Proceeding books:
The 2nd International Conference of Education on Science, Technology, Engineering, and Mathematics (ICE-STEM 2020)

Development of Digital Based Friction Coefficient Practicum Tool in Newton's Law Material

Hadianti Deliana[1*] and Sugianto[1]

[1]Physics Education Study Program, University of Muhammadiyah Prof. DR HAMKA
Tanah Merdeka Street, Kp.Rambutan, Pasar Rebo, East Jakarta, 13830, DKI Jakarta, Indonesia

*Correspondence email: serbabu05@gmail.com

ABSTRACT

This research was conducted which aims to solve the problem of difficult practicum activities and the minimum use of digital-based practicum tools. In addition, for the development of physics learning media in the form of a product, namely a digital-based practicum tool on the material Newton's law with a focus on the Friction Force on an Inclined Plane. The research method used is research and development (Research and Development) and the Borg & Gall development model. At the research stage and initial information gathering, problem analysis and needs analysis activities were carried out in the form of a questionnaire. Furthermore, the planning stage begins with the design of the tool and the development of the initial product format. The prototype is designed as an embodiment of defined ideas and ideas. In the initial trial phase, the media is tested on material experts and media experts and then evaluated. In the field trial phase, it was carried out at SMA Islam PB Soedirman 2 Bekasi and SMA TAMHAR for class XI IPA students. The media is tested in small-scale trials and large-scale trials, for small-scale trials conducted by PB Soedirman 2 Bekasi Islamic High School students with 15 students using online data collection and large-scale trials conducted on PB Soedirman 2 Bekasi Islamic SMA students with 17 students, and SMA TAMHAR with a total of 20 students, for data collection at the two schools used two different methods for SMA Islam PB Soedirman 2 Bekasi online and SMA TAMHAR face-to-face. Data collection was obtained using a Likert scale questionnaire, data for data collection at the two schools using two different methods for SMA Islam PB Soedirman 2 Bekasi online and SMA TAMHAR face-to-face. Data collection was obtained using a Likert scale questionnaire, data For data collection at the two schools using two different methods for SMA Islam PB Soedirman 2 Bekasi online and SMA TAMHAR face to face. Data collection was obtained using a Likert scale questionnaire, dataThe data obtained is quantitative data in the form of a percentage of the feasibility of the developed media and qualitative data in the form of comments and suggestions for improvement given by respondents. On the due diligence bymaterial experts obtained a percentage of 83.42% (good). Feasibility test by media experts obtained a percentage of 93.71% (very good). The percentage obtained through small-scale trials was 85.15% (good), while large-scale trials obtained a percentage of 85.11% (good). So it can be concluded that the digital-based friction coefficient practicum tool is suitable for use as a medium for learning physics.

Keywords: Practicum Tools, Friction Style, Digital

INTRODUCTION

The rapid development of technology is very influential on the learning media in schools. The development of science and technology increasingly encourages renewal efforts in the use of technological results in the learning process. According to [1] Learning using teaching aids is a series of activities to convey material that aims to provide students with opportunities to be active in learning so as to allow students to gain knowledge and develop psychomotor skills and increase student creativity to solve problems faced in learning. In the teaching and learning process, educators are required to be innovative so that students get new experiences in the learning process to be fun. To see success in the learning process requires media or practicum tools that can help the learning process and outcomes in accordance with the level of thinking of students, therefore educators must use learning media.

Practicum tools can be used in understanding concepts and showing abstract phenomena in physics theory so that it becomes an adequate learning medium. One of the positive impacts of using props or practicum tools is: serve and facilitate a variety of human needs, but negative impacts can arise from technology that makes it easy to make things done instantly, making many generations less familiar with the basic concepts of science. So this is a challenge for educators to be able to prepare a generation that is ready for science and technology.

Some of the important electronic devices in the development of learning media include control devices such as microcontrollers, detectors or sensors, display devices or LCDs, and actuator devices. So with

various existing electronic devices, if the design of props or practicum tools using various electronic devices will produce data that is more effective, efficient and has accurate measurement and visualization results presented in digital form, it can be connected to computer devices for storage purposes and better data management.

