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The Development of Impulse and Momentum E-Module with Authentic Learning Content in Cooperative Learning Model Syntax

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Abstract: The Development of Impulse and Momentum E-Module with Authentic Learning in Cooperative Learning Model Syntax. Objectives: The general objective of this research is to produce an impulse and momentum e-module product containing authentic learning in the cooperative learning model syntax, as well as describing its feasibility. **Methods:** The type of research is research and development used the ADDIE model within 17 students. Data obtained through instrument used is e-module validation sheet, student response questionnaire, and learning outcomes test. **Findings:** The results showed that: (1) validity of e-module scored by 3.25 categorized as valid, (2) practicality of E-Module scored by 2.94 categorized as practical, (3) effectiveness of e-module scored by 0.57 categorized as medium. **Conclusion:** It can be concluded that e-module impulse and momentum contained authentic learning through cooperative learning model is eligible to be used in learning process.

Keywords: e-module, impulse and momentum, authentic learning.

Abstrak: Pengembangan E-Modul Impuls dan Momentum Bermuatan Pembelajaran Autentik dalam Sintaks Model Pembelajaran Kooperatif. Tujuan: *Tujuan umum penelitian ini adalah menghasilkan produk e-modul impuls dan momentum bermuatan pembelajaran autentik dalam sintkas model pembelajaran kooperatif, sekaligus mendeskrispsikan kelayakannya.* ***Metode:*** *Jenis penelitian ini adalah penelitian dan pengembangan dengan menggunakan model ADDIE. Subjek uji coba dalam penelitian ini adalah 17 peserta didik. Data diperoleh melalui instrumen lembar validitas e-modul, angket respon, peserta didik, dan tes hasil belajar peserta didik.* ***Temuan:*** *Hasilnya menunjukkan bahwa: (1) Validitas E-Modul diperoleh skor 3,25 berkategori valid; (2) Kepraktisan E-Modul diperoleh skor 2,94 berkategori praktis; (3) Efektivitas e-modul diperoleh skor 0,57 berkategori sedang.* ***Kesimpulan:*** *Diperoleh simpulan bahwa e-modul impuls dan momentum bermuatan pembelajaran autentik melalui model pembelajaran kooperatif dinyatakan layak digunakan dalam proses pembelajaran.*

Kata kunci: *e-modul, impuls dan momentum, pembelajaran autentik.*

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INTRODUCTION

Teachers and students each play an important role in learning activities which are a changing trend in the era of educational transformation in the 21st century. The teacher plays a role not only as a transfer of knowledge, but also as an active mediator and facilitator in developing the potential of students (Chen & Tsai, 2021). Global demands require the world of education to continue to adapt technological developments in an effort to improve the quality of education in its use, especially during the learning process (Kennedy & Odell, 2014).

The use of technology in the learning process leads to the use of media. This has an impact on the presentation of teaching materials that are used as a source of learning information data (Mhlanga & Moloi, 2020).

Teachers must be able to take advantage of currently developing technology in the learning process to create a fun learning atmosphere and make it attractive for students to be motivated to learn. In accordance with the statement from Mahardika, Pertiwi & Miriam (2021) that currently developing technology must be integrated in the learning process in the classroom. The progress of science and technology is not an exception that can be separated and denied its existence, so for the education sector and the system adopted in it, it is required to be able to keep pace with the development of science and technology through various fields, including through digitally packaged learning media or better known as electronic modules (Sutirman, 2016). Therefore, teachers are expected to be able to integrate information and communication technology in the learning process to make it more interesting and eliminate the impression of being rigid in teaching. Likewise, the attraction for the creation of more meaningful learning, if there is a link between the material being taught and real events for this matter contains authentic learning.

E-Module is a form of presenting material that is arranged systematically into the smallest learning units designed to achieve certain learning objectives and presented in electronic format (Susanti, Yennita, & Azhar, 2020). The module component contains the concept of delivery and the materials organization, the type of tasks assigned, the evaluation questions (Serivina, Artra, & Sari, 2018). During the covid-19 pandemic, e-modules can help students overcome distance learning obstacles, where generally distance learning that does not use e-modules only provides electronic files of material through social media or learning management system, but by using e-module, learning materials, exercises, and evaluations can be presented more attractively and increase student learning motivation (Prasetya, 2021).

