JURNAL PEMBELAJARAN FISIKA

http://jurnal.fkip.unila.ac.id/index.php/JPF

Vol 10 (1), 2022, 043-054 ISSN: 2302-0105 (p); 2684-9828 (e)

Development of Interactive Electronic Practicum Module by Utilizing Tracker Software

Ismu Wahyudi, Eko Suyanto, Hervin Maulina*

Pendidikan Fisika FKIP Universitas Lampung, Bandar Lampung

** e-mail: hervin.maulina@fkip.unila.ac.id*

Received: December 14, 2021 *Accepted: June 12, 2022* *Published: June 13, 2022*

Abstract: This study aims to develop physics practicum module for straight motion material in order to make student are able to do practicum independently at home or school by utilizing free-acces tracker software to obtain the data with various features and user flexibility. This study was research and development, which were consisted of four stages; there were Design, Development, Implementation, and Decision Making. The data of this study were obtained from questionnaires from the expert's validation and small group tests, which were then analyzed quantitatively descriptively. The results of the research analysis show that the developed interactive electronic practicum module has been validated, feasible, and effectively used in learning. In addition, this module is also very effective in training students' multiple representation skills and quite effective in training students' graphic interpretation skills.

Keywords: Interactive electronic practicum module, Straight motion, Tracker software

DOI: http://dx.doi.org/10.23960/jpf.v10.n1.202205

INTRODUCTION

The development of science and technology today requires various aspects of life to be able to follow the direction of its movement, including the world of education. The learning process in the world of education today has also adapted to the needs and developments of the times. Especially with the sudden change in the world of education today, which requires students to study from home, all things involved in learning are able to provide distance learning optimally. In distance learning, a teacher must be able to think about how to communicate and deliver material to students so that learning becomes effective and efficient. In addition, so that distance learning that is carried out online runs well, it is not about the technology used but how they use it and what is conveyed through the media used.

Media enable educators to bring sights from the real world into the learning environment or classroom. However, when new information is presented, it is important to be as realistic as possible. Similarly, when younger learners are involved, more realistic instruction is required. However, one misconception about the essence of experience is the belief that "more realistic" is always better. This is clearly not true. More realistic forms of learning are much less efficient in terms of resource use, and are often less effective because of the large number of distractions from realistic instruction.

Various media such as films, television, diagrams, printed materials (printed material), computers, and instructors, can be considered as learning media if they carry messages in order to achieve learning objectives (Susilana, 2007). The most popular development of learning media in education today is learning that refers to the use of information and communication technology (ICT) in learning and teaching (Shen and Ho, 2020). The power of ICT is able to support learning needs in universities, so that they can be adopted in universities (Lin, Lu, and Liu, 2013; Liu et al., 2016). For examples, learning by utilizing the Learning Management System (LMS) which has been successfully used to improve the quality of education (Findik-Coskuncav, Alkis, and Ozkan-Yilidrim, 2018), the use of tables/smartphones in improving student performance and engagement (Wakefield et al., 2018), as well as the development of electronic teaching materials, which are currently one of the most important things to do, especially in distance/online learning.

Physics which is a subject that is considered difficult for most students becomes a challenge for teachers to teach it. Physics material feels increasingly difficult when the teacher is not able to present a learning experience that is able to deeply instill concepts in students' minds. One way that can be done is by doing practicum. Unfortunately, physics practicum is also a challenge for teachers to implement, apart from there may not be practicum tools available, and no practicum modules available that can be used as a reference for teachers and students in conducting practicum, current conditions with the application of online learning during the covid-19 pandemic, encourages teachers to innovate in their learning, so that practicum can still be done to provide direct experience to students. Practicum in online learning can be done by utilizing technology-based media, one of which is tracker software. Practicum using a tracker as a medium to assist students in observing moving objects and analyzing data, can be done by students independently by utilizing existing equipment and supplies in the home environment. This independent practicum can be done by students of course with the help of an interactive electronic module as a guide in these independent practicum activities.