Based on the description above, the researcher is interested in developing a physics practicum tool entitled "Development of Digital-Based Friction Coefficient Practicum Tool on Newton's Law ". In this study, researchers made a digital-based physics lab tool to measure the coefficient of friction, angle, distance, velocity, and acceleration in Newton's law material. Expected Digital-based physics practicum tools can make it easier for educators to explain concepts so that students are enthusiastic about participating in physics practicum activities at school.

THEORITICAL REVIEW

a. Practicum Tools

The practicum tool is a tool that can be absorbed by the eyes and ears with the aim of helping educators to make the learning process more effective and efficient [2]. "Tool can be interpreted as a means that can be used to do something"[3]. Then according to KBBI "Tools: objects used to do something; tools; furniture (an)" [3]. In KBBI it is said that "Practicum: part of teaching, which aims to give students the opportunity to test and implement in real situations what is obtained in theory; practical lessons"[3]. Practicum in physics learning is a series of activities to prove and develop physics concepts that have been studied abstractly through books, the internet and classroom learning.[4].

So it can be concluded that the practicum tool is a tool that can be used to carry out an implementation in realizing theory in reality with the aim of helping educators in the learning process more effectively and efficiently.

According to Hodson [5] there are 5 objectives of practicum activities, namely: 1) To increase scientific knowledge, 2) To teach experimental skills,3) To develop a 'scientific attitude' such as being open-minded, being objective, and a willingness to suspend judgment, 4) Can develop skills, and can provide assessments, 5) To motivate students, with an interesting and fun simulation [5]. Meanwhile, according to Woolnough the objectives of implementing the practicum include: 1) Allows learners to develop and use their personal knowledge through hands-on experience, 2) Develop basic skills and social skills, 3) Motivate students so that they can increase interest in learning, 4) Become a vehicle for learning a scientific approach [5].

Then these objectives can be concluded that the purpose of practicum tools is to develop basic skills and social skills that can develop expertise from direct experience that can provide an assessment. The criteria for the feasibility of practicum tools include: (1) practicum tools must be in accordance with the concept of physics, (2) practicum tools according to the curriculum, (3) the performance of practicum tools must be interesting and in accordance with the subjective research, (4) practical tools are easy to understand, and (5)) easy to use practicum tools [2].

b. Arduino

Arduino is an electronic prototyping platform that is open-source hardware based on flexible and easy to use hardware and software[6].

According to [2] Arduino is a platform consisting of software and hardware. Arduino hardware is the same as a microcontroller in general, only the Arduino pin naming is added to make it easy to remember. Arduino software is open source software so it can be downloaded for free. This software is used to create and enter program code into Arduino. Arduino programming is not as much as a conventional microcontroller stage because Arduino has been designed to be easier to learn, so beginners can start learning a microcontroller with Arduino.

Based on the description above, it can be concluded that Arduino is an electronic prototyping platform consisting of hardware and software.

RESEARCH METHOD

The research method used is the research and development method (Research and Development which aims to improve the instructional design, development and evaluation process based on other specific problem-solving situations or generalized examination procedures. Research and development methods or in English, Research and Development is a research method used to produce certain products, and to test the effectiveness of these products [7]. To be able to produce certain products, research is used that is needs analysis and to test the effectiveness of these products so that they can function in the wider community, research is needed to test the effectiveness of the product.

The model used for product development is the Borg and Gall model. Brog and Gall define 10 steps used for Educational Research and Development (R&D). The research steps carried out in this study only reach the end product - not until the mass product manufacturing activity. Therefore, the researcher shortens / simplifies the steps taken. Thus, the steps used for module research and development include:

a. Preliminary research and information collection to analyze instructional media products to be developed,
b. Develop the initial product
c. Perform expert validation,
d. Conduct field trials, and
e. Make product revisions [8].

