



Development of Interactive Digital Module Based on Virtual Laboratories in The Covid-19 Pandemic Era in Dynamic Fluid Materials

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Abstract

Research and development for distance learning has been carried out during the Covid-19 pandemic which has produced learning media in the form of an interactive digital physics module based on a virtual laboratory for dynamic fluid material. At the development stage, the research was carried out at SMAN 1 Tempel, to test the use of modules in class XI MIPA1. The research method used is the theory of research and development (research and development) or R & D by Sugiyono. The module view uses the Flip PDF Professional application and the content is self-learning videos with the vokoscreen application, youtube link, PHET application, Quizizz. The digital module was validated by media expert lecturers and material content experts, as well as module trials by 35 students of class XI MIPA1. The results of the validation of the media expert obtained 92.36%, the expert validation of the material content was 86% so that the expert validation obtained by the classification of the module was very valid / very feasible to use. The results of student responses using the module gave an average response of 87.8% with a good category, with an average quiz result of 78. These results indicate that the use of interactive digital modules based on virtual laboratories on dynamic fluid material is very feasible, easy, and attracts students to studied physics at home during the C-19 pandemic.

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INTRODUCTION

In order to prevent the spread and transmission of the Corona Covid-19 virus in educational units, the Ministry of Education and Culture has taken a policy to close schools during the Covid19 pandemic. During the closing period, teaching and learning activities were transferred through the implementation of distance learning (PJJ), in accordance with the Circular of the Secretary General of the Ministry of Education and Culture Number 15 of 2020 concerning Guidelines for Organizing Learning from Home in an Emergency for the Spread of Coronavirus Disease (Covid-19) and letters Circular of the Head of the Yogyakarta Special Region Government's Youth and Sports Education Office number 42/02280 dated March 20, 2020 regarding distance / home learning for school children in the context of preventing Covid-19.

In the letter, activities are arranged for students studying at home which are initiated by the teacher with distance learning, with an online model by optimizing virtual classes, or giving assignments/projects to students in the form of activities that foster creative and innovative thinking skills.. Switching from face-to-face learning to distance learning amid an unprecedented crisis, with little experience or preparation, will be a huge challenge for teachers. For example, teachers must review the curriculum, focus on literacy and numeracy, prepare different lesson plans, to determine the methods and interactions used in delivering learning online, offline, or a combination of both, Learning from Home through Distance Learning, Minister of Education and Culture Circular Number 4 Years 2020 is 1). Providing a meaningful learning experience for students, without being burdened by the demands of completing all the achievements of the curriculum for class promotion and graduation. 2). Focusing on life skills education, among others, regarding the Covid-19 pandemic. 3). Provide a variety of activities and learning assignments from home between students, according to their respective interests and conditions, including considering gaps in access / learning facilities from home. 4). Provide feedback on evidence or products of learning from home activities that are qualitative and useful for the teacher, without being required to give a qualitative score.

The implementation of learning from home, the teacher ensures the learning competencies to be achieved, does not force the completion of the curriculum and focuses on life skills education; prepare learning materials with a

material focus on: a. literacy and numeracy; b. prevention and handling of the COVID-19 pandemic ;. determine the methods and interactions used to deliver online, offline learning, or a combination of both; determine the type of learning media, such as text format, simulated audio / video, multimedia, teaching aids, and so on in accordance with the learning method used; and teachers need to increase capacity by taking online training provided by the government and non-governmental organizations to support skills in organizing PJJ in an emergency situation of COVID-19. Facilitating face-to-face virtual distance learning online via video conferencing, teleconferences, and / or group discussions on social media or Learning Management System (LMS) messaging applications. LMS is an online integrated learning management system through the application. Examples of LMS include virtual classroom, learning house, google classroom, teacher room, Zenius, Edmodo, Moodle, LMS seamolec, and so on. Facilitating offline distance learning using books, modules and teaching materials from the surrounding environment using television media, using radio (Kemendikbud, 2020).

Regarding remote learning during the pandemic, this is in accordance with the three 21st century education concepts that have been adapted by the Ministry of Education of the Republic of Indonesia for the development of elementary and secondary school curricula, namely 21st Century skills, scientific approach, learning, assessment and authentic learning. 21st century skills are life and career skills, learning and innovation skills and information media-technology skills. In online learning teachers must identify problems that arise, determine strategies, analyze student learning modalities / styles, determine the type of online learning as needed (LPPKSPS Kemendikbud, 2020: 2).

