

# Development of Science E-Module by Integrating Quantum Learning to Improve Students' Concept Understanding and Creative Thinking

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## ABSTRACT

*Twenty-first-century education requires students to have creative thinking skills. The field found that the average student learning outcomes in science subjects and the value of students' creative thinking skills were still in the sufficient category. This research aims to develop an integrated Science e-module with a quantum learning model on additive, addictive, and blood circulation material. Analysis using research and development methods with 4D models. Science e-modules are assessed using validity sheets and practicality sheets. The validity sheet is given to three lecturers who are experts in their field. Practicality sheets were given to two teachers and students – data collection techniques using questionnaire techniques. The instrument used is a questionnaire. The results showed that the average validity value was 90.4, which was very good.*

*Meanwhile, according to the teacher, the average value of practicality is 92.08 and is in the very good category. According to students, the average practicality is 80.69, which is in the good category. Thus, the integrated science e-module integrated with the quantum learning model is valid and practical.*



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## INTRODUCTION

Technological advances require every human being to have comprehensive capabilities. They must use a balanced ability between knowledge, skills, attitudes, and values in their lives (Chalkiadaki, 2018; Schleicher, 2018; Wang et al., 2018). They must harness and handle the rapidly growing information, computing, automation, and communications in everyday life. Human resources need to be well-prepared to exist and compete globally. Advances in technology encourage electronic-based teaching materials to support the changing times as they are felt today.

One of the teaching materials that can be used is the E-module or electronic module. E-Modules are modules designed in electronic or digital form that contain various interactive media (Sidiq & Suhendro, 2017; ElAdli & Musawi, 2020). E-Modules are learning materials that are made systematically to support the learning process. Teachers and students can use E-Modules easily through gadgets (Dore et al., 2018; Ramirez & Mercado, 2019). E-Modules can be designed in various formats according to needs by adding many features (Alshaya & Oyaid, 2017; Sriyanti et al., 2020). E-modules can indirectly help readers reduce the use of paper or paperless (Prabhasawat et al., 2019). The advantages of E-Module include easily accessible (Abidin & Walida, 2019), being designed with multiple media or multimedia (Suwatra et al., 2018), greater interactivity (Boticki et al., 2019), and very affordable economically because E-Modules do not need print. Other advantages of the E-module are Narration (text can be added or highlighted) (Hsieh & Huang, 2020), Hot Spots (possible images, graphics, or text are provided with links with practice question links), Audio (sound effects that can be included in the text), and Visual (images can be added with animation or video) (Bates et al., 2016; Ormançı & Çepni, 2020). E-Modules can be accessed via smartphones, laptops, or P.C. (Handayani et al., 2021).

Science events are often found in real life. In learning science, students are actively involved in identifying the context of science in everyday life, formulating problems, formulating hypotheses, conducting investigations, applying knowledge, and transferring it to other fields of science. The application of integrated science learning is active, authentic, holistic, and meaningful (Rahmania et al., 2017; Asrizal et al., 2018). The reality in the field found that the students' science learning outcomes were 47.20, while the student's MCC score was 80. Based on these data, students' natural science learning outcomes have not reached a completeness score, so improvements are needed in the learning process and the value of creative thinking skills. The average value of students' creative thinking skills is 43, which is in the sufficient category. Thus, electronic teaching material is needed to improve students' conceptual understanding and creative thinking skills through integrated science e-modules in which learning activities are arranged according to students' daily lives to learn meaningfully.

Integrated science learning is relevant to 21st-century learning. Science events that are found in real life are generally in an integrated form. For example, water, air, humans, and other living things can be seen from various sub-disciplines, including biology, physics, chemistry, and technology. With this basis, science learning starts from the real-world context. Students are trained to learn to connect science learning materials with real-world contexts. In learning science, students are actively involved in identifying the context of science in everyday life, formulating problems, formulating hypotheses, conducting investigations, applying knowledge, and transferring it to other fields of science. The application of integrated science learning is active, authentic, holistic, and meaningful (Rahmania et al., 2017; Asrizal et al., 2018). The reality in the field found that the students' science learning outcomes were 47.20, while the students' KKM score was 80. Based on these data, students' science learning outcomes have not reached a completeness score, so improvements are needed in the learning process, likewise, with the value of creative thinking skills. The average value of students' creative thinking skills is 43, which is in the sufficient category.