Electronic modules, simply defined as electronic versions of printed modules, offer many advantages to readers (Simonson et al. 2015). The main characteristics of the module are (1) independent learning (the module allows a person to learn independently and does not depend on other parties), (2) independent (all required learning materials are contained in the module as a whole), (3) stand-alone (the modules developed do not depend on other teaching materials, or do not have to be used in conjunction with other teaching materials), (4) adaptive (the modules are prepared to adapt to the development of science and technology, and are flexible for use on hardware), and (5) user-friendly (the module should contain instructions and information presentations that are useful and user-friendly, and easily accessible as desired. In this case, the use of language that is simple, easy to understand, and uses commonly used terms).

Several advantages of electronic books including promoting reading, faster and cheaper production costs, updateable, searchable, portable, easy to distribute, can be annotated without destroying original works, make reading accessible to people with disabilities, can be hyperlinked, and can be inserted sound so that it can read content automatically. The advantages offered through this e-book can be one of the best solutions in implementing distance learning. However, educators are required not only to make electronic books/modules, but must be able to present interactive electronic modules.

Practicum during Pandemic Covid-19 was quite difficult to be implemented, especially during this pandemic all student have to learn from a distance at their own home.Beside that, based on the survey analysis from teacher's and student's responses, it can be concluded that practicum were never be implemented in physics. It was happen because they felt confuse to design the learning at a distance. This condition becomes a challenge for us to overcome by developing interactive electronic practicum module. There are many studies about the development of electronic practicum module, such as development practicum e-module to improve distance learning efficiency (Mauliana *et al.*, 2021), guide book of basic physic practicum equilibrium material (Kurniawan *et al.*, 2021), TPACK and AR in Kinematics Practicum Module (Bakri *et al*., 2021). Based on literature review, there is no study about developing interactive electronic practicum module wich is embed with using Tracker Software. This condition becomes the reasons for developing an interactive electronic practicum module that can be accessed on a smartphone and can be used both online and offline. The touch of technology in the development of this interactive electronic practicum module will be more interesting for students because based on the data it is known that prospective physics teacher students in the Province are very interested in integrating technology (Maulina et al., 2020) in learning. It is hoped that through the interactive electronic practicum module resulting from this development research, it is able to become a guidebook and guide for teachers and students.

RESEARCH METHODS

Research Design and Procedure

This research is a type of development research that produces a product in the form of an Android-based interactive digital module. The research design used adopted Richey and Client (2007) with the stages of Design, Development, Implementation, and Decision Making. In detail the treatment at each stage of the study is shown in Figure 1.

Figure 1. Research and Development Stages

(adopted from Richey *and* Klein, 2007)

Research Area and Subject

This research was conducted in Lampung involving product validators, namely experts in the fields of media and physics. In the small-scale group trial phase, it involved class X students at SMAN 5 Bandar Lampung and SMAN 1 Tanjung Bintang.

Instrument and Data Analysis

The instruments used in this study include a questionnaire given to students and a validation questionnaire. Student questionnaires are given to students who have taken basic mathematics and thermodynamics courses to get content information that will be loaded according to their needs. Furthermore, validation questionnaires both content and media validation were given to determine the level of validity of the developed product so that it can be used on a large scale. This questionnaire contains a Likert scale adopted

from Ratumanan & Laurent (2011). The scores for the level of validity of the products developed are listed in Table 1.

Table 1. Validity test questionnaire scale

Answer option	Score
Very valid	3
Valid	2
Unvalid	1

The data analysis technique used in this study used quantitative descriptive analysis techniques. The validity data were analyzed using the equation:

$$\% \, x = \frac{\sum Earned\ score}{\sum Maximum\ score} \, x \, 100\%$$

The % x results are then converted according to the criteria in Table 2. In addition, the effectiveness of the product is also assessed and compared with the range of student assessment scores at the undergraduate level. The effectiveness criteria are listed in table 3.

Table 2. Product validity score criteria (Adopted from Arikunto, 2011)

Percentage (%)	Criteria
0.00 – 20.00	Low
20.10 – 40.00	Enough
40.10 – 60.00	Medium
60.10 – 80.00	High
80.10 – 100.00	Very high

Table 3. Product effectiveness criteria

Percentage (%)	Criteria
0-49	Low
50-55	Enough
56-65	Medium
66-75	High
76-100	Very high

Analysis of Graphic Interpretation learning outcomes and graphical representations was carried out using the N-gain test. Quantitative data from the pretest and posttest results show the value of students' graphic interpretation abilities. To compare the normalized gain between the pretest and posttest, in order to obtain an overview of the increase in graph interpretation ability. To find out the increase in students' pretest and posttest scores. The N-gain interpretation criteria are as in table 4.