Based on direct experience in the field from March 2020 to the end of 2020, there were many obstacles in distance learning during the Covid-19 pandemic that did not seem to be over. Constraints or problems that arise from both teachers and students are: there are some students who have a slow response in the formation of virtual classrooms, in this case the WA group, telegram, google classroom; when face to face with the Zoom application, google meetings are sometimes constrained by internet signals, on-of electricity, student complaints about quotas, there are students who are not ready even though they have been told beforehand, waiting for a few minutes for students to attend virtual so that learning becomes ineffective.

Based on the above problems, it is concluded that a medium that is able to help students understand teaching material is needed better, fun without creating stress can be done independently can be on-off line. Media is also very helpful for teachers to support learning physics with experiments during the Covid-19 pandemic. Therefore, an e-module for the development of physics learning with this virtual laboratory was created, in which students get an encouragement to think more critically and creatively.

The learning model during the Covid-19 pandemic was online learning, so learning could not be separated from the use of information science and technology. This has become the latest lifestyle that brings a new paradigm to learning media in the world of education. Products of technology and information provide alternative learning media in digital form, including electronic modules based on electronic multimedia or interactive digital modules.

According to Imansari and Sunaryantiningsih (2017), various types of print media, one of which is a module, can be transformed into digital or electronic forms, known as e-modules. The use of interactive e-modules in learning is made by combining two or more media (text, graphics, images, audio, video, or animation) which can lead to a two-way relationship between the module and the user, which involves the senses of sight and hearing, so that students are motivated to be active, creative, and independent in learning (Aprileny et al, 2019).

An interactive e-module is defined as a module that combines two or more interactive text, graphics, audio, video, or animation to control a command, which then creates a two-way relationship between the module and its users (Prastowo, 2015). Therefore, the integration of an interactive e-module with the learning process can encourage students to actively learn. In addition, this multimedia-based interactive e-module display will make students more free to choose, synthesize, and elaborate the knowledge they want to learn and master (Rita, 2014). This digital module is interactive because students will experience interactions with various available navigation and will also be active, such as being active in viewing animation, listening to audio and also watching videos (Abdullah, 2013).

The concept of interactive in E-books refers to the interaction between users and E-books which allows users to run and manipulate various forms of media, such as text, sound, video, computer graphics, and animation. The interactions between users and the E-book are: (1) there is feedback when users answer

questions; (2) users can run video, audio and animation, as well as various other tools (Alifya, 2020).

From this description, it can be concluded that the interactive digital module is an interactive media / teaching material in the form of a flip book as if opening a real book sheet by sheet. Students can act actively run and manipulate text, sound, video, computer graphics, various animations, and there is feedback when working on questions and various other tools.

A virtual laboratory or virtual lab is a series of laboratory equipment in the form of interactive multimedia-based computer software, which is computer-operated and can simulate learning activities in the laboratory as if the user were in a real laboratory. Virtual laboratories are superior products resulting from advances in information technology and laboratories, learning using virtual laboratories can be used as an alternative to eliminate the limitations of laboratory equipment (Wegener et al., 2012). The virtual laboratory is a series of programs that can visualize abstract or experimental phenomena so as to increase learning activities in an effort to develop skills needed in problem solving. A virtual laboratory provides many advantages, namely that it can carry out dangerous experiments without harming yourself or others, simulations are affordable, can be done at any time, do not require a lot of money, the experimental results obtained are always the same, and a virtual laboratory allows for independent or collaborative work in relation to lessons (Swandi, 2014).

From this description it can be concluded that a virtual laboratory is a laboratory in the form of software (software) that is run by a computer, all laboratory equipment is provided by various kinds of simulation software. With this software there are many experiments that can be done, students can use practicum simulations for various types of material topics. PhET simulation is a virtual tool that resembles the actual situation, so this simulation PhET can be used as an alternative in carrying out practicum learning physics (Hikmatul, 2019). The virtual laboratory used in this interactive digital module is a PhET (Physic Education Technology), a simulation medium for learning the results of the use of information and communication technology developed by the University of Colorado. The application of active learning media needs to pay attention to the physical and cognitive activity services of students (Kristiyanto, 2017).

METHOD

The type of research that will be used in this research is research and development or R&D by Sugiyono (2013). In the scope of education, this type of research is very influential in improving the quality of education. The quality of education can be increased through the products produced. The product produced in educational research is the development of teaching materials (Dwi, 2019).

The 10 steps of research and development according to Sugiyono (2013). The steps used in this study are up to the sixth step, namely the use trial. The research subjects were students of SMAN 1 Tempel class XI IPA in the academic year 2020/2021 who were users in the module trial process. The object of this research is the development of interactive digital modules based on virtual laboratories on dynamic fluid material, carried out in the first semester of the 2020/2021 academic year between September and November 2020.