One of the fun learning models is the quantum model. E-modules need to be integrated with the quantum learning model. According to Wena (2013), the quantum model is a new way of integrating the learning process, which combines elements of art and subject learning objectives by combining the privileges of learning towards a form of teaching planning that will enhance students' understanding of concepts. The quantum learning model is accelerated, making learning comfortable and enjoyable. The quantum model has a learning

formula that becomes steps in the learning process. This formula is known as the Grow, Experience, Name, Demonstrate, Repeat, and Celebrate (TANDUR) formula. Students will be actively involved in learning activities by properly implementing each step of the quantum learning model. In addition, students will also learn in a lively and fun atmosphere so that students will not quickly feel bored during learning activities (DePorter, 2001). With these efforts, it is hoped that students' conceptual understanding and creative thinking will increase.

Creative thinking skills need to be improved in students so that students can answer the problems they face in their own lives (Hagi and Mawardi, 2021). Students can be said to have good creative thinking skills if they meet the characteristics of the indicators of creative thinking skills. Four indicators of creative thinking include fluency, flexible thinking, originality, and elaboration (Silalahi et al., 2020). Creative thinking skills are also included in divergent thinking, namely divergent thinking. They were spreading or expanding where one person can bring up many ideas from one initial idea or topic. Not everyone has inborn creative thinking skills. Therefore, it is necessary to hone and help use the brain differently (Abubakar et al., 2021). Creative thinking skills should be cultivated in every education in Indonesia. Good creative thinking skills are expected to support students' motivation in learning to positively impact learning outcomes (Hamidy & Merliza, 2019) or capture learning because this skill invites participants to solve problems from various points of view. Creative thinking skills are a stage of thinking skills that adapt good and correct answers to help students solve problems from multiple points of view (Atikah and Ramadhani, 2021).

Several studies have been conducted, including Cahyaningrum, Yahya, and Asyhari (2019), which state that the quantum learning model can improve student learning outcomes. The opinion of Fauzi Noviantati (2018) says that the quantum learning model can increase student learning motivation. Yahya (2017) put forward the same argument: the quantum learning model can increase student understanding. Similar research results were conveyed by Rohimah, Suprpta, and Agung (2019), who stated that the quantum learning model can grow its knowledge and think creatively to explore material with everyday life so that lessons become more interesting. Elaboration of the research results that have been carried out and the advantages of the quantum learning model can improve student learning outcomes, and the application of this model will answer or, in other words, be able to provide solutions related to the problems previously described. This study aimed to determine the valid and practical categories of integrated science e-modules integrated with quantum learning models (QLM) to improve students' conceptual understanding and creative thinking. This research differs from previous studies – first, teaching materials based on ICT science developed in E-Modules. The application used is Flip PDF Professional. Second, science learning material in the E-Module includes additive and addictive substances and the circulatory system. Third, the E-Module integrates QLM in its application. They are fourth, developing QLM-integrated Science E-Modules to improve students' conceptual understanding and creative thinking.

## METHODS

The type of research used is research and development (R&D). This research aims to develop a product through a series of trials and revisions to produce a feasible product. The research development model used is the 4D model. The 4D development model consists of four main stages: Define, Design, Develop, and Disseminate or adapt it to a 4-D model (Thiagarajan, 1974). The object of this research is the integrated science e-module integrated quantum learning model (QLM) on the material of additive and addictive substances and the

circulatory system for class VIII Semester 1. This research is expected to produce a valid and practical QLM-integrated science e-module.