Bosman & Fernhaber (2019) stated that authentic learning is a learning approach that allows students to discuss, explore, and develop ideas related to concepts and relationships involving real problems and projects that are relevant to students. This is in accordance with the results of research that authentic learning helps students to understand learning materials and can help improve student learning outcomes (Chin et al, 2015; Noreen et al; 2019). By using authentic learning, the construction of students' knowledge will be easier because it is in accordance with the existing knowledge of students' cognitive concepts. Therefore, authentically charged e-modules can help improve the quality of learning during the Covid-19 pandemic.

From the definition of authentic learning, the researcher considers that one of the appropriate learning model solutions to use is the cooperative learning model that prioritizes cooperation (discussion) between students to achieve learning objectives. Therefore, from this background, research on the development of E-Modules was carried out, entitled "Development of Impulse

and Momentum E-Modules Loaded with Authentic Learning through Cooperative Learning Models". In general, the purpose of this study is to produce an impulse and momentum E-Module loaded with authentic learning through a cooperative learning model that is suitable for use in the learning process and its specific purpose is to describe the validity, practicality, and effectiveness of the E-Module containing authentic learning. The results of this study are expected to provide benefits related to the renewability of teacher teaching resources and student learning resources and can have a positive impact on student learning outcomes.

METHODS

The subjects/ participant of this research were students of class X MIPA 1 SMAN 10 Banjarmasin as many as 17 students who took physics subjects. The technique of taking the test subject using purposive sampling.

The design of this research is Research and Development (R&D) which is used to produce a product, and to test the validity, practicality, and effectiveness of the products made (Sugiyono, 2016). The development model used is the ADDIE (Analysis, Design, Development, Implementation and Evaluation) model.

First, at the analysis stage, the researcher identified the causes of the learning problems. The analysis carried out is, analysis of existing products and needs in the field, analysis of student characteristics, analysis of characteristics of teaching materials, and analysis of facilities and infrastructure. Second, at the design stage, three activities were carried out, namely designing learning activities in the research to be carried out and designing product assessment instruments and designing learning media, namely the professional PDF flip application. The designed E-Module was designed first using microsoft word 2010 and then converted into a PDF and then imported into Flip PDF Professional.

Furthermore, the third stage, namely the development stage, activities at this stage remodel and/or add content from several books, teaching materials, and E-Modules from various sources and combine material content with authentic images and videos, because the E-Modules developed contain authentic learning. At this stage, so that it can be accessed through students' smartphones of various types, development is also carried out by using hosting for web services.

At the development stage, several actions were also carried out, namely validation, revision, and simulation. In addition, so that it can be accessed through students' smartphones of various types, development is also carried out by using hosting for web services.

The four stages of implementation are applying the impulse and momentum E-Module containing authentic learning through the cooperative learning model to determine its feasibility. The application of the E-Module will be tested on students of class X MIPA 1 SMAN 10 Banjarmasin.

The fifth stage is the evaluation stage which includes formative and summative. Formative evaluation is carried out at each phase of the ADDIE model for the refinement of the E-Module. While the summative evaluation was conducted to determine the feasibility of the developed E-Module based on the values of validity, practicality, and effectiveness.

The research data was obtained based on the E-Modul validity sheet instrument, student response questionnaires, and learning outcomes tests. The E-Module was validated by three validators consisting of two physics education study program lecturers as academic experts and one practitioner, namely a physics teacher at SMAN 10 Banjarmasin. The validity of the E-Module has a score range of 1 to 4. The assessments of the three validators are averaged and adjusted according to the validity criteria used from Widoyoko (2016): $x > 3.4$ (very valid);

2.8 < x d" 3.4 (valid); 2.2 < x d" 3.8 (Sufficiently valid); 1.6 < x d" 2.2 (less valid); and x d" 1.6 (invalid).

To calculate the reliability between the three validators using the Cronbach Alpha formula as follows.

$$r_{11} = \left[\frac{k}{k-1}\right]\left[1 - \frac{\sum \sigma_b^2}{\sigma_t^2}\right]$$

Information:

r_{11} = Instrument reliability
k = Number of assessment items
$\sum \sigma_b^2$ = Sum of variances
σ_t^2 = Total of variances

The determination of the reliability of the validated e-module assessment used criteria from Arikunto (2014): 0.80 d" r_{11} d" 1.00 (very high); 0.60 d" r_{11} d" 0.80 (high); 0.40 d" r_{11} d" 0.60 (medium); 0.20 d" r_{11} d" 0.40 (low); and 0.00 d" r_{11} d" 0.20 (very low).

