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E-Module of Cube and Beam Based on Inquiry for Five Grade Students of Elementary School

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Abstract: The background of this research is to produce and develop an e-module product of cube and block material centered on the approach. The teaching materials used printed books containing material and questions without any complex mathematical concepts so there is a lack of contextual learning in learning. That affects the lack of understanding of students' contextual knowledge during the geometry material pandemic. This study aims to develop an inquiry-based cube and block e-module for fifth-grade elementary students. Development research methods with 4D models include Definition, Design, Development, and Deployment. This research uses quantitative and qualitative data analysis techniques through media and material expert validators and teacher and student response questionnaires. The results showed that the inquiry-based cube and beam e-module was declared feasible or valid with an average score of 89.05%. Furthermore, e-modules through teacher and student response questionnaires obtained an average of 91.5%, which is very practical. Therefore, it influences students' cognition in understanding cube and block material with an average value of 84.1. Therefore, the inquiry-based cube and block e-module can help students improve their contextual abilities.
Keywords: E-Module, Cube and Beam, Inquiry

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Introduction

Indonesia is currently experiencing significant challenges facing industrial revolution 4.0 and COVID-19 in every field. The perceived impact of these problems is not only felt by the health sector but almost all sectors are affected, one of which is the education sector (Pragholapati, 2020). Technology can distribute information so that all students respond in the learning process (even minimum). Along with the growth of the Fourth Industrial Revolution and the digitization of the present system, learning activities throughout the epidemic utilize an online system that students may access from any location (Lestari, 2020; Ningrum et al., 2022). Strategies to improve online learning are interactions between students, creating conducive learning conditions, involving supportive learning tools, providing feedback, and creating learning content (Yulia, 2020). For example, using technology, students can produce sketches to solve problems related to experience (Hoyles, 2018; Herwin & Dahalan, 2022). So, teaching materials such as texts, reference books, journals, dictionaries, encyclopedias, magazines, and more can be accessed via mobile phones or computers online (Kufi et al., 2020; Herwin et al., 2022).

The technology module is a modern educational medium and helps learn activities during the pandemic. Creating modern media, commonly known as electronic modules, requires knowledge of the correct installation program and system (Atiwitayaporn & Vehachart, 2012; Sartono, 2022a; Sartono 2022b; Rahayu et al., 2022). The definition of an e-module is in four parts: the absence of loss of books, content, devices used to create reader content, and distribution of readers that anyone can access (Letchumanan & Ahmad, 2010). So, the use of this e-module can help achieve learning goals that students can access and cannot be lost even though time has passed, so this is advantageous during a pandemic that can be traveled long distances and can be accessed anywhere (Syah, 2020). On the other hand, e-modules in mathematics learning have failed due to students' difficulties in reasoning

mathematically in elementary schools. Each student needs concrete items based on examples of experience and phenomena ccc.

Based on the research results in the field, the teaching materials used by fifth-grade elementary school teachers, especially mathematics learning with geometry material, still use printed books or student handbooks containing material and questions. There are several disadvantages to using printed books or student handbooks in learning. Namely, the material presented is less contextual. When conducting research, students still did not understand the concept. However, there were still students who memorized the formula without understanding the concept in its application in everyday life. Thus, students have not been taught to relate the material to everyday life or their environment to find concepts. It impacts the learning process where we are currently experiencing a pandemic period. The limited face-to-face process causes online learning through technology conducive, and teachers can still deliver material to students. We need a forum that facilitates the learning process through e-modules packaged excitingly. Not dull students when studying at home, forming independent students without involving parents in their use related to the contextual cube and block material, one of the math materials.

Mathematics is a science that is related to the concept of everyday life, especially three-dimensional material (Yuniasih, Nury; Wahyuningtyas, 2019). In the opinion of Suryawati et al. (2010), mathematics is not a science for memorizing formulas to calculate and find the final result. However, mathematics is understanding and inculcating mathematical concepts by linking the lives around students to impact the process of applying mathematics in student activities. That is closely related to Bai et al.'s (2015) statement suggesting that children taught mathematical concepts do not link them in their daily lives. Because it will make children forget quickly and even cannot apply mathematics to cube and block material or geometry mathematics, namely problem solving, reasoning and proof, communicating, connection, and representation (Cook & Borkovitz, 2017). The application of various mathematical concepts is building material (cubes and blocks), known as learning geometry.