Table 4. N-Gain test criteria

Score	Criteria
$g \geq 0.7$	Tinggi
$0.7 > g > 0.3$	Sedang
$g \leq 0.3$	Rendah

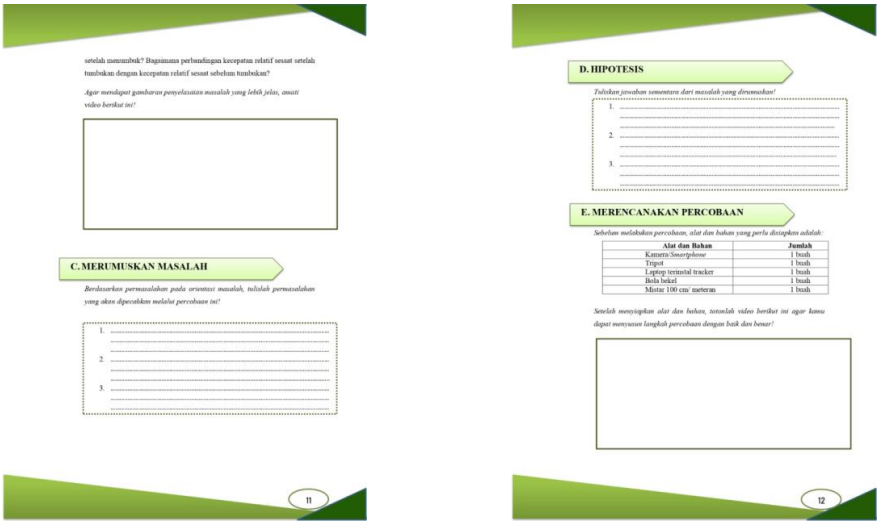
(Husein, Herayanti, & Gunawan, 2015)

RESULTS

The product resulting from this development research is an Android-based interactive electronic practicum module, as an alternative to student independent practicum guides in online learning using a guided inquiry-based video analysis tracker, which was developed for high school/MA physics learning in straight motion at a constant speed, in straight motion with constant acceleration, parabolic motion, simple harmonic motion, and momentum impulses and collisions. The development of this interactive electronic module began with observing real conditions in several schools in Lampung, as a preliminary study to obtain information related to physics learning on the focus of mechanics, the facilities owned by the school, knowing the needs of teachers and students in physics learning conducted online during the covid-19 pandemic, in particular the need for practical physics learning that trains students in finding concepts, practicing graphic interpretation skills, and multiple representation skills. Then proceed with analyzing the content standards (KI and KD) of physics material which will be developed in the module, in accordance with the Regulation of the Minister of Education and Culture of the Republic of Indonesia No. 54 of 2013.

(a) (b)

Figure 2. (a) Cover, and (b) Experiment objectives



(a) (b)

Figure 3. (a) Problem orientation; and

(b) Hypothesizing and planning experiments

Furthermore, the module development is carried out by looking at the results of the analysis; the product developed from this stage is called the initial product. This initial product was then validated by experts, which involved lecturers from Physics Education FKIP University of Lampung, including media experts and physics substance experts. Input from expert validation is used as material to revise the initial product, so that the main product is obtained. This main product was tested for attractiveness, usability and usefulness of the module, which involved 15 students (>semester 3) as potential users, to provide responses to the developed module, then the product was revised so that it became an operational product. Furthermore, the operational product was tested externally in two experimental classes, to determine the effectiveness of the module in online physics learning. The interactive electronic practicum module developed is as shown in Figure 2 and 3. In addition, the results of expert tests carried out showed that the module design developed was very valid with a very high category as shown in table 5.

