE SCIENCE COMMUNICATION SKILLS-BASED INTERACTIVE E-MODULE

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ABSTRACT

The science learning process in the 21st century era, especially at the tertiary level requires prospective science teachers to have science communication skills. Science communication skills are part of the science process skills that direct students to be able to express ideas, knowledge which contains data and facts that can be expressed in oral or written form. Science communication skills are considered as a source for developing and creating knowledge in the science learning process which are needed to act as a link so that students can share their experiences and understanding. Apart from that, the lack of availability of teaching materials in biotechnology lectures is a concern in this research. This research aims to describe student responses toward the science communication-based interactive e-module that has been developed and implemented in the Biotechnology course. This research is a quantitative descriptive study using a survey method. The samples involved in the research were 37 students from the sixth semester of the Science Education Study Program, class B, where practical tests were carried out on a limited scale. The research sample was taken using random sampling. The instrument used was a student response questionnaire sheet consisting of 40 statements. The data obtained includes practical results through student responses toward the e-module being developed. Student response questionnaires were analyzed quantitatively using descriptive analysis. The research results showed that student responses were very positive from all respondents with an overall average percentage reaching 82%. It can be concluded that the science communication-based interactive e-modules can be well received by science students as users.

Keywords: ***E-module, Interactive, Science Communication, Student, Response***

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Introduction

Industrial revolution 4.0 brings changes in the world of education. Students not only have to master science learning content, but are required to have scientific experience that can be applied to solve problems in the real world (Sajidan et al., 2022). Therefore, the competencies are needed to help students face the challenges of the 21st century (Subali et al., 2019). One of the skills that students must have been science communication skills. In science learning, science communication skills are considered as a source for developing and creating knowledge. In building science learning interactions, science communication skills are needed to act as a link so that students can share their experiences and understanding (Oktasari et al., 2019).

Science communication becomes an interaction process when individuals are involved in investigative activities and make decisions in resolving scientific cases (Urwani et al, 2018). Science communication skills are part of the science process skills that direct students to be able to express ideas, knowledge which contains data and facts that can be expressed in oral or written form (Redhana, 2019). Science communication skills are not only limited to delivery, but are accompanied by ways to understand the information provided. Through science communication, students can exchange information, reveal the results of investigations based on data obtained in the field. Apart from that, students are also given the opportunity to provide responses, ask questions and express scientific arguments (Pursitasari et al., 2020).

The science learning process should be able to direct students to participate actively. Science communication skills are needed so that students can interact well with other people and the environment around them (Urwani et al, 2018). Science communication is an essential part of science learning. Students are given many opportunities to communicate scientific knowledge through the experimental results. Science communication has the function of providing support in activities and making decisions. Apart from that, students can also construct their own knowledge and develop a scientific attitude through science communication (Ahmed et al., 2023).

One of the courses in the Science Education curriculum is Biotechnology. During the learning process, students are provided with insight and knowledge regarding the role of microorganisms and the application of biotechnology in various fields of life, the differences between modern and conventional biotechnology and genetic engineering which contain many abstract concepts so that a learning media is needed to help students train their visualization skills in order that they will understand the concepts easily (Muhtadi and Herawati, 2018). Apart from that, students are also required to be skilled in communicating their ideas through discussions in groups to solve contextual cases given by the lecturer. Therefore, in its application, biotechnology learning does not only focus on understanding but on developing student skills, one of which is science communication skills.

Observation results show that students' science communication skills are still not in line with expectations. Students still have difficulty when asked to present information in graphic form to communicate solutions to problems. Students are also not able to build effective communication with other people to develop mutual understanding when they are involved in discussion activities. This problem happens because lecturers have not provided learning tools that are able to facilitate students in supporting the achievement of science communication skills. Based on the research results of Siregar et al. (2020), students' low communication skills are caused by lecturers not being able to create an interesting learning atmosphere, and the limited teaching materials used. Therefore, the teaching materials in the form of interactive e-modules based on science communication skills was developed to overcome the above problems.