The research procedure begins with the definition stage. At this stage, it is carried out to establish and define the reasons for the need for developing a product. The following research procedure is the design stage. Based on the problems obtained, the product designed is an integrated QLM integrated Science e-module to improve students' conceptual understanding and creative thinking. The following procedure is the development stage. At this development stage, experts are needed to assess the product's validity. The e-module that has been designed must first be validated by experts and then revised so that the module can be used to test its practicality and effectiveness. In this study, product validation was carried out by one UNP Physics lecturer, one UNP Science lecturer, and one UNIMED Science lecturer. Product validation is done by filling in the value of each indicator in each component on the validity test questionnaire sheet. Based on the results of the product validation assessment, it can be seen the weaknesses and strengths of the products that have been designed. The validation results will show the parts that need to be fixed. These improvements were made in the design revision stage. Modifications were made to improve weaknesses encountered by experts in the design validation process based on researchers' input. The purpose of improvement is to produce products that are suitable and suitable for use in science learning.

Then, The QLM integrated science e-module was tested in schools. In product testing, it is used to determine the practicality of the product. Practicality testing of the module was carried out by two science teachers and 32 students of SMP N 7 Padang. The practicality of the module was tested using a questionnaire sheet instrument in the practicality test. The practicality test sheet from the teacher is used to find out the opinion and assessment of the science teacher regarding the ease of using integrated science e-modules for science learning. There are four components to measure the level of product practicality, namely usability, ease of use, attractiveness, and efficiency. Each of these components is translated into several more specific indicators aimed at facilitating analysis of the advantages and disadvantages of the modules that have been made.

The data analysis technique used to assess validity and practicality is descriptive statistical analysis. Descriptive analysis is displayed in tables or graphs, so researchers only look for the average value. In this analysis, a discussion is carried out regarding assessing the validity and practicality of e-module science the QLM-integrated. Validity test results data are presented in tabular form, and the practicality test is presented in graphical form. The criteria used to determine the validation and practicality of the module (Arikunto, 2015) are if the range of values is 80-100 categories very good, values 66-79 are good categories, values 56-65 categories are sufficient, values are 40-55 categories are poor, and values are 30-39 failed categories.

## RESULTS AND DISCUSSION

### Results

#### *Preliminary Study Analysis Results*

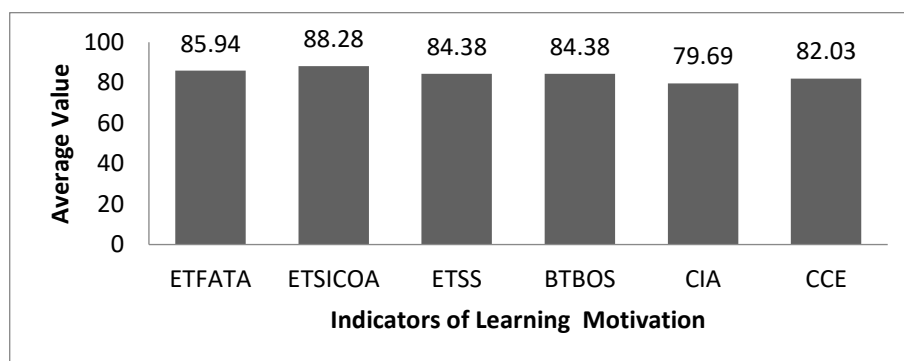
The initial study carried out was regarding the use of electronic-based teaching materials used by teachers and the obstacles experienced by students in learning science. This study was conducted using a technique in the form of interviews. The initial research found that school teachers had not used electronic-based teaching materials. We

recommend that in this era full of technology, teachers already use technology to make learning easier for students. Electronic-based teaching materials can be accessed by students anywhere and anytime. Furthermore, the obstacles faced by students were in the form of science learning resources that were not yet integrated, the delivery of subject matter was still separated, and the language in student books was challenging to understand. It is hoped that the existence of the QLM integrated science e-module can help overcome students' obstacles in learning science.

The second study is the analysis of student characteristics. This analysis was carried out to determine the characteristics of students in learning. The assessment includes learning interest, motivation, and style toward integrated science learning. The results of the analysis of each component are as follows.

*Results of Analysis on Learning Motivation Indicators*

Motivation is very important because if someone is motivated, he will surely be enthusiastic about completing the work he wants. This motivation occurs in students who participate in the learning process. Indicators of student learning motivation consist of six assessment indicators. The assessment indicators are efforts to find answers to assignments, efforts to succeed in carrying out assignments, encouragement to study science, belief in the benefits of science, creating interesting activities, and creating a conducive environment. The results of the analysis of learning motivation can be seen in Figure 1.