Table 5. Result of design test and material expert test

Test Item	Score	Percentage (%)	Criteria
Media Expert Test	2.71	90.20	Very high
Substance Expert Test	2.79	92.98	Very high
Average score	2.75	91.59	Very high

Table 6. Small group test results

Item Test	Score	Percentage (%)	Criteria
Module Attractiveness Test	2.65	88.25	Very high
Module Usefullnes	2.50	83.49	Very high
Module Usability Test	2.75	86.67	Very high
Average	2.58	86.14	Very high

The first small group trial of the electronic module was conducted on 15 students (prospective teachers) in the physics education undergraduate study program. The test results are as in table 6. The second small group trial was to implement an interactive electronic practicum module in learning at school, which was carried out in two classes, namely class X at SMAN 1 Tanjung Bintang and SMAN 5 Bandar Lampung. Learning using the developed module is treated with guided inquiry-based learning conducted online, to train students' graphic interpretation skills. The increase in student learning outcomes in the ability to interpret graphs reached N-gain 0.37 in the medium improvement category, while student learning outcomes in multiple representation abilities reached N-gain 0.73 in the high improvement category, as presented in table 7 and table 8.

Table 7. N-gain of students' graph interpretation ability

Graph interpretation Indicator	Pretest Average	Postest Average	N-Gain
Graph to verbal	5.56	50.00	0.47
Graph to mathematics	25.93	44.44	0.25
Drawing graphic	12.96	47.22	0.39
Average	14.82	47.22	0.37

Table 8. N-gain of student's multiple representations

Multiple representation indicator	Pretest Average	Postest Average	N-Gain
Picture to verbal	19.43	80.57	0.76
Picture to mathematics	53.71	85.71	0.69
Mathematics to verbal	18.29	82.86	0.79
Mathematics to picture	14.29	67.43	0.62
Verbal to mathematics	9.14	84.57	0.83
Verbal to picture	7.43	68.57	0.66
Average	20.38	78.29	0.73

DISCUSSION

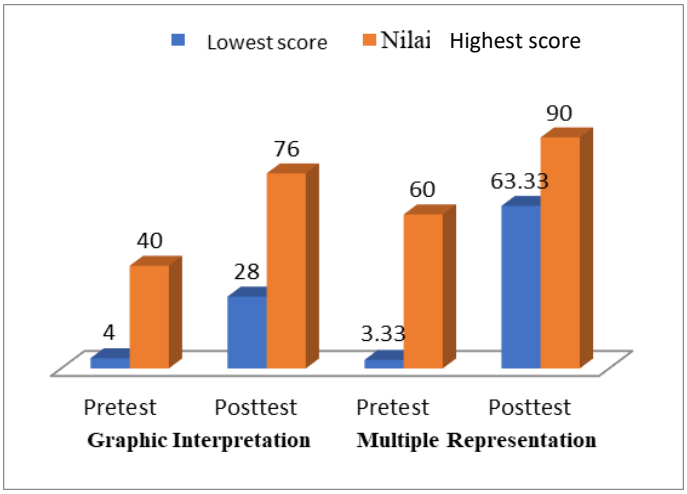
In the material expert validation test, the validator provides many suggestions for improvement, including the phenomena or facts expressed in the problem orientation, which need to be digested again, so as not to cause ambiguity; In general, the grammar used is good, but there are still a few errors in typing and there are writings that do not follow the EYD, such as the word so that at the beginning of the sentence, the word while at the beginning of the sentence; and In general, student activities in the module have shown the syntax of Guided Inquiry, but there are several things that developers need to improve, such as in the problem orientation, problem formulation, and data analysis sections. The input of this material expert validator is then used as material for the formative evaluation of the developed module. The revisions made were by adding an explanation to the video of the phenomenon, so that it was clearer; correcting writing errors and changing words/sentences by following the EYD; as well as adding guidance sentences to the module that can guide students in understanding problem orientation, formulating problems and analyzing experimental data.

The interactive electronic practicum module that was developed received a very good assessment by students who were respondents in the module test. The module test for students is carried out online, by providing a questionnaire via google form, besides that the electronic module is also given, so that respondents can open it directly using an android or laptop/PC, so that respondents can feel the attractiveness, ease of use, and usefulness directly in using the module developed. The module is considered interesting, easy to use, and very useful for students in learning physics. The level of attractiveness, usability and usefulness of the three modules reached the very high category. The product assessment is assessed by the user from the aspect of the appearance and content of the practicum module, namely the attractiveness of the practicum module design, the use of letters, illustrations, lay-out designs, variations in the use of colors, the use of pictures, practice questions, and the attractiveness of problem orientation.