The practicality data of the e-module contains authentic learning seen from the student response questionnaire sheets. The assessment is calculated by averaging the scores obtained and then the results of the average scores are adjusted to the students' questionnaire responses according to the practical criteria used from Widoyoko (2016):): x > 3.4 (very practical); 2.8 < x d" 3.4 (practical); 2.2 < x d" 3.8 (Sufficiently vali practical d); 1.6 < x d" 2.2 (less practical); and x d" 1.6 (not practical).

The reliability of the student response questionnaire used the Alpha Cronbach formula and was measured by the criteria in Table 2. The response questionnaire was distributed to students in the form of a link (google from) that could be accessed and filled out by students.

Data on the effectiveness of the e-module is seen from the test of student learning outcomes by conducting a pretest and posttest which are distributed in the form of a link (google form). According to Richard Hake (1998) the level of student learning outcomes is determined by using

$$N_{-Gain} = \frac{S_{Posttest} - S_{Pretest}}{S_{Maximal} - S_{Pretest}}$$

the following normalized gain (N-gain) equation.

The effectiveness criteria can be seen from Hake (1998): 0.70 d" n-gain d" 1.00 (high); 0.30 d" n-gain d" 0.70 (medium); 0.00 d" n-gain d" 0.30 (low).

The student learning outcomes test is distributed in the form of a link (google form) that can be accessed and filled out by students in collecting the answers.

RESULT AND DISCUSSIONS

The results of the development of this e-module are used to support the learning process for class X MIPA 1 SMAN 10 Banjarmasin which is carried out online through google meet. This research was conducted online due to the covid-19 pandemic status. The e-module is designed by implementing the revised 2013 curriculum and is expected to be used as a source of independent study material by students.

The Impulse and Momentum e-module containing authentic learning consists of 51 pages. and composed of several parts, namely: cover, preface, table of contents, instructions for use, concept maps, material descriptions, physics info, sample questions, practice questions, quizzes as learning evaluation materials, summaries, and bibliography. The e-module is structured for 3 meetings, namely the first meeting of the concept of impulse and momentum which includes the concept of impulse, the concept of momentum and the impulse-momentum relationship. At the second meeting of the law of conservation of momentum and at the third meeting the types of collisions in which there are three types of collisions, namely perfectly elastic, partially elastic

and not at all elastic. Making the e-module developed by the researcher in the form of a flipbook using the help of the Flip PDF Professional application. The application provides links, hyperlinks, images, audio and video. Then the e-module is published by using hosting for web services so that it can be accessed through students' smartphones of various types.

This e-module developed is updated in terms of material, examples of questions and questions that are related to real events (containing authentic learning) and are also supported by video and audio features in order to help students better understand the material presented. In addition, this e-module is made in a cooperative learning model setting which has six phases. In the first phase, namely conveying the learning objectives that have been provided in the e-meodul and

motivating participants to be encouraged to learn them. The second phase is to present the information that has been presented in full regarding the impulse and momentum material. Next, the third phase is organizing students into study groups that will be distributed by the teacher based on the number of students available. The fourth phase is guiding the group to work and study where the teacher guides students when working on group exercises and the teacher guides them. The fifth phase is the evaluation of students by doing individual quiz questions. Finally, the sixth phase is to give awards to students in the form of the number of stars obtained based on the number of scores obtained both individually and in groups. The following is a table of design drawings resulting from the development of the e-module.

The e-module containing authentic learning are categorized as suitable for use in the learning process if they meet the valid, practical, and effective criteria. The following is a description of the results of the validation, practicality and effectiveness of the e-module with authentic learning.

The Validity of E-Module with Authentic Learning Content

The results of the validity of the e-module are assessed from the aspect of content and construct. In the content component, the average validity score for the Software aspect indicator is 3.38 in the valid category, content quality is 3.15 in the valid category, content organization is 3.50 in the very valid category, language is 3.08 in the valid category, and the evaluation is 3.33 with valid categories.