Interactive e-modules are innovative teaching materials that can be accessed digitally both online and offline (Elvarita et al., 2019). This learning media will make it easier for lecturers when implementing e-learning, lecturers can share their teaching materials so students can learn. The e-module not only contains text explaining biotechnology learning material, but is equipped with animated images and videos to make it easier for students to master the content being studied (Wulandari et al., 2021). Interactive e-modules are designed in various forms so students will not feel bored and they can increase students' interest and motivation in learning. The interactive e-module also can develop students' thinking patterns through interactive activities contained in e-modules (Winatha et al., 2018; Astuti & Hayati, 2019)). Through interactive e-modules, the learning process will become more interesting and the effectiveness and flexibility of learning can be attained well (Putri et al, 2021).

The developed e-module contains indicators of science communication skills which include understanding other people's ideas, creating tables and graphs, integrated and coherent reports, making audiovisual presentations and effective communication with other people to develop shared understanding which is reflected in learning activities in the e-module and evaluation tools used to measure students' science communication skills. The advantages of interactive e-modules are that they are able to provide space for students to study independently, are more practical and lighter to carry anywhere because they are not large in size and do not get damaged quickly, can be stored in various devices such as flash disks, hard disks or CDs (Laili et al., 2019).

By using the e-module, students will be faced with working on assignments in the form of case studies, written projects (infographic media, popular articles), oral projects (vlogs and podcasts) which are linked to the scope of material in the Biotechnology course and support the achievement of students' science communication skills. The e-module itself aims to train students' independence because it is equipped with instructions and steps for using it. Apart from that, the components in it are arranged systematically and complexly so that they can create a two-way communication pattern (Arsal et al., 2019). Interactive e-modules can allow students to involve their senses of sight and hearing, meaning that the more senses are involved, the greater the chance that the information conveyed by the lecturer can be understood and remembered by students (Ramadhani et al., 2022). Therefore, the integration of interactive e-modules in science learning can encourage students to be active in learning and make individuals more flexible in selecting and elaborating the knowledge they have.

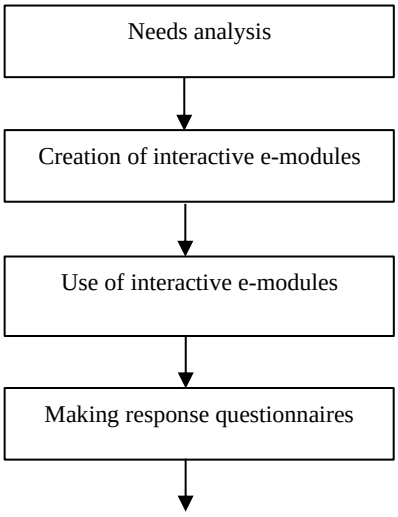
E-learning modules are assumed to be effective if they contain characteristics, as follows: 1) self-instruction, 2) self-contained, namely the learning material displayed must be complete so that students can complete their learning, 3) stand-alone means not depending on other teaching materials or in other words being independent, 4) adaptive, namely adjusting to advances in information and technology, 5) user friendly means easy to use by users. In creating an interactive e-module, adequate media is needed. One tool that can be used is Canva. Canva is a site that includes programs that help users design things that can be accessed online, which provides various templates such as graphics, posters, presentations and images equipped with videos, resumes, photo editing and can facilitate lecturers to carry out assessments in distance learning. Through this application, modules can be designed attractively and can increase the creativity of lecturers and students because many features are easy to use, practical in nature so they can save time (Tanjung and Faiza, 2019).

The Canva site can help users design easily, attract students' attention through the visualizations displayed, and provide effective information through teaching materials presented in the learning process (Yundayani et al., 2019). The ease of developing e-modules using the Canva application can be utilized to make the learning process more impressive for students (Rofiyadi and Handayani, 2021). This research aims to describe student responses toward the interactive e-module teaching materials based on science communication skills.