The interactive electronic practicum module developed is considered very easy to use, because the module is equipped with a phenomenon video on problem orientation, a video on the use of the module, and a practicum video using a software tracker. The module is also equipped with guidance sentences in each learning activity in the module, as well as questions on multiple representation practice questions.

The interactive electronic practicum module that was developed also received a very good response, the module was considered very useful in helping students to do practical work independently in online learning. The practicum module that utilizes tracker software can assist students in observing the motion of objects in an experiment, tracking object motion tracks, assisting in processing experimental data, and assisting students in practicing finding physics concepts.

The interactive electronic practicum module that was developed is also implemented in online school learning. The results of the implementation of the module indicate that the module is effectively used in learning physics in high school, with an effectiveness level of reaching an N-gain of 0.73 (high) in improving the ability of multiple representations of high school students, and reaching an N-gain of 0.37 (medium) in improving interpretation skills. student chart. Student learning outcomes are measured on the ability to interpret graphs and the ability to multiple representations, as presented in Figure 4.



Gambar 4. Student learning outcomes using the module

Seen in Figure 4, student learning outcomes have increased significantly. The interactive electronic practicum module that was developed can function well as a student independent practicum guide in online learning. Students in their homes by forming small teams can do practicums with tools and materials that are easily found at home, guided by interactive electronic practicum modules, and also guided by online teachers, do real experiments, can do practical experience in real time. independent in learning, so that students can practice inquiry starting from formulating problems to be solved, predicting possible solutions that will be obtained, planning experiments, processing data and finding their own concepts being studied. The ability of students' plural representation was proven to increase significantly after learning using the module. When conducting experiments, students are required to be able to conduct experiments in groups, and this must be done with great care and precision, so as to train students' skills. At the time of processing data from the track of the observed object's motion, students can directly observe the track of the object's motion every second, students can immediately process the object's motion data into data tables and graphs, so that students can directly find the equations of motion of the object they are looking for, thus students in learning have been able to find concepts directly. Habibbulloh M., et al. (2014) conducted research on the application of the video analysis software tracker method in physics learning the concept of free fall motion to improve the process skills of class X sman 1 Sooko Mojokerto students, the results obtained stated that students' process skills in observing, measuring, designing experiments, interpreting data, and communication has increased both in quality and quantity.

Learning physics using a tracker provides a learning experience of observing the motion of objects from video recording experiments, analyzing data in tabular form, analyzing data in graph form, analyzing data in finding mathematical equations, and practicing finding physics concepts. So that students can experience getting a direct and interesting learning experience, students are also very helpful in observing the motion of objects in experiments, assisted in analyzing data and finding physics concepts. Edgar Dale in Simonson et al. (2015) which classifies learning outcomes in terms of learning experiences from the most concrete to the most abstract levels known as the cone of experience, that learning that only involves verbally produces only 10% to 20% memory, visually (pictures, videos and demonstrations) the results are around 30%, by involving students they are able to succeed 70%, and by providing hands-on experience they are able to succeed 90%.

CONCLUSION

Interactive electronic practicum module as an alternative independent practicum guide for SMA/MA students in guided inquiry-based online learning, by utilizing tracker software, has been successfully developed. Based on expert validation has been validated, feasible, and effectively used in learning.

REFERENCE

Abdullah, F., Ward, R., & Ahmed, E. (2016). Investigating the influence of the most commonly used external variables of TAM on students' Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) of e-portfolios. *Computers in Human Behavior*, *63*, 75-90.

Arsyad. (2011). *Media Pembelajaran*. Jakarta: PT Raja Grafindo Persada.

Arikunto, S. (2011). *Prosedur Penelitian Suatu Pendekatan Praktek*. Jakarta: Bumi

Aksara. Asyhar, Rayanda. (2011). *Kreatif Mengembangkan Media Pembelajaran*. Jakarta: Gaung Persada (GP) Press Jakarta.