The first stage carried out was a preliminary research in the form of a needs analysis carried out on students. The data from the needs analysis were obtained through a questionnaire filled out by students. The questionnaire contains questions that are asked in order to find out the needs of students for the media to be developed. The questionnaire given is also equipped with a suggestion column for researchers.

Then the preparation of the initial product begins with making a product design, namely the design of the practicum tool, then development is carried out in accordance with the design. The results of the development that have been made are then validated by experts to be assessed, then the practicum tool is revised based on suggestions from the validator.

The next stage is the limited trial stage. The results of the revised practicum tool were then tested on a small scale on 15 grade XI students at SMA Islam PB Soedirman 2 Bekasi. Large-scale trials for 17 students of class XI at SMA Islam PB Soedirman and 20 students of class XI at SMA TAMHAR. Limited trials were carried out by filling out student questionnaires.

After a limited trial was carried out, the last stage was a revision of the digital-based practicum tool based on the suggestions of students. Then from the revised results obtained the final product.

RESULTS AND DISCUSSION

In this research, a digital-based friction coefficient lab tool product has been developed on Newton's Law material. In the early stages of the research, the researcher conducted a preliminary study in the form of a needs analysis by giving questionnaires to students.

Needs Analysis Results

The results of the needs analysis show that students need a digital-based friction coefficient practicum tool that makes it easier for them in practicum activities. In developing this practicum tool, students need to understand concepts and are interested because no one in schools has developed digital-based practicum tools.

Developed Media Outcomes.

After obtaining data through needs analysis, the next step is to develop learning media.

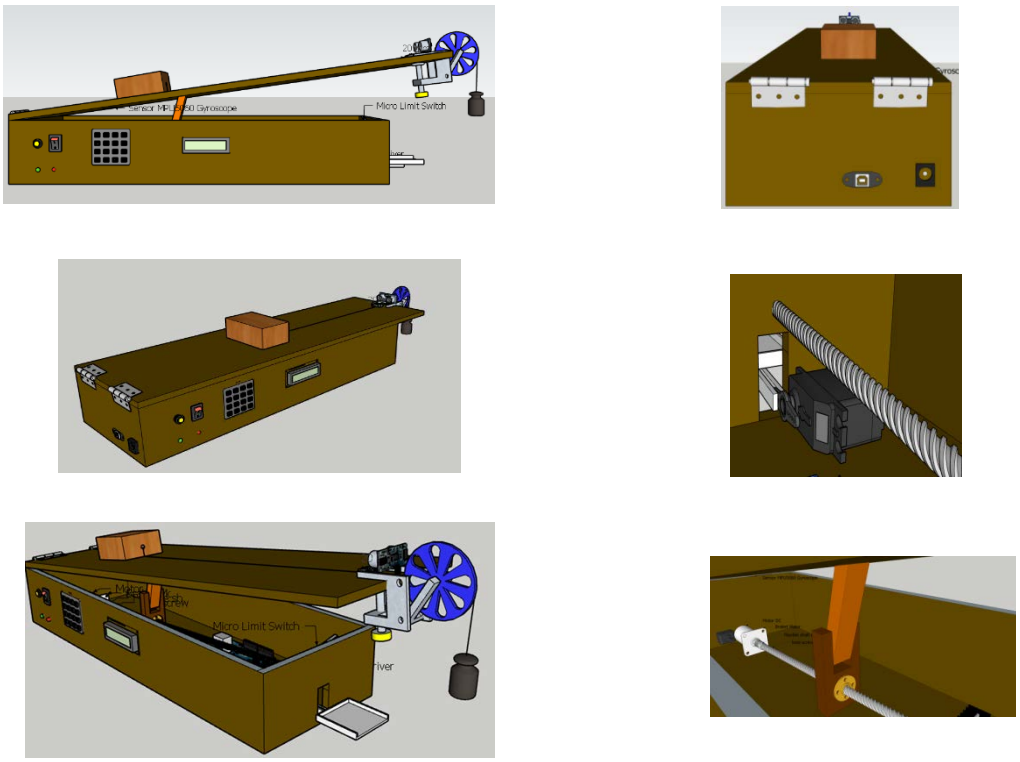

Figure 1. The results of the media that have been developed

Feasibility Test Results

Learning media can be said to be suitable for use in the learning process to be tested on students if it has gone through the due diligence process by experts. In this study, the feasibility of the media was assessed by three experts, namely two material experts and one media expert. The results of the assessment obtained through material experts and media experts are:

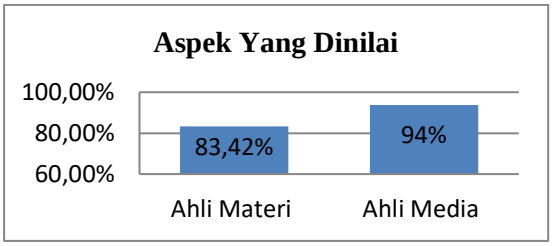

Figure 2. Results of research by media experts and material experts

The assessment by the experts showed that the percentage of eligibility given by the material expert was 83.42% with a good predicate, and the percentage of eligibility given by media experts is 94.00% with the predicate very good. Based on these results it can be concluded that the learning media developed by the researcher is suitable for use both in terms of material and media.

Small and Large Scale Trial Results.

After going through the due diligence by the experts, the learning media that had been developed by the researchers were tested on students. The following are the results of a small-scale trial:

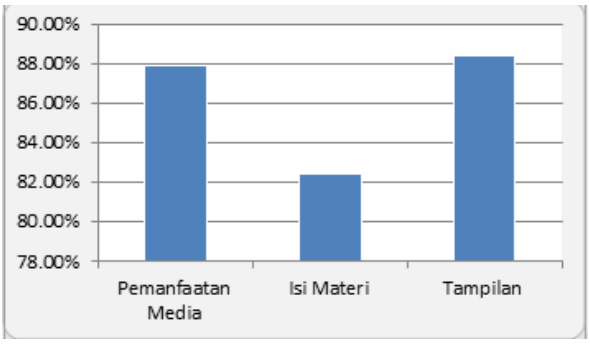

Figure 3. Small Scale Trial Results

These results show the results of the percentage of small-scale trials on the aspect of media utilization was 87.85% with a very good predicate, on the content aspect of the material obtained a percentage of 82.45% with a good predicate. In the aspect of display feasibility, the percentage is 88.38% with a very good predicate. If the three aspects are calculated on average, it will produce a percentage of 86.22% with a very good predicate. The following are the results of a large-scale trial:

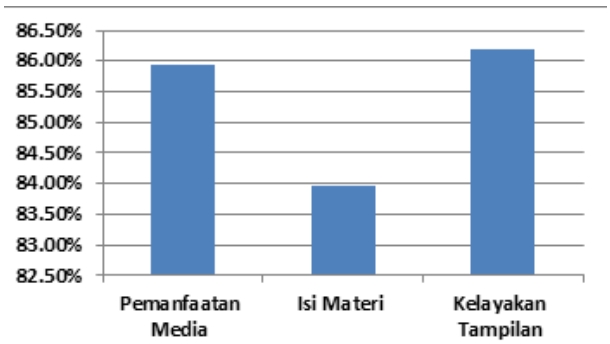

Figure 4. Large Scale Trial Results

These results show the results of the percentage of large-scale trials on the aspect of media utilization, namely 85.93% with a good predicate, on the content aspect of the material obtained a percentage of 83.95% with a good predicate, and the aspect of display eligibility obtained a percentage of 86.20% with a very good predicate.