Van Hiele argues that in elementary school geometry, students will learn the material of flat shapes, building spaces where flat shapes are for third grade, and spatial shapes for fifth grade in their application. Technology-based geometry is (constructed), manipulated, measured, searched, and verified (Chan & Leung, 2014). That relates to the teaching and learning process, especially for teachers who must teach geometry to children by providing direct experience (Bayrak et al., 2014). In addition, topographical assignments can be used as a solution to increase students' abilities and skills in determining the area of the gazebo, garden, guardrail, and house volume (Vidermanova & Vallo, 2015). The geometry of the part of the concept information creates an opportunity to generate an attractive and pleasant positive attitude (Bayrak et al., 2014). Geometry is related to everyday life, for example, observing geometric shapes, reasoning geometric concepts, recognizing their properties, sorting the nature of concepts, reasoning and organizing evidence logically, and comparing geometry without being shown a concrete object (Bulut & Bulut, 2012). Geometry materials can find both printed and electronic teaching materials.

The use of teaching materials to support online learning during the COVID-19 pandemic is by using electronic modules (e-modules). According to Sugianto, an e-module is a set of independent teaching materials arranged in detail and presented in electronic form in animation, audio, and navigation to achieve learning objectives (Syukra, 2019). Independent teaching materials prepared to support the teaching and learning process are e-modules. An electronic module is a book format presented in electronic form, so a computer or electronic book reader is needed to read it. E-modules can attract students' interest in learning geometry because, in the e-modules, there are animated images, learning videos, and quizzes that can be done directly by students. One of the software used in making this e-module is a sigil. Sigil is an application for creating digital books in ePUB format stored on a flash drive. Word files converted to ePub can use the ePub Ebook Reader application to read them (Liana et al., 2019). The sigil application helps develop digital learning modules (Ramadhani & Fitri, 2020). The application of e-modules by applying an inquiry approach during learning.

The inquiry approach includes identifying questions, designing and conducting scientific investigations, formulating and refining scientific explanations, identifying and analyzing alternative answers, and communicating and defending scientific answers (Zhou et al., 2010). Inquiry learning requires a higher level of thinking, encouraging students' thinking levels (Kitot et al., 2010). As quoted by Thuneberg et al. (2018), Gorlitz states that curiosity, imagination, and games can encourage authenticity to collaborate with peers and apply research techniques. Inquiry-based learning can occur

online, where students read informational texts and conduct experiments in virtual laboratories (van der Graaf et al., 2020). The goal is to motivate students to solve realistic problems, find out about technological advances and encourage students to explore and solve problems scientifically actively (Y. A. Chang et al., 2015). Inquiry in online learning through independent reading helps conceptual mechanisms that explain phenomena around students, how the variables operate, the results of the data, and supporting evidence (van der Graaf et al., 2020).

The researcher needs the inquiry to foster curiosity and attention to find products by asking questions, obtaining data, and evaluating (Kandil & Işıksal-Bostan, 2019). They are deep learning because concrete examples prove it is based on student experience and improve student cognition (Laursen et al., 2016). The benefits of inquiry learning are interest in learning, perseverance, self-development, and cognitive and social toward mathematics (G. Tang et al., 2017). Inquiry cycles include defining problems, formulating hypotheses, conducting tests involving students, and attracting students' attention to complex components (Pedaste et al., 2015). Inquiry learning helps students develop the ability of each individual to recognize or work in a complete environment so that students can think critically and apply a balance that supports students in implementing inquiry learning through technology (Suárez et al., 2018).

Several previous studies have developed e-module teaching materials using the inquiry method with desirable criteria so that the e-module is feasible and ready to be used (Mardiah et al., 2018). Furthermore, the results of research from Wibowo's (2018) e-modules are suitable for use in group learning by using a supporting application in the form of a kvisoft flipbook maker. E-modules are towards chemical literacy skills for materials with colligative properties whose solutions are feasible to use (Irwansyah et al., 2017). Hastin's research (2020) states that e-modules can be a source of learning mathematics with material and functions using the sigil software application. In previous studies, the inquiry approach requires development with learning and other applications. In addition, this e-module increases reader understanding, so that engagement between students and readers is of high value associated with events around the students themselves (Connor et al., 2019). Based on this research, it is crucial to conduct sustainability research in developing an inquiry-based cube and beam e-module. In this research, there are still several weaknesses, both from the developing system and the use of e-modules in terms of appearance, presentation of materials, materials, or supporting images, so it is important in conducting further research. The purpose of the study was to determine the feasibility, practicality, and effectiveness of developing an inquiry-based e-module of cubes and beams for fifth-grade elementary school students.