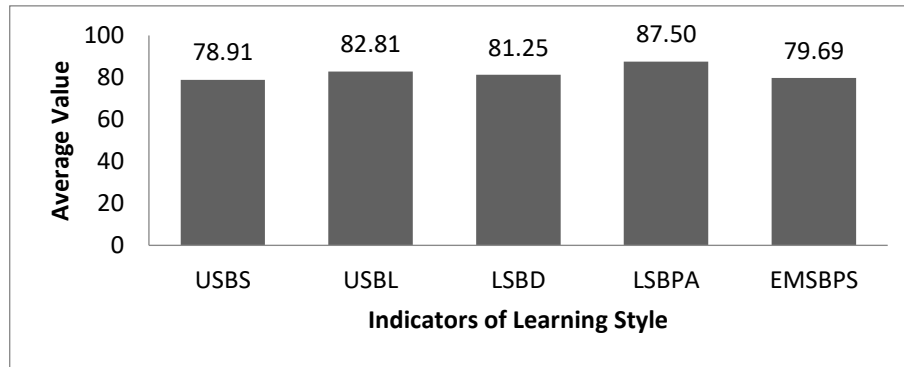


**Figure 1.** Analysis Of Learning Motivation

The data shown in Figure 1 shows that the value of each indicator of student learning motivation is in the good and very good categories. The average value of the five indicators on the learning motivation component is 84.11, with a very good category. Through these results, there has been effort, encouragement, confidence, and efforts to create interesting activities and conducive conditions for learning science.

2) Results of Analysis on Learning Style Indicators

Each student's learning style is influenced by natural factors (congenital) and environmental factors. Recognizing learning styles does not necessarily make students smarter. However, the existence of learning styles allows students to determine effective learning methods. Indicators of learning style consist of five assessment indicators: understanding science by seeing, understanding science by listening, liking science by discussing, liking science by practicum activities, and quickly mastering science by practicing science. The graph of analysis results on the learning style indicators is shown in Figure 2.

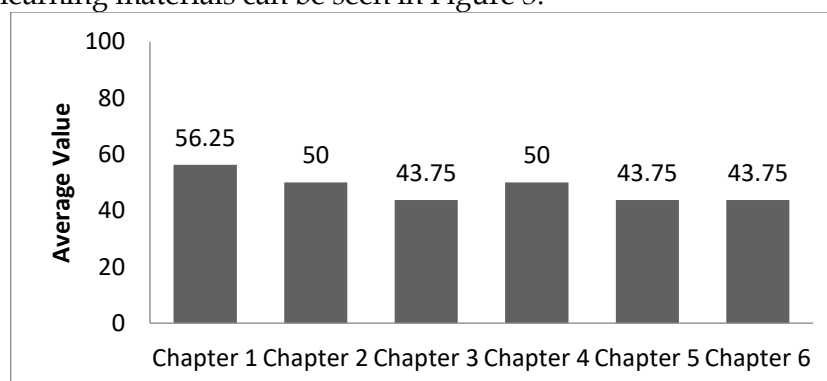


**Figure 2.** Learning Style Analysis

The data shown in the graph in Figure 2 explains the results of the analysis of students' preferred learning styles. The average value for the five assessment indicators is 82.03. The very good category is seen in understanding science through what is heard, likes discussions, and likes science with practical activities. Based on the results of this analysis, it is obtained that the preferred learning styles of students in learning science are listening, discussing, and doing science practicum activities.

The third preliminary study is about understanding science concepts for class VIII students. Initial abilities for students will significantly influence the learning outcomes they achieve. The teacher can determine where learning begins if students' initial skills are known. This analysis was carried out by looking at the Science scores from the Semester 1 MID exam results that had been carried out. As a sample, the average value of the IPA MID Semester 1 of the two classes with the same value is 44.76. The average value of the two sample classes appears to be in the sufficient category. Students' conceptual understanding can be improved again so that students' conceptual understanding can be better.