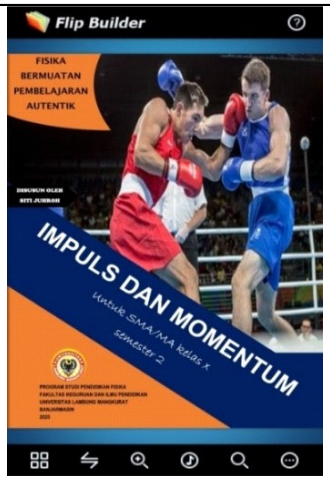
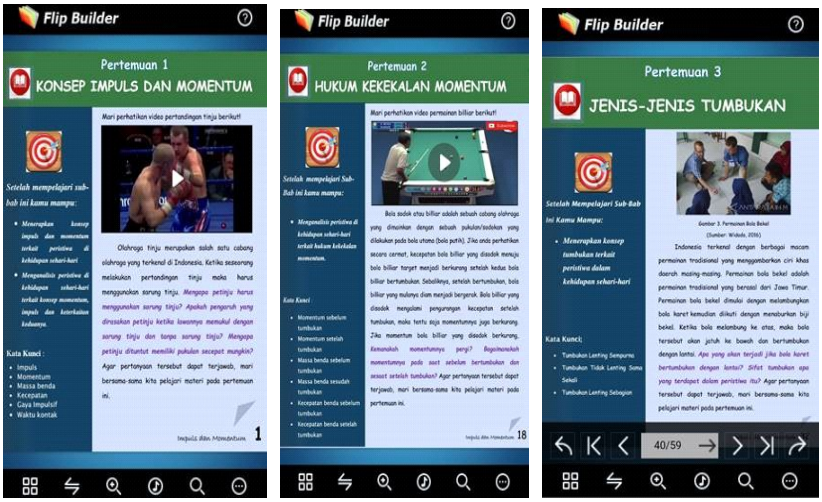
In the construct component, each of the obtained average validity scores for the construct consistency aspect indicator is 3.11 in the valid category, format is 3.33 in the valid category, appeal is 3.25 in the valid category, Font Shape and Size is 3.22 in the valid category, and characteristics is 3.33 with valid category.

Based on the average score of content and construct validity, the validity of the e-module is 3.25, which means it is valid with a reliability of 0.95, which means that the reliability is very high.

The results of the assessment for the value of validity include aspects of content and aspects of the construct which can be seen in Table 6 in the valid category with an acquisition score of 3.25 and for the reliability of the e-module in the very high category with an acquisition score of 0.95 with minor revisions.

Based on the content aspects, which include: software aspects with valid categories which indicate that the application description is clear, does not take up much memory and also uses the right software, namely a professional PDF flip application and the e-module icon button works well with loading the application not too long or short. The content quality aspect has a valid category that the criteria for the content of teaching

Table 1. E-module design

Result	E-modul Screenshots
Cover	
Contents of e-module: ➢ Meeting 1 ➢ Meeting 2 ➢ Meeting 3	

materials containing authentic learning have an accurate breadth and depth accompanied by facts, concepts, principles, theories, symbolic terms, units and accompanied by authentic examples of questions with systematic solutions to make it easier for students to understand. understand it. The organizational aspect is categorized as very valid, this means that the material in this e-module is arranged systematically, sequentially, and regularly with the aim that students' thinking activities can run in a sequential and systematic manner. The linguistic aspect has criteria that are categorized as valid which shows that the language used is clear, according to the concept and easily understood by students. The evaluation aspect has a valid category, in which there are quiz questions as evaluation materials with an even level of difficulty and are used to measure the achievement of learning objectives and evaluation also aims to ensure whether students have met the required standards.

Furthermore, the construct aspect includes aspects of consistency which are categorized as valid use of terms or symbols, spacing, distance between titles and the first line, between titles and the main text, shapes and letters consistently. Second, the format aspect also has a valid category, this means that the column format is used according to the shape and size of the e-module. Third, the attractiveness aspect also has valid category criteria, which means that images and videos are useful for conveying clear and interesting material messages and because of the relationship between the material being taught and real events or containing authentic learning. In accordance with the definition of authentic learning, namely, learning that is more closely related to real life. Aspects of form and letters are categorized as valid which indicates that the shape and size of the letters are appropriate and easy to read. Aspects of the characteristics of the e-module have valid categories which include: Self Instruction, meaning that this e-module can be used by students to learn independently without depending on the presence of the teacher. Self-Contained, which means that students can learn the material that has been packaged in a unified whole completely. Stand Alone means that the developed e-module does not depend on other media. Adaptive which means that e-modules can adapt to the development of science and technology which is one of the growing trends in 21st century learning now and is flexible to use and teachers can integrate it in the learning process. User friendly means that the e-module is easily accessible by students.