Methods

The researcher uses 4D model development (four D models): Define, Design, Develop, and Disseminate. The researchers chose the 4D model because the developed e-modules can be arranged in detail and coherently, making it easier for researchers to develop products. First, defining activities determines the conditions, finding material limits, and online media needed in the learning process. Then, planning is to compile material according to an inquiry approach, including format selection, media selection, and initial design. In development, this stage tests two validators, namely media experts and material experts, who assess the validity of the product. A module is valid if developed based on the module development procedure and validated by experts (Faroh et al., 2018). After that, the development activities go through the validity/feasibility test, product improvement/improvement, and the trial phase. Furthermore, dissemination or distribution activities distribute with a broader reach, such as in other classes or other educational units.

The research uses quantitative and qualitative data analysis techniques. Quantitative analysis in the form of validators and respondents filling out questionnaires related to the e-module cube and beam-based inquiry for fifth-grade elementary school. The results of the validator as evidence to test the feasibility or validity of the inquiry-based cube and beam e-module. The qualitative analysis comes from media and material experts' suggestions and criticisms. Furthermore, the response of teachers and students to menisci criteria as a reference for the primary material for revision of the inquiry-based cube and beam e-module developed by the researcher.

The inquiry-based cube and beam e-module design consist of titles, basic competencies, indicators, and learning objectives. There are descriptions, instructions for using e-modules, and

material concept maps. The description of the material for the spatial e-module is the characteristics of the space structure, nets, surface area, and volume of cubes and beams. In this research, there are still several weaknesses, both from the developing system and the use of e-modules in terms of appearance, presentation of materials, materials, or supporting images, so it is important in conducting further research. Furthermore, there are evaluations in the form of assignments, practice questions, and assessments that function to measure students' abilities.

Results and Discussion

Developing an inquiry-based cube and block e-module for fifth-grade elementary school students uses the 4D method through the four stages of Thiagarajan. The stages are 1) Definition, researchers determine material limits and determine online teaching materials used during the pandemic, 2) Planning, researchers make designs such as format selection, media, and initial design, 3) development, researchers validate or test the feasibility of material experts and media based on module procedures (Faroh et al., 2018), 4) dissemination, researchers distribute e-module products with a wide range, either distributed in class or other educational units and fill out teacher and student response questionnaires and carry out learning outcomes students in the use of inquiry-based e-modules for fifth-grade elementary school students.

The design of e-modules is arranged sequentially with attractive presentations in terms of material and statements related to students' daily lives or the environment around students. Each picture has an explanatory sentence or topic according to the material and the steps of the inquiry approach to measuring cognitive or understanding of the material contained in the e-module.

Inquiry Phase Observing Problems and Making Hypotheses

The results of the e-module development are in inquiry stages 1 and 2, which are in Figure 1 below.