Located at SMAN 1 Tempel, students learn from home and teachers remain at school. The form of data used is the quality of the module based on the validation of media and material experts using a questionnaire, the value of the student quiz after learning becomes an indicator of student interest in the interactive digital physics module that has been produced. Student responses are taken from a google form questionnaire sent to students via google classroom / telegram group. This data is used to determine the response of students after using the interactive digital physics module that has been developed. This data can also serve as a reference for the next steps, namely steps seven to ten. Data analysis used a score or scale obtained by adopting a Likert scale with a scale of four.

RESULTS AND DISCUSSION

The results of the development carried out resulted in an interactive digital module based on a virtual laboratory with PHET simulations implemented during the Covid-19 pandemic with online-offline combination distance learning (PJJ).

Pensions and problems

Since distance learning has been implemented a combination of online - offline (face-to-face Virtual, Learning Management System, using books, modules and teaching materials from the surrounding environment) where students learn from home and teachers continue to work from school. Teachers must review the curriculum, focus on literacy and

numeracy, prepare different lesson plans, to determine the methods and interactions used in delivering learning online, offline, or a combination of both, while still paying attention to health protocols during the pandemic. Teachers are required to always be professional and learn to learn new things in accordance with the demands of 21st century learning and the pandemic situation. In accordance with the Principles of Implementation of Learning from Home Circular Letter of the Ministry of Education and Culture Number 15 of 2020, among others, BDR activities are carried out to provide meaningful learning experiences for students, without being burdened with demands to complete all curriculum achievements; Activities and assignments during BDR may vary between regions, educational units and students according to their respective interests and conditions, including considering gaps in access to BDR facilities.

Starting from the above and experiences during distance learning where virtual face-to-face via video conferences (the Zoom application and google meet) is often ineffective with short lessons one time face to face 60 minutes due to various obstacles, including signals from students, teachers, students complain that the quota is running out, students are not ready even though they have been told one day before.

In each basic competency there is KD 4. Which contains presentations and experiments, this still has to be carried out to provide meaningful learning experiences for students. With the various considerations above, the most appropriate for the current situation is to make an interactive digital module design where students can do learning without being bound by school schedule time, can learn to understand material as needed, can do practicum assignments virtually, technology quiz questions are just tools . The commitment, creativity and care of teachers will show a difference in distance learning experiences for students (Kemendikbud, 2020).

The data collection strategy or information greatly affects the results, some of the strategies carried out are extracting information from students when distance learning takes place what are the obstacles and what is desired, then studying the syllabus, basic competencies of physics subjects in class XI during the Covid-19 pandemic, sources of information such as journals related to the development of teaching materials, studying various applications supporting interactive digital module products and other sources of information relevant to the research and development of this module.

Product Design

Product design includes: designing the cover page or module cover; The interactive digital module content display consists of a list of active contents (which can be linked), learning objectives, module usage instructions, introductory material, virtual laboratory worksheets, PHET application videos, Bernoulli video material accompanied by video practice questions and interactive quizzes ; and at the end of the module there are practice questions

and interactive quiz exercises, there is feedback or quiz results scores when students have completed the quiz. For those who have mastered the material, or passed a score of 75 or completeness of 75%, it is recommended to continue the quiz with the Quizizz application, whereas, for those who have not completed it, it is recommended to repeat studying the module again. Part of the module display is shown in Figure 1.