Research Methods

The type of research used is descriptive research with quantitative methods. The research was conducted at Faculty of Teacher Training and Education, University of Sultan Ageng Tirtayasa in June 2022. The population in this research were all students of the Science Education Study Program. The research sample involved 37 class B science students from the Class of 2020 who taught the Biotechnology course. The data collection technique uses observation to obtain information related to the implementation of learning in the Biotechnology course. The sampling technique was carried out by random sampling.

Based on the description of the research method above, a research flow was created which was able to clearly describe the research steps from the initial to the final stages as explained in Figure 1 below:



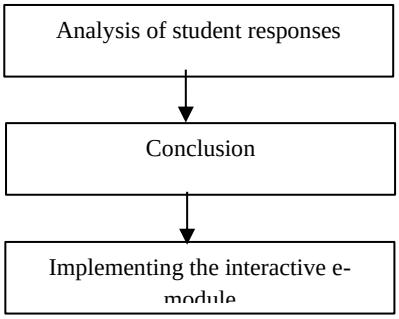


Figure 1. The Research Procedures

The research instrument used was a questionnaire sheet in the form of a Google form. The research instrument uses a student response questionnaire sheet consisting of 7 response indicators related to construction, content (substance), language, suitability of the e-module display, motivation, attractiveness, and presentation of learning used in the interactive e-module based on science communication skills. In formulating the instrument items in the questionnaire in the form of statements. The instrument items consist of positive and negative statement items with a total of 40 statements which are used to test the practicality of the e-module developed through student responses.

The questionnaire was developed in a closed questionnaire using a Likert scale with 4 rating scales, namely strongly agree, agree, disagree, and strongly disagree. The category of scores is described in Table 1.

Table 1. Scale in Questionnaire of Students' Response

Score for item		Categories of student answer
Positive	**Negative**	
1	4	Strongly Disagree
2	3	Disagree
3	2	Agree
4	1	Strongly Agree

Research data was analyzed using quantitative descriptive statistical techniques. The data analyzed is in the form of questionnaire data from student responses which are presented in the form of a bar chart. The stages in carrying out data analysis are 1) carry out a recapitulation first on each statement item based on student respondents, 2) proceed with calculating the total score for each student by calculating the score for each statement., 3) the final stage is to calculate the percentage value of the student response scoring results using the following formula:

$$\%\text{NRM} = \frac{\sum_{i=1}^{n}}{NRS\ Maximum}\ x\ 100\%$$

Note:
%NRM: Percentage of Student Response Values
$\sum_{i=1}^{n} NRM.$:Total student response value for each statement item
Maximum NRM: n x 4, where n is the number of respondents

The percentage values obtained are then categorized according to the criteria contained in the Table 2.

Table 2. Criteria for The Practicality of Science Communication Skills-based Interactive E-module

Average score %	Category
85-100	Very Positive
70-84.9	Positive
55-69.9	Quite Positive
40-54.9	Less Positive
25-39.9	Not Positive

Results and Discussion

In the first stage, the research was begun by conducting a needs analysis to find analysis gaps. Researchers can find out hopes, gaps and solutions to solve problems that occur in science learning, especially in biotechnology courses. The science learning process should be able to direct students to have 21st century skills. However, based on the results of observations, it was found that there were obstacles where learning was not fully oriented towards science communication skills.

The learning process is also not supported by adequate teaching materials so that students still have difficulty expressing ideas orally and in writing in order to complete contextual case studies. Therefore, an interactive e-module is needed by integrating several indicators of science communication skills in it. The e-modules created are also packaged in digital form according to student characteristics where there is the use of technology in developing teaching materials. Students have the ability to use basic technology knowledge quite well. Many students use technology to obtain learning resources in order to complete assigned assignments. lecturer

In the second stage, an interactive e-module was developed by integrating the science communication skills with systematic material, namely the basic principles of biotechnology, types of biotechnology and examples of their products, food, agricultural, modern biotechnology and its applications and impacts on life. The learning materials and activities displayed in the e-module are designed to support the achievement of science communication skills and case study and project-based learning. Based on the results of the analysis of the science curriculum for Junior High School, there are basic competencies related to biotechnology content, namely basic competency 3.7 regarding applying biotechnology concepts and their role in human life.