The Practicality of E-Module with Authentic Learning Content

The results of the practicality of the e-module containing authentic learning from the overall student response questionnaire covering aspects of benefits obtained an average score of 2.92 this is in the practical category, aspects of convenience obtained an average score of 2.87 this is in the practical category and aspects of efficiency e-model obtained an average score of 3.00 this is in the practical category. From the three practical aspects observed, the practicality of the e-module is 2.94 which is in the practical category and reliability of 0.73 in the high category.

In the aspect of convenience, it has a practical category with a score of 2.87. This shows that the e-module is easy for students to use during the learning process in understanding the content of the material contained. In addition, this e-module is flexible in its use because it is easily accessible at any time. This is in accordance with the statement from Song, Tang, & Awang (2021) that flexible e-modules are those that students can access whenever they want to study independently.

The benefit aspect has a practical category with a score of 2.92. This states that e-modules provide benefits to students and during learning by using these e-modules make learning fun by presenting authentic videos and pictures and making students gain a lot of new knowledge and information. Studying in groups during learning can increase interaction between students and can exchange knowledge about the impulse and momentum material being studied. The efficiency aspect has a practical category with a score of 3.00 which indicates that the impulse and momentum e-module contains authentic learning that is efficiently carried out in the learning process.

The Effectiveness of E-Module with Authentic Learning Content

The results of the effectiveness of the E-Module containing authentic learning in terms of learning outcomes tests students with n-gain calculations. The average score of students in the pre-test was 28.19 and the average score

of students in the post-test was 69.25. From the analysis of all students' pre-test and post-test scores, the average n-gain was 0.57 which was in the medium category.

The students' pretest and posttest results are used to determine the N-gain (Selvia, Arifuddin & Mahardika, 2017). The effectiveness of the E-Module impulse and momentum loaded with authentic learning in terms of the results of the calculation of student learning outcomes measured from the pretest and posttest in the form of an essay test of 8 questions using the N-gain test with a moderate category with an acquisition score of 0, 57. Based on the average value of the acquisition score at the time of the pre-test and post-test, it can be seen that it has increased, so this e-module can be said to be effective in improving student learning outcomes. This is because it is influenced by several factors including, teaching materials in the form of E-Modules that are presented can combine learning materials, pictures, and videos which are one of the attractions for students to learn. In addition, the E-Module presented contains authentic learning which has the advantage that learning is student-centered and gives them a learning experience in interacting with the surrounding environment, thus making the learning atmosphere more fun and more meaningful. This is in accordance with the statement from Dewi & Primayana (2019) that physics will be more meaningful if it has a link between the material being taught and everyday life. Students will also have skills in analyzing real problems related to learning, and allow students to understand the material as a whole. According to Theelen, Van den Beemt & Brok (2020) that authentic learning is designed to connect what students are taught in school with real-world problems and applications. As for other factors that influence it, namely during the learning process takes place using a cooperative learning model with one of its characteristics, namely prioritizing cooperation between students in groups who have different levels of ability to solve academic problems.

CONCLUSIONS

It was concluded based on the results of development and testing that the impulse and momentum e-module contains authentic learning through cooperative learning models that are suitable for use in the learning process. This is supported by the research data, namely, (1) Impulse and momentum e-module charged with authentic learning through cooperative learning models are declared valid based on the valid e-module validity sheet, (2) E-module impulses and momentum charged with authentic learning through the cooperative learning model is declared practical based on the student response questionnaire which is categorized as practical, (3) the impulse and momentum e-module containing authentic learning through the cooperative learning model is declared effective based on the results of the n-gain test seen from the results of the pre-test and post-test categorized currently.

The findings in this study also show that authentic learning and cooperative learning syntax which is generally only used in face-to-face learning can be integrated in the development of e-modules and are suitable for use in distance learning. In this study, there are also limitations, namely the e-module developed has not yet integrated a virtual laboratory to support distance learning of physics.

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