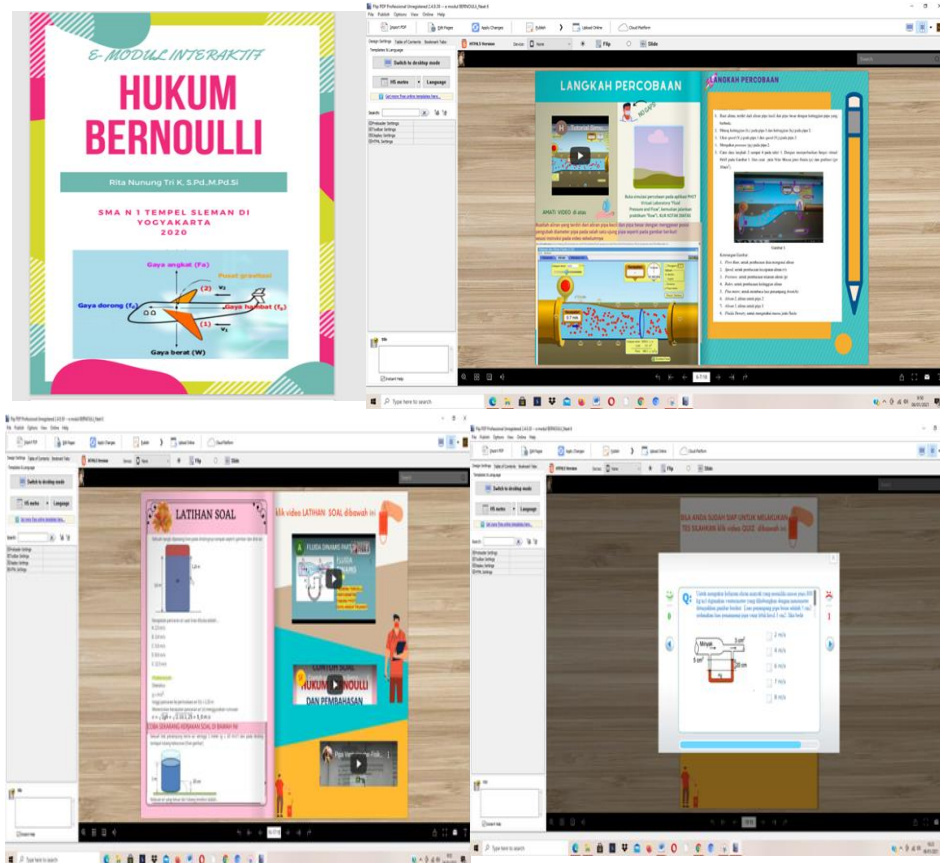


Figure 1. Module view

Validation of Media Expert Module and Material Content

Based on the conversion table and the qualification of the valid results, it was found that the aspect average was 92.36%, then the results of the expert validation of the interactive

digital media module developed by WHK could be tested because they had entered a very valid classification. Table 1 is the analysis of conversion data and classification of interactive digital modules based on the analysis of media experts.

Table 1. Data conversion and classification of interactive digital modules based on media expert analysis

No	Aspect	Score	Max Score	Aspect Average (%)	Classification
1	Conformity for Purpose	18	20	90	Very Valid
2	Aspects of Conformity with Learning	28	32	87.5	Very Valid
3	Practical, flexible, and enduring	20	20	100	Very Valid
4	Cost	4	4	100	Very Valid
5	Access	19	20	95	Very Valid
6	Suitability of Target Grouping	22	24	91.6	Very Valid
7	Technology Quality	19	20	95	Very Valid
8	Novelty	3	4	75	Sufficiently Valid
Total score		133	144	92.36	Very Valid

The results of the validation of the material content expert BR, obtained an aspect average of 86%, so the results of the expert validation of the content of the interactive digital module material that were developed could be tested because they had entered a very valid classification. So that the results of the module development are very feasible to use even though there are several

things that need improvement and the final conclusion from the media experts is that it is very feasible to use without revision. Table 2 is the analysis of conversion data and classification of interactive digital modules based on the analysis of media experts.

Table 2. Data conversion and classification of interactive digital modules based on expert analysis of the content of the material

No	Aspect	Score	Max Score	Aspect Average (%)	Classification
1	Content eligibility aspect	41	44	93.2	Very Valid
2	Presentation feasibility aspect	18	20	90	Very Valid
3	Aspects of language eligibility	27	36	75	Sufficiently Valid
Final score		86	100	86	Very Valid

Design Revision

Improvements to the interactive digital module are based on validation results, suggestions, comments from media expert validation experts and material content experts, some of the improvements made are:

- Figure numbering, equations and tables are sorted.
- improve assessment indicators
- improve grammar

- recording the results of the experiment directly accessible to the spreadsheet (for example, Ms. Excel)
- adding more media to the prerequisite information or additional instructions needed for students who need it.
- Fixes the display so it doesn't look solid.

Implementation

The use of modules at SMAN 1 Paste for three meetings for learning two meetings and for tests in the third meeting. Distance learning through google classroom and telegram students learn from home teachers work from school. Interactive digital module, interactive quiz using Quizizz and student response sheets sent via google classroom and telegram by downloading <https://online.flipbuilder.com/brtt/vpus/>. Obtained response data from 28 students in table 3.

Table 3. Student response data

NO	Aspects measured	Performance percentage %	Classification
1	No difficulty learning distance	75	pretty good
2	Modules are useful, interesting, easy to understand	91.1	Very good
3	Completeness of the contents of the module	97.3	Very good
Average		87.8	Very good

From these data, the mean of all aspects is 87.8%, this indicates that the classification of the digital module is very good. The results of the student quiz from 28 participants obtained the highest score of 95 and the lowest score of 60 with a class average of 78, this score indicates that the module helps students in learning during this pandemic.