Bakri, F., Kusuma, R., & Permana, A. H. (2021, October). TPACK and Augmented Reality in Kinematics Practicum Module: Forming HOTS Physics Education Students. In *Journal of Physics: Conference Series* (Vol. 2019, No. 1, p. 012041). IOP PublishingFindik-Coşkunçay, D., Alkiş, N., and Özkan-Yildirim, S. (2018). A Structural Model for Students' Adoption of Learning Management Systems: An Empirical Investigation in the Higher Education Context. *Journal of Educational Technology & Society*, 21(2), p.13-27.

Habibbulloh, M., Madlazim. (2014). Penerapan Metode Analisis Video Software Tracker Dalam Pembelajaran Fisika Konsep Gerak Jatuh Bebas Untuk Meningkatkan Keterampilan Proses Siswa Kelas X Sman 1 Sooko Mojokerto. *Jurnal Pendidikan Fisikadan Aplikasinya (JPFA)*,Vol. 4 No.1.

Husein, S., Herayanti, L., & Gunawan. 2015. Pengaruh Penggunaan Multimedia Interaktif Terhadap Penguasaan Konsep Dan Keterampilan Berpikir Kritis Siswa Pada Materi Suhu Dan Kalor. *Jurnal Pendidikan Fisika dan Teknologi*.1 (3): 221-225.

Kurniawan, D. A., Anggraini, L., & Perdana, R. (2021). Digitalisation Guide Book of Basic Physics Practicum Equilibrium Material. *JTP-Jurnal Teknologi Pendidikan*, *23*(1), 70-80.

Liu, Ou Lydia, Mao, L., Frenkel, L., Xun Jun. (2016). Assessing critical thinking in higher education: the HEIghten^{TM} approach and preliminary validity evidence. *Assessment & Evaluation in Higher Education, vol.41*, p.677-694.

Lu, Hsin-Ke, Lin peng-Chun, and Liu, Shang-Chia. (2013). Toward an Education Behavioral Intention Model for e-Learning Systems: an Extention of UTAUT. 2013. Journal of Theoritical and Applied Information Technology, 47(3).

Mauliana, M. I., Shifiyah, N., Rahmawati, Y., & Nisa, K. (2022). Practicum E-Module Development to Improve Distance Learning Efficiency in Basic Physics Courses in the Pandemic Period. *Acitya: Journal of Teaching and Education*, *4*(1), 189-206.

Maulina, H., Abdurrahman, Sukamto, I., Kartika, N., and Nurulsari N. (2020). Z-generation learner characteristic and expectation in the RI 4.0 era: a preliminary research in physics teacher college in Lampung. *Journal of Physics: Conference Series, 1572(1).*

Ratumanan, T. G., & Laurent, T. (2011). Penilaian Hasil Belajar pada Tingkat Satuan Pendidikan (2nd ed.). Surabaya: Unesa University Press. Sadiman. 2007. *Media Pendidikan*. Jakarta: PT Raja Grafindo Persada.

Richey, C Rita and Klein, D James. (2007). *Design and Development Research Methods*. Lawrence Erbaum Associates, Inc.

Shen, C. and Ho, J. (2020), "Technology-enhanced learning in higher education: a bibliometric analysis with latent semantic approach", Computers in Human Behavior, Vol. 104, p. 106177, doi: 10.1016/j.chb.2019.106177.

Shen, C.-w., & Kuo, C.-J. (2015). Learning in massive open online courses: Evidence from social media mining. Computers in Human Behavior, 51, Part B, 568-577.

Simonson, M., Smaldino, S., & Zvacek, S. (2015). Teaching and Learning at A Distance. North Carolina: Information Age Publishing, Inc.

Steven Yulando, Sutopo, and Tabughang Franklin Chi, "Electronic Module Design and Development: An Interactive Learning." American Journal of Educational Research, vol.7, no. 10 (2019): 694-698. doi: 10.12691/education-7-10-4.

Susilana, Rudi, & Cepi Riyana. 2007. *Media Pembelajaran*. Bandung: CV Wacana Prima.

Wakefiel J., Frawley, J.K., Tylera J., and Dysonc L.E. (2018). The impact of an iPad-supported annotation and sharing technology on university students' learning. *Computers and Education, 122, p.243-259.*

Wang, feng & Hannafin, Michael J. (2005). Design-based research and technology-enhanced learning environment. *Educational technology Research and Deleopment, Vol 53*, p 5-23.