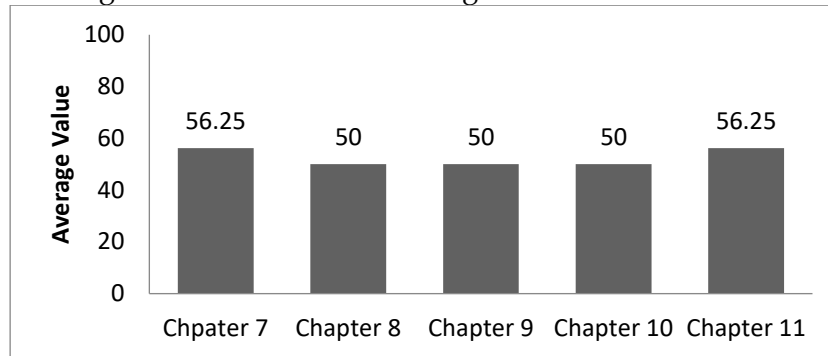
The fourth preliminary study identified the primary materials that needed to be taught in the lesson plans and teaching materials used in schools, collected and selected relevant materials, and rearranged them systematically. Learning materials were analyzed to find the integration of learning materials in each chapter in the school science textbooks. The science textbooks analyzed were for grade VIII students in semester one and semester 2. Semester 1 material consisted of the motion of living things and the motion of objects, work, and simple machines, the structure and function of plants, the human digestive system, additives, and addictive substances. , bloodstream system. The results of the analysis of semester one learning materials can be seen in Figure 3.



**Figure 3.** Analysis of Semester 1 Learning Materials

Based on the data in Figure 3, we can see an overview of the integration of science textbook learning material for class VIII SMP Semester 1. Integrating learning material from the six chapters has an average score of 47.92 in the less category. These results illustrate the

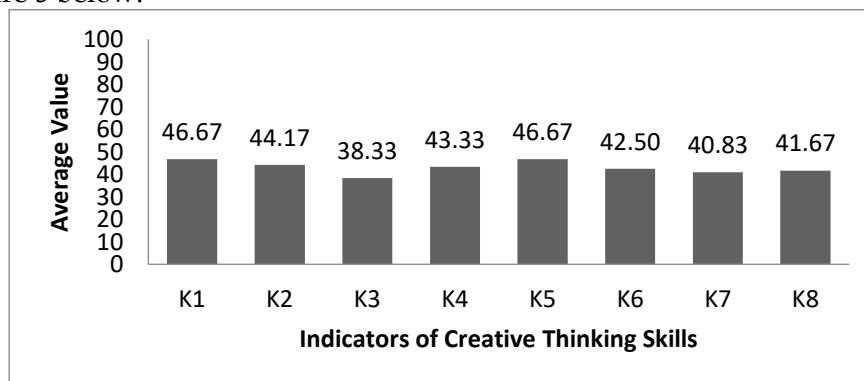
need to improve the integration of learning materials in semester one science textbooks to guide students to get integrated science learning materials. Grade VIII semester two science textbook consists of five chapters. Semester 2 material comprises pressure, respiratory, excretory, vibrations and waves, light, and optical devices. The results of the analysis of semester two learning materials can be seen in Figure 4.



**Figure 4.** Analysis of Semester 2 Learning Materials

Based on the data in Figure 4, we can see an overview of the integration of science textbook learning material for class VIII SMP Semester 2. Integrating learning material from the five chapters has an average score of 52.50 in the less category. The result illustrates the need to improve the integration of learning materials in semester two science textbooks to guide students to get integrated learning materials.

The fifth preliminary study concerns the analysis of students' creative thinking skills. This analysis was conducted to see the initial conditions of students' creative thinking skills. The analysis component of creative thinking consists of eight components, including providing various ideas or ideas, expressing many ways (K1), asking lots of questions (K2), providing different alternatives or directions (K3), putting forward many answers (K4), provide logical problem solving (K4), present new and unique expressions (K5), and propose details of an object (K6). The results of the analysis of creative thinking skills can be seen in Figure 5 below.