CONCLUSION

The results of the research on an interactive digital module based on a virtual laboratory are suitable for use as a medium for learning physics during the Covid-19 pandemic. This is evidenced by the acquisition of a percentage of the results of the validation test by media experts of 92.36% with a very valid classification, the acquisition of a percentage of the content validation experts of the material is 86% with a very valid classification so that the module is suitable for use as learning and testing for students as learning media users obtains percentage of 87.8% with very good classification. The use of virtual laboratory-based interactive digital modules on dynamic fluid material is very suitable for use in learning and has a fairly good effect on student learning outcomes as evidenced by the mean score of 78 quizzes including complete classification. Suggestions for further research are the need to continue up to the next steps, namely 7 to 10 and research on the effectiveness of using virtual

laboratory-based modules to improve science process skills and critical thinking.

REFERENCES

- Alifya, N & Edi, S. 2020. "Efektifitas penerapan interaktif e-book matapelajaran pemrograman dasar pada siswa SMK". *Jurnal MEDIA ELEKTRIK*, Vol. 17, No. 2, April 2020 p-ISSN:1907-1728, e-ISSN:2721-9100 14
- Prastowo, A. 2012. *Panduan Kreatif Membuat Bahan Ajar Inovatif*. Yogyakarta : Diva Press.
- Dwi, E. 2019. *Research and Development (R&D): Inovasi Produk dalam Pembelajaran*
- Hikmatul, A. 2019. *Pengembangan modul berbasis Phet pada materi getaran harmonis sederhana*. Skripsi. Jambi: IAIN Sulthan Thaha Saifuddin. Jambi
- Imansari, N. & Sunaryantiningsih, I. (2017). "Pengaruh Penggunaan E-Modul Interaktif terhadap Hasil Belajar Mahasiswa pada Materi Kesehatan dan Keselamatan Kerja". *Jurnal Ilmiah Pendidikan Teknik Elektro*, Vol 2 No 1 pp 11-16.
- Kemendikbud. 2020. *Panduan Pembelajaran Jarak jauh*. Dirjen GTK.
- Kristiyanto, W.H. 2017. *Implementasi Media Pembelajaran dalam Pembelajaran Aktif dengan Pendekatan Baru Sebagai Wujud Profesionalisme Guru di Era Global*. Prosiding Seminar Nasional ALFA VII. Universitas PGRI Semarang.
- Aprileny, L dkk. 2019. "Pemanfaatan e-modul interaktif sbagai media di era digital". *Prosiding Seminar Nasional Teknologi Pendidikan Pascasarjana UNIMED* ISBN : 978-623-92913-0-3 298. Universitas Sebelas Maret Surakarta
- Wegener, M., Mcintyre, T. J., Mcgrath, D., Savage, C. M. & Williamson, M. 2012. *Developing a virtual physics world*. *Australasian Journal of Educational Technology*, 28(3), , 504–521
- Rita, J. 2014. "Pengembangan pembelajaran Multimedia interaktif berbasis internet pelajaran Bahasa inggris". *Jurnal Teknologi Informasi & Komunikasi dalam Pendidikan*, 1 (2), 2355-4983.
- Sugiyono. 2013. *Metode Penelitian Kuantitatif Kualitatif dan R & D*. Bandung : Alfabeta
- Surat edaran Kepala Dinas Pendidikan Pemuda dan Olahraga Pemerintah daerah Istimewa Yogyakarta nomor 42/02280 tertanggal 20 Maret 2020 perihal pembelajaran jarak jauh/di rumah bagi anak sekolah dalam rangka pencegahan Covid-19

- Surat Edaran Sekretaris Jenderal Kementerian Pendidikan dan Kebudayaan Nomor 15 Tahun 2020 tentang Pedoman Penyelenggaraan Belajar dari Rumah dalam Masa Darurat Penyebaran Coronavirus Disease (Covid-19)
- Swandi, A. 2014. "Pengembangan Media Pembelajaran Laboratorium Virtual untuk Mengatasi Miskonsepsi pada Materi Fisika Inti di SMAN 1 Binamu, Jeneponto". *Jurnal Fisika Indonesia*. Volume: XVII, Nomor: 52, ISSN: 1410- 2994, hlm. 20-24.
- Widoyoko, E. P. 2018. *Penilaian Hasil Pembelajaran di Sekolah*. Yogyakarta: Pustaka Pelajar