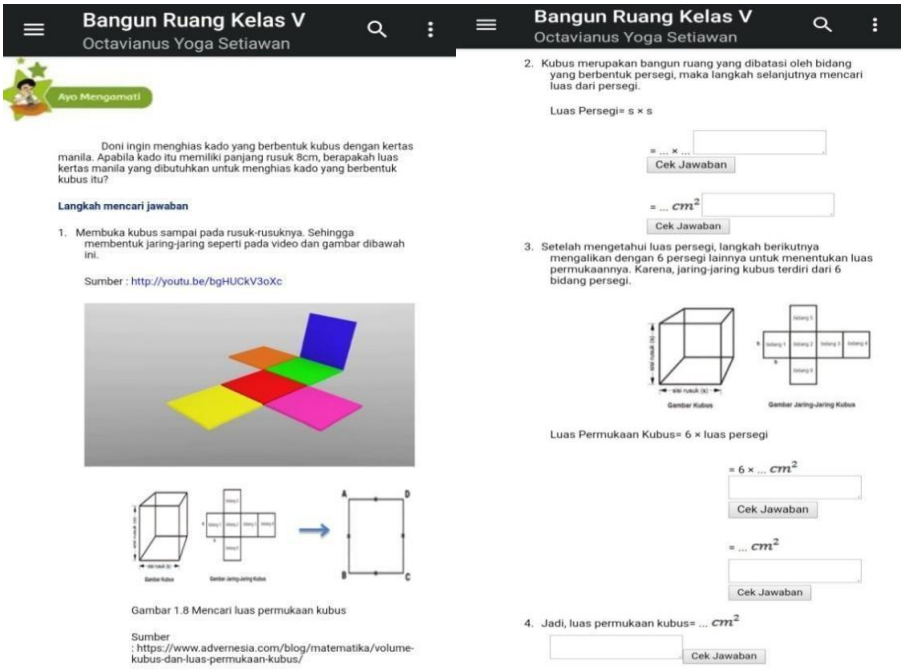

Figure 1. Inquiry Phase Observing the problem and making a hypothesis

They are based on Figure 1, observing the problem by presenting questions related to the shape of a cube in which the shape of the space with images of cube nets. First, students will observe the nets, and then the net pattern splits into a square shape. So, students will learn the concept that the shape of a cube is a combination of a flat square shape so that students will find the surface area of the cube and easily understand the volume of the cube. After students observe, students will try to express their opinions by making hypotheses or conjectures. In contrast, students will try to answer questions according to the questions presented before, from story questions to finding the area of a square and

story questions accompanied by pictures of nets. The cuboidal space determines the surface area of the cube and how to do the work step by step. More importantly, there is a check of answers. After students work, students can immediately check the answers. Is by (Villardón-gallego, 2016), states that the inquiry step is related to observing the problem with the experiences they have and making temporary guesses between the events in the e-module and the individual experiences of students. This learning also contextualizes learning with concrete facts (Bush et al., 2017).

Inquiry Stage Designing and Conducting Experiments

The results of the e-module development in terms of inquiry stages 3 and 4 are in the image below.

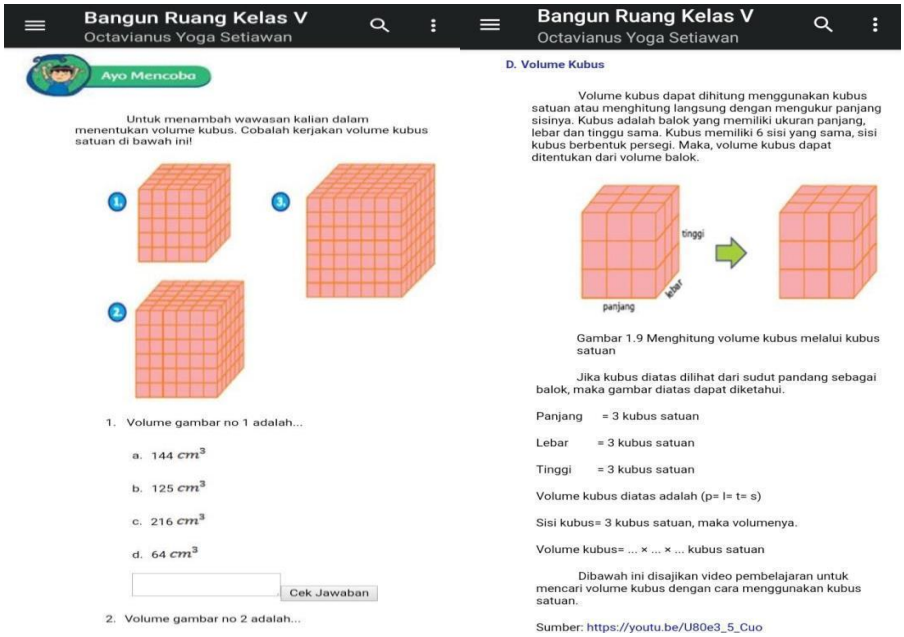

Figure 2. Inquiry Stage Designing and conducting experiments

Figure 2 is the stage after making a hypothesis or guess. That will invite the students to the stage of designing an experiment where they will find a cube presented with three images that have different sizes with the image of the cube presented in a square in it, and students will determine the volume. It is from picture one, and students immediately check the answers. After that, invite the students to experiment to obtain information. Students are trying to find a picture of a cube, calculating the volume of a cube through a unit cube by looking for students' length, width, and height. Designing and conducting this experiment can be related to understanding cause and effect, relationships and forces, designing, and collecting concrete evidence with each individual's idea that corresponds to the reality that students themselves experience about geometry (Thuneberg et al., 2018).

Inquiry Stage Analyzing data and conclusions.

The results of the e-module development in terms of the stages of inquiry 5 and 6 are in the image below.