**Figure 5.** Analysis of Creative Thinking Skills

Based on the data in Figure 5, the values of the eight indicators of creativity can be seen. The results of the analysis show that they provide various ideas or ideas, put forward many ways (K1), ask lots of questions (K2), provide different alternatives or directions (K3), put forward many answers (K4), provide logical problem solving (K4). ), expressing new and unique expressions (K5), and proposing details of an object (K6) is in the less category. Overall, the average value of the four indicators of the creativity component is 43, with the failed category. The analysis results indicate the need to improve students' creative abilities.

**Description of Integrated IPA E-module**

The results of the following study are product descriptions. The product developed is an Integrated Science e-module integrated with QLM to improve students' conceptual understanding and creative thinking skills. The e-module is designed based on the e-module writing structure. Following are the results of the e-module cover, which can be seen in Figure 6.



Figure 6. Integrated Science E-Module

At this module's beginning is a cover and main menu. The e-module cover display contains the title, author, semester, and class. The title section explains the material to be studied, namely additive and addictive substances and the circulatory system. This teaching material is provided for grade VIII junior high school students in semester 1. The cover displays sentences written in English and is made as attractive as possible by balancing the colors. On the e-module cover are coffee and colored food and blood circulation organs representing the science material to study—the second display section of the e-module contains the introduction, content, and closing of the e-module. The learning activities contain learning objectives, material descriptions containing QLM-integrated natural science material, conclusions, exercises, and evaluations. In the learning evaluation, objective test questions related to integrated natural science material are given and packaged in quizzes. In the evaluation questions, answer keys are given to students at the end of this e-module as feedback.

The resulting QLM integrated natural science e-module is of high quality, so the validator provides various suggestions for improving the e-module. The advice given by several validators is in the form of input given by the validator on the quality of the product being developed. Some of the improvements suggested by the validator regarding the appearance of the Science e-module must be colorful and added animations so that students are interested in learning. Then, the validator also directs the correct way of writing learning objectives. Not only that, the validator also directs learning activities to integrated science e-modules according to the stages of the quantum learning model. The suggestions given by the validator are used as a first step to improve the e-module.

#### *Validity Test Results of Integrated Science E-Module*

The validity test will provide input on the products and instruments being developed. The product validity test will produce a better product because the validity test provides an



opportunity for the validator to provide input and suggestions for the product being developed. One Physics lecturer and two Science lecturers were the validators in assessing this product. The results of the validity test can be seen in Table 1.

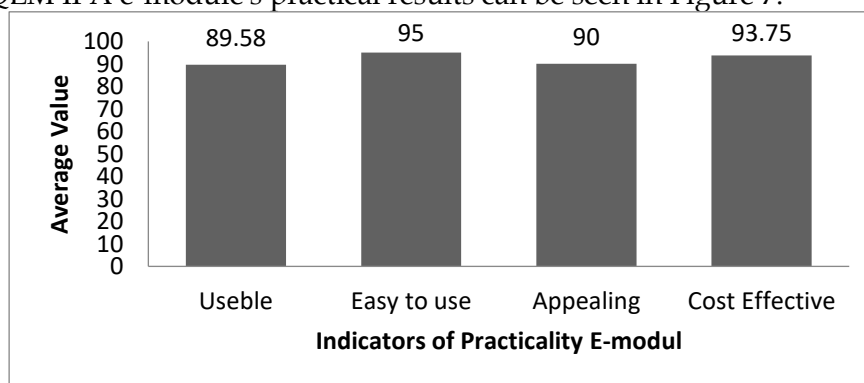
**Table 1.** Results of the Validity of the Integrated Science E-module

No	Components of Validity	Value of Validity	Category
1	Material Substance	94	Very good
2	Learning Design	93	Very good
3	Visual Communication	92	Very good
4	Software Utilization	86	Very good
5	QLM Integration Assessment in E-Modules	88	Very good
	Average Value	90.4	

Based on the data in Table 1, it can be seen that the average validity value of the integrated QLM integrated Science E-Module. The highest value is found in the material substance component. In comparison, the lowest score is on the software utilization component. Of the five components of validity, the average value, according to the validator, was 90.4. It can be interpreted that the validity of the QLM integrated Science E-Module is in the very good category. The result means the QLM integrated Science E-Module is appropriate for school use in the integrated Science learning process.