The following is a comparison of the percentages obtained through small-scale trials and large-scale trials:

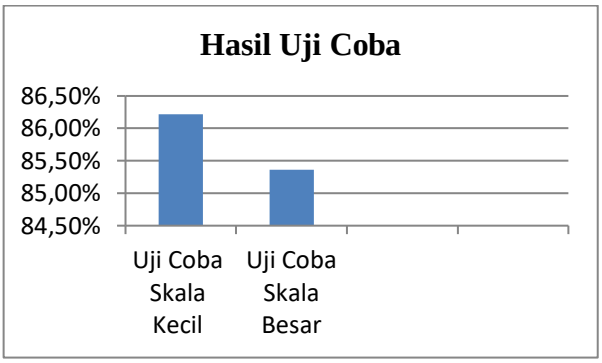

Figure 5. Comparison of Small Scale and Large Scale Trial Results.

The results of large-scale trials were 85.36% and small-scale trials were 86.33%. When compared to the results obtained when conducting small-scale trials and large-scale trials, the percentage value increases by 0.97%.

CONCLUSIONS

Based on the research results, it can be concluded several things about the development of learning media developed by researchers, namely:

1. The end result of this development is a digital-based friction coefficient practicum tool and a practicum module which contains material, how to use it and student worksheets (LKPD). In addition, it is also equipped with pictures of the developed practicum tools.
2. The media developed has also passed the feasibility trial stage starting from the precision and accuracy trials, validation trials by experts and student responses. From the trial, it was produced that the coefficient of friction practicum tool has accurate accuracy because it produces data that is in accordance with the literature, and has good accuracy. Meanwhile, the results of validation by experts show the average value of material expert at83.42% (Good), media experts 93.71% (Very Good). Based on the material and media expert's assessment, the media developed is suitable for use.
3. Apart from being assessed by material experts and media experts, the media developed by the researchers were also tested on learners. On a small scale test was carried out on students with a total of 15 person. on a small-scale trial, obtained a percentage value of 85.15% with the predicate (Good)

Then for a large scale carried out to students with a total of 37 people. The results of large-scale trials were 85.11% with the predicate (Good). Based on these results it can be concluded that the coefficient of friction practicum tool is suitable for use as a reference for physics learning media at the high school level.

REFERENCES

[1] H. S. Wahyuni and D. Rosana, “Physics Props Development based on Personal Desk Laboratory System to Improve Creative Thinking Ability and Students’ Scientific Attitude,” *J. Phys. Conf. Ser.*, vol. 1233, no. 1, 2019, doi: 10.1088/1742-6596/1233/1/012032.
[2] W. Widayanti and Y. Yuberti, “Pengembangan Alat Praktikum Sederhana Sebagai Media Praktikum Mahasiswa,” *JIPFRI (Jurnal Inov. Pendidik. Fis. dan Ris. Ilmiah)*, vol. 2, no. 1, pp. 21–27, May 2018, doi: 10.30599/jipfri.v2i1.161.
[3] P. Siswa, D. I. Sma, and K. Bengkulu, “Korelasi Pengetahuan Alat Praktikum Fisika Dengan Kemampuan Psikomotorik Siswa di SMA Negeri Q Kota Bengkulu,” vol. IX, no. 1, pp. 67–76, 2011.
[4] A. Waris and D. Nurjannah, “Pengembangan Alat Praktikum Sederhana Konsep Listrik Magnet untuk Siswa SMP Daerah Terpencil,” vol. 3, no. 2, pp. 1–7.
[5] M. L. Dewi, A. S. Budi, and E. Budi, “Pengembangan Modul Praktikum Fisika Berbasis Data Logger Untuk SMA SNF2015-II-169 SNF2015-II-170,” vol. IV, pp. 169–172, 2015.
[6] H. Santoso, “Panduan Praktis Arduino untuk Pemula,” 2015.
[7] Sugiyono. 2017. Metode Penelitian Kuantitatif dan Kualitatif dan R&D. Bandung: Alfabeta.
[8] Muji, “Pengembangan Perangkat Pembelajaran Keterampilan Membaca Model Pembelajaran Kontekstual,” *Pancaran*, vol. 4, pp. 1–14, 2014.
[9] Kause, MC (2019) 'Design of Arduino-Based Physics Teaching Aids (Case Study of Free Fall Motion)', Cyclotron, 2 (1). doi: 10.30651 / cl.v2i1.2511.