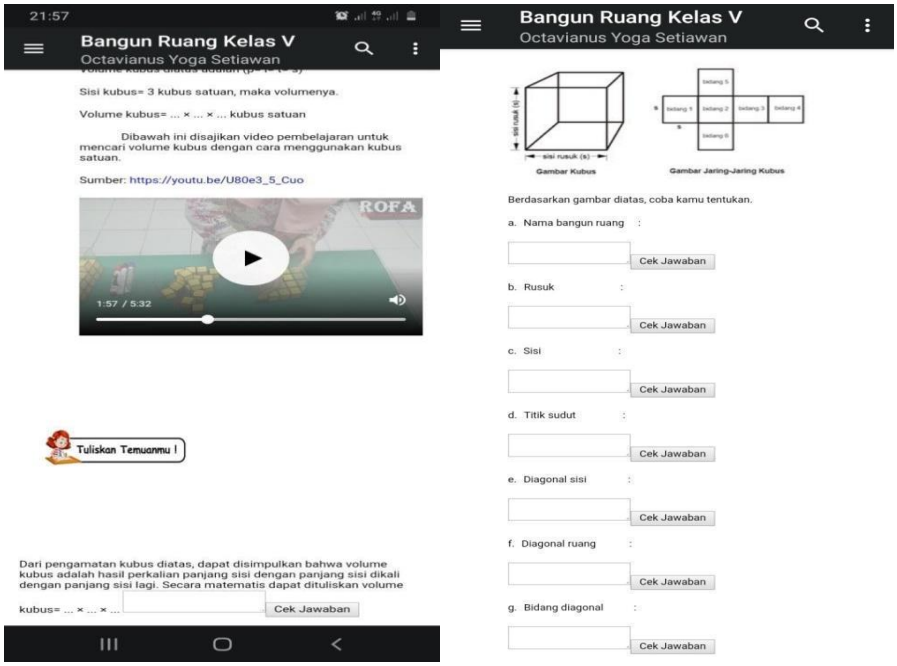

Figure 3. Inquiry Phase Analyzing data and conclusions

Figure 3 shows students collecting information through video by observing the video from beginning to end and then collecting detailed information. After that, students analyze the collection of information related to the video, and students can immediately check the answers. In the last stage, students conclude by observing the cube-shaped image and the cube nets to answer the questions, starting with the shapes' names, edges, sides, and more. Again, students can immediately check the answers. Students' efforts in developing their ideas draw a conclusion based on objective evidence with a conceptual review. It can account for it well from concepts based on student experience or literature and so on (Voet & Wever, 2017). The student experience can show increased results and satisfaction for students (Y.-L. (Aldy) Chang et al., 2015).

The stages in the inquiry approach in the e-module include (1) presenting questions or problems; (2) creating a hypothesis; (3) designing the experiment; (4) conducting discussions to obtain information; (5) collecting and analyzing data; (6) draw conclusions (Pedaste et al., 2015). This inquiry approach can attract students to participate in active learning in the classroom. That is to unite students' opinions while developing each student's personality so that the learning process takes place effectively in learning activities (Inoue et al., 2019). These stages are stages with geometric materials considering their structure, the way of reasoning interacts and producing objective evidence derived into a conclusion (Voet & Wever, 2017). Stages are arranged systematically and can be implemented in learning activities to run well and effectively and obtain effective results when used or applied during the learning process.

The researcher conducted a feasibility test practicality test and tested the effectiveness of the inquiry-based cube-based e-module. The feasibility assessment carried out by media expert validators, and teaching materials are in table 1.

Table 1. the media and material expert validation of questionnaire assessment results

Validator	Value obtained
Media expert	91%
Material expert	87,1%
Average	89,05%

Based on the assessment results in table 1, the average percentage is 89.05% in the feasible category. Learning using the inquiry-based cube and block e-module was declared feasible or valid in the fifth grade of elementary school. Researcher Kao et al. (2016) stated that e-modules could increase motivation to improve students' reading performance by ($r = 0.48$, $p = 0.05$) to have high instructiveness. That is following the research results by Cheva & Zainul (2019), which states that the validation results

from the experts obtained an average of 0.88 with a very high level of validation. Presentation experts can validate the use of e-modules with an average of 85.77% declared valid and feasible (Irwansyah et al., 2017).

After that, deploy e-module development and pass the expert validation stage and development trial. Finally, an inquiry-based cube and block e-module for fifth-grade elementary school students are ready to be distributed in the form of soft files and the addition of an application reassuringly on each student's android.

After conducting field trials by researchers in product testing in the field, the assessment results of student and teacher responses are in table 2.