**Practicality Test Results of Integrated Science E-Module**

The result of further research is the practicality of integrated QLM integrated science e-modules. The practicality test was carried out by teachers and students of SMP Negeri 7 Padang. According to the teacher, the Science e-module's practical value was obtained from the analysis of practicality trials. The number of teachers who assessed the practicality of the integrated QLM integrated science e-module was two teachers. The practicality component for teachers consists of four components that have been analyzed. These components are: 1) usable (D.D.), 2) easy to use (M.D.), 3) attractive (M.N.), and 4) efficient (E.F.). The integrated QLM IPA e-module's practical results can be seen in Figure 7.



**Figure 7.** Practicality Results of E-module Science Integrated by Teacher

The data in Figure 10 shows the practicality of the Integrated Science E-module Applying Quantum Learning according to the teacher's response. The highest value is found in the easy-to-use component. The lowest value contained in the component can be used. Based on the teacher's response, the average practicality score was 92.08. So, it can be interpreted that the practicality of the Integrated Science E-module Implementing Quantum Learning based on the teacher's response is very good.

Second, the practicality of the Integrated Science E-module Applying Quantum Learning is seen from the students' responses after using teaching materials. Students are

given a practicality questionnaire with four assessment components: 1) usable, 2) easy to use, 3) interesting, and 4) efficient. The students found the highest integrated science e-module practicality component score interesting. At the same time, the lowest value is found in the easy-to-use component. Based on the student's response, the average practicality score was 80.69. Thus, it can be indicated that the practicality of the QLM integrated science e-module, according to students, is very good.

## Discussion

The results of the validity of the integrated natural science e-module integrated with the QLM model are very good, with an average value of 90.4. This value can be seen from the assessment given by the experts who validated the integrated natural science module integrated into the QLM model. Based on the value obtained from the validity test by experts, it can be concluded that the validity of the integrated natural science module integrated with the QLM model is very good. This aligns with previous research, which stated that the E-Module learning material on global warming based on quantum learning is valid for science learning (Zahra & Sunaryo, 2019). Another opinion is from Reswita and Wiratsiwi (2022) that e-modules created through the professional Flip PDF application can be suitable for use. Besides increasing learning motivation, these e-modules can also quickly help students achieve their needs in 21st-century learning. The same was stated by Sembiring et al. (2021) that the developed e-module can be appropriately applied in the learning process at school because it creates a pleasant learning atmosphere for students so that it can facilitate the process of transferring knowledge at school. Thus, the integrated QLM integrated science e-module is valid in schools.

According to teachers and students, the results of the practicality of the integrated science e-module integrated the QLM model. According to the teacher, practicality results showed an average of 92.08, and practicality results, according to students, were 80.69. From these two results, the practicality of the integrated natural sciences e-module integrated with the QLM model is very good. In line with the results obtained, the developed E-module contains various information and videos as knowledge support, making it easier for students to understand the material. In addition, this professional PDF flip-based e-module is also very easy to access for free, which makes learning easier. Therefore, the results of implementing education were categorized as very practical. Wahyuliani et al. (2022) that the designed e-module can make it easier for students to improve their creative thinking skills in learning at school. This is supported by research where the research results state that the results of students' responses to practical e-modules can be used directly by users (Darmaji et al., 2019; Ningsih et al., 2020; Rahayu & Sukardi, 2021; Triwahyuningtyas et al., 2020). The practicality of e-modules can impact students who are more enthusiastic about learning (Nisa et al., 2020; Sriyanti et al., 2021; Syahrial et al., 2021).

## CONCLUSION

Based on the study results, the validity value of the integrated MPK E-Module Natural Sciences to improve students' conceptual understanding and creative thinking, namely 90.4, is in the very good category. According to the teacher, the practicality value of the integrated MPK E-Module IPA is 92.08 in the very good category. The MPK integrated practical E-Module IPA practicality value, according to students, was 80.69 in the good category. Thus, it can be concluded that the MPK integrated Natural Sciences E-Module to improve conceptual understanding and creative thinking is valid and practical.

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