The use of Canva in creating e-modules is able to accommodate links so that lecturers are more flexible in determining alternative activities and interactive learning resources. Then the e-modules produced can be in various forms such as flip books or pdfs. The display of the contents of the e-module being developed is shown in Figure 2.

Setelah kalian menyimak videonya sekarang sudah paham kan bagaimana perbedaan antara Bioteknologi Konvensional dengan bioteknologi modern? Berikut perbedaan Bioteknologi Konvensional dan Bioteknologi Modern dapat kalian lihat juga pada tabel 1.6

Tabel 1.6 Perbedaan Bioteknologi Konvensional dan Bioteknologi Modern

No	Faktor Pembeda	Bioteknologi Konvensional	Bioteknologi Modern
1.	Perkembangan	Sejak 6000 tahun SM	Sejak ditemukannya DNA oleh James D Watson dan Frances H C Crick pada 1953.
2.	Peralatan dan teknologi yang digunakan	Peralatan dan metode masih sederhana contohnya menggunakan wadah biasa	Peralatan dan teknologi yang canggih dan modern, contohnya bioreaktor dan lain lain.

Figure 2. The Interactive E-module

The third stage was carried out by conducting a validation test involving content and media expert lecturers to see the feasibility level of the interactive e-module. Based on the expert judgment results, data can be obtained that the overall percentage value of various aspects of the assessment is 83.5% with a valid category so that it can be continued for trials in biotechnology learning. Trial activities were carried out on a limited basis to obtain information regarding student responses to the interactive e-module created. Following are the results of the student response trials which can be seen in table 3.

Table 3. Student Responses toward the Science Communication Skills-based Interactive E-Module

Aspects of the Statement	Percentage	Category
Construction	85	Very Positive
Content	77	Positive
Language	78	Positive
Appropriateness of e-module display	87	Very Positive
Motivation	84	Very Positive
Attractiveness	79	Positive
Learning Presentation	84	Very Positive
Overall Average	**82**	**Positive**

The research results show that overall students gave a positive response with a percentage of 82%. This achievement has good criteria, meaning that interactive e-modules can help students practice science communication skills. This is in line with research by Aulia et al. (2020), among several types of learning resources there are modules that can be used by students independently and contain science communication skills as an alternative teaching material used by lecturers.

The first aspect, namely the construction of the e-module, obtained a percentage of 85% where students gave a very positive response. This was because students thought that the e-module was packaged in an interesting way so that it could encourage them to study biotechnology material. The material is presented clearly and completely, including related text, images and videos. Presenting concepts equipped with animation, videos and images can increase individual motivation in participating in a learning process because it can attract their attention. The e-modules used by students are also equipped with clear and complete study instructions, making them easier to use. This is in line with the statement by Turnip et al. (2021), namely that the instructions contained in the e-module are able to provide information about using the e-module so that it can make it easier to learn more deeply. The material presented in the e-module is also well structured and systematic, equipped with challenging learning activities that support the achievement of students' science communication skills. Hikmah & Astuti (2018) said that in developing teaching materials consistency is needed in presenting the discussion in each chapter in a structured manner which includes an introduction, contents and conclusion.

The content which is the second aspect obtained a percentage achievement of 77%, meaning that students perceive that the learning activities designed in the e-module are able to help students practice science communication skills, increase curiosity to learn more about biotechnology material, cases. The cases presented are very contextual in that they raise issues that occur in society which are connected to biotechnology content so that students are expected to not only develop science communication skills but critical and creative thinking skills in an effort to provide solutions to solve problems that occur in everyday life. On each topic, students are invited to be critical of the problems that occur and then students are given space to solve the case in a "speak up time" room.