Table 2. Results of Teacher and Student Responses

Respondent	Value obtained
Teachers	93%
Students	90%
Average	91,5%

The average of all teacher and student assessments showed that the inquiry-based cube and block e-module got an average score of 91.5% using the "efficient" category. That follows Buchori & Rahmawati's (2017) research with student responses using e0modules resulting in an average of 85.2% with appropriate criteria. So, the inquiry-based cube and block e-module for fifth-grade elementary school students is feasible in the mathematics learning process. The researcher analyzed the student learning outcomes test to determine the effectiveness of developing the inquiry-based cube and beam e-module. The average test score obtained after using the inquiry-based cube and beam e-module is 84.1. the inquiry-based cube and beam e-module is feasible, practical, and effectively used in the mathematics learning process in fifth-grade elementary school. The average value follows the research of Kumnuansin & Khlaisang (2015), which states that there is a statistical difference between the pretest and post-test scores; the result is 0.05 with a significant level. In addition, e-modules create characteristics and contexts for innovative thinking learning methods in everyday life so that student-centered creative learning occurs. With the e-module, students can answer questions more accurately and can answer questions given by the teacher (Deshmukh et al., 2019). The results of the research by Korat & Shamir (2008) that the exciting concept of e-module will be a means to improve literacy by conceptualizing students' context. In addition, K. Y. Tang (2021) stated that achieving better results and reducing anxiety during the learning process. The advantage of this research is that it can develop distance learning activities using e-modules that can be accessed throughout education, and activate student learning, so that collaboration occurs between students and students who think critically and lowly so that they can be maximized in learning, learning is more fun because it is based on experience. students with concrete things related to geometry topic which is declared valid, practical, and effective. The contribution of this research is conducting research from the beginning of research activities that begin by observing directly at school the problems that occur, collecting materials to overcome problems, and conducting validity, practical, and effectiveness tests to direct use in the elementary school.

The research findings of Roskos et al. (2017) stated that the basic concepts in learning activities are more controlled regarding the effectiveness of the content of e-modules for curriculum development and more active collaboration. So, e-modules are an effective solution for distance learning, one of which is that everyone has broad opportunities to access and try to solve problems in e-modules (Gorghiu et al., 2011). Inquiry learning will increase activity in learning, for example, being able to provide direction and form collaboration with peers to produce better achievements after doing the pretest (Bush et al., 2017). The use of e-modules achieves higher and lower engagement but is also widespread in social networks (Zarzour et al., 2020). Students can access geometry learning through electronic devices that help them in learning activities to develop and produce examples that provide feedback and essential information related to geometric concepts. Learning has a lasting impact on students' thinking processes through inquiry because students will learn about experiences, struggles, and challenging questions to answer (Flores, 2017). In addition, students can play an active role in the process of discovery and knowledge (Fernandez, 2017).

Based on the analysis results, e-module learning has met the criteria. The inquiry-based cube and beam e-module for fifth-grade elementary school students has met three criteria: feasibility, practicality, and effectiveness. Research has innovation in terms of display components, material that has concepts, motivates students, and the development of an inquiry approach in the era of technology and education. Thus, the inquiry-based cube and block e-module for fifth-grade elementary school students can improve students' contextual abilities in learning activities.

Conclusion

Based on the initial product design results from the discussion, the inquiry-based cube and beam e-module are declared valid or feasible. Meanwhile, the practicality of the e-module through teacher and student response questionnaires was stated very practically. In addition, the product's effectiveness using the e-module learning outcomes test by obtaining an average score of 84.1 with an effective. These acquisitions indicate the completeness of learning outcomes related to contextual students.

This research expects to develop teaching materials in the form of electronic modules, cube-based e-modules, and inquiry-based beams that can be used during a pandemic like this so that students will develop a spirit of learning and self-motivation to improve their abilities. Students will also be able to relate mathematics, especially to cube material and beam with its contextual or usually referred to as the daily life of the surrounding environment around Shiva. That is to create a mindset that Mathematics is a concept that integrates with the environment of each student. Further research can continue by displaying e-modules with more interesting material and creating a critical mindset in linking the conditions around students, e-modules can be developed not only in elementary schools but also in the world of education so that the world of education will develop further by following the development of an increasingly advanced digital era so that the spread of e-module use is further enhanced throughout elementary school levels in Indonesia planting more detailed concepts to produce innovations in developing teaching materials as sustainable research.

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