In the discussion corner feature, there is an opportunity to build science communication as a form of problem solving. The e-module is designed not only to help students communicate data, but

students also carry out problem solving activities which can provide opportunities for students to train their self-confidence and give full attention to learning. In the process of solving a problem a confident attitude is needed to make decisions in determining solution steps.

In the e-module, formative tests are also available as an effort to practice science communication skills which have been adapted to the student's semester level. The percentage obtained in the content aspect is much lower compared to other aspects, this is because students think that the science communication skills questions presented are quite difficult for them because students are not used to being faced with questions that require students to build scientific communication. Student communication skills can be built through training activities, seminars, reading books and articles.

In the aspect of language, the percentage obtained was 78%, meaning that the language used in the e-module is in accordance with the enhanced language so that the e-module presented meets the standard rules in accordance with the rules of good grammar and Correct. In line with research by Mahfuddin & Wahyuni (2021), e-modules should be in accordance with Indonesian language rules, complete with correct punctuation, sentence structure and spelling. The language used in the e-module uses general terms that can be understood by students from various different backgrounds and is in accordance with the Biotechnology content being taught. The language used in the e-module is also proved that being communicative. The use of communicative and standard language in preparing teaching materials makes students understand the material being taught better. If the language used is not understood by students, the information will not be well received by the recipient of the message. The terms used are in accordance with the learning material. However, there were still several ambiguous sentences found, especially in the presentation of science communication skills questions, which could give rise to multiple interpretations among students.

The suitability of the e-module display obtained a percentage value of 87%. This indicates that students gave a very positive response where the images, illustrations, videos in the e-module matched the content of the material so that students could easily understand it. The learning material will be easier for students to understand and accept if it is supported by the use of images whose appearance is adapted to the subject. The type and size of the letters, the use of spacing, the size of the e-module is correct, the color selection used in the e-module is matched so that it makes it easy for students to learn it. If a section uses colors that lack contrast, it will make it difficult for individuals to distinguish one section from another and the size and type of letters must be used in accordance with the appearance of the teaching material. Putri et al. (2021) also added that the use of color in the e-module must be appropriate and harmonious between the color of the writing and the background color because it will enable students to read the contents of the e-module clearly.

In the motivation aspect, the percentage was 84% in the very positive category, meaning that the existence of the e-module motivates students to study Biotechnology material, think scientifically and find solutions to problem solving. Apart from that, reading and studying the contents of the e-module can encourage students to develop their science communication skills which are reflected in the learning activities contained in each discussion, practice questions, and case studies presented. E-modules are also equipped with authentic, challenging assignments that make students enthusiastic about learning. In line with Dari & Sudatha (2022), the use of e-modules that make it easier for students to solve the problems they face will increase students' enthusiasm for learning. Zaharah & Susilowati (2020) also said that the use of e-modules is expected to increase student motivation in learning which can have an effect on improving learning outcomes.

Students gave a positive response to the attractive aspect of the e-module with a percentage gain of 79%. This shows that the content in the e-module is interesting for students to read because it has an appropriate layout. This is supported by research by Hervi & Ristiono (2021) that accuracy in determining the layout can attract students' attention to use the e-module. The e-module is also equipped with attractive picture illustrations that adapt to the scope of the Biotechnology material being taught. Marsela et al. (2022) also said that illustrations can make students interested in reading the e-modules presented so that they do not feel bored compared to teaching materials which only contain text.

The learning presentation aspect received a percentage score of 84% in the very positive category, meaning that students think that e-modules can increase interest in learning, provide easy time and place to study and provide opportunities for students to be independent in learning. This happens because the e-module itself can be accessed without time limits, the e-module is also equipped with accurate material, complete instructions and a learning activity that requires students to solve a problem in their own way.

Digital modules are designed to provide space for students to be able to study independently so that it will have an impact on improving learning outcomes.

Conclusion

This research aims to describe student responses toward the science communication skills-based interactive e-module. Based on the research results, it can be concluded that the response of students to the use of interactive e-module was declared positive with an average score of 84%. These results show that e-modules are well received by science students.

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