The validity of introduction to nuclear physics e-module as a teaching material during covid-19 pandemic

M Misbah¹, F D Sasmita¹, P A C Dinata², U A Deta³, N Muhammad⁴

¹Physics Education Study Program, Universitas Lambung Mangkurat
²Physics Education Study Program, Universitas Palangka Raya
³Physics Education Department, Universitas Negeri Surabaya
⁴Physics Education Study Program, Universitas Khairun

*Corresponding author: misbah_pfis@ulm.ac.id

Abstract. During this pandemic era, learning becomes inseparable with technology. Online learning can be an alternative in using technology during the current Covid-19 condition. An example is shown through the use of Flip PDF Professional electronic module (e-module). Therefore, this research and development of an e-module on the Introduction to Nuclear Physics is carried out. This study aimed to describe the validity of the e-module developed. Research and Development method was selected for this study, and ASSURE model was further implemented with the focus on utilizing the developed instructional material. The instrument used in this study is an e-module validation sheet. The data analysis showed that the developed e-module fell into score of 83.80% which was categorized as “valid” category. Thus, Introduction to Nuclear Physics e-module is a suitable teaching material alternative during the Covid-19 pandemic. Further studies are suggested to investigate the practicality and effectiveness of this e-module.

1. Introduction

Without a doubt, the Covid-19 pandemic has brought serious impacts on various sectors in human life, including education. In regards with the education system affected, Indonesian government has established “Study from Home” policy to help control the spread of the virus outbreak. This applies to schools from elementary to tertiary levels. Under these conditions, teachers need to adapt to new learning systems to facilitate student learning activities [1–4]. Teachers are required to adjust to a variety of aspects, such as the ways to interact with students, types of learning media, the kinds of assignments distributed, and the teaching materials provided [5–9].

Introduction to Nuclear Physics is one of the compulsory subjects that must be completed by a prospective physics teacher. In this course, students learn the atomic nucleus, nuclear force, nuclear models, nuclear reactions, and radioactivity. Students need to understand these concepts, along with the various equations and calculations that accompany them. In general, learning in this course discusses declarative knowledge and procedural skills in solving calculation problems. To help students learn independently whenever and wherever, especially with the current conditions (COVID-19 pandemic), useful and engaging teaching materials needed. Teaching materials which contain not only teaching material, but also videos, practice questions, etc. Thus, electronic learning module is seen as a more suitable teaching material fitted in the current situation.
Learning module is a teaching material arranged through a systematic language which is comprehensible to students according to their age and knowledge [10,11]. Modules have self-instructional characteristics which enable students to learn independently both at school and at home despite the minimal assistance from lecturers [12]. The modules must also contain all the teaching materials needed which provide students with the opportunity to study the material thoroughly. Consequently, the learning process provided becomes more systematic and can increase students’ desire to learn and enhance their motivation [13]. Even so, the use of printed module is not efficient due to its limited access during this pandemic and that the use of papers within the modules has a potential to become a medium for virus transmission. Thus, the availability of an electronic version of the module is demanded to solve the above problems. This version is referred as an electronic module or e-module. Electronic module as a teaching material consists of educational content which are arranged systematically into the smallest learning units to achieve learning objectives that presented or published in an electronic format. The content can be in the form of audio recordings, audio visual, or interactive multimedia [14,15]. This version of the module is convenient to use as it can be accessed via internet, making it easier for students to make use of the teaching materials [16,17]. In addition, e-module is 100% paper-free as it can be read from any portable device, which makes it environmentally friendly. E-module gives learners the opportunity to be able to learn whenever, wherever, in real-time manner, through media-based Internet [18]. Furthermore, effortless access to teaching materials enable students to easily learn at their own pace [19].

One of the software used to create e-modules is Flip PDF Professional. One of the merits that Flip PDF Professional provides is that the software allows interactivity within the module, which makes learning more meaningful [20,21]. In line with these studies, another advantage that Flip PDF Professional has is that it is beginner-friendly, even to those who are unfamiliar with HTML programming language. Flip PDF Professional is a flipbook maker with the feature of editing each individual page. This software can create interactive pages in an electronic book by inserting multimedia resources such as YouTube video clips, images, audio recordings, hyperlinks, MP3 audio, flash videos, quizzes and many more [22].

Learning using Flip PDF Professional software promotes enjoyable learning atmosphere as the software allows teachers to provide knowledge through broader reference. This is in line with a research conducted by Seruni [23] which states that the developed electronic module on biochemistry using Flip PDF Professional is deemed suitable for learning and teaching purposes. Another research conducted by Sriwahyuni [15] states that developed products of electronic teaching materials using Flip PDF Professional fall into the category of a very valid teaching material quality with excellent response. Various previous studies have been conducted on integrating e-modules using Flip PDF Professional, such as Optic Geometry material [15] and Blood Circulatory Systems material [24]. However, no studies regarding the developments on e-modules for nuclear physics introductory courses have been carried out yet. Thus, the researchers believe that the urgency of this study leads the present study’s aim to develop an e-module for a nuclear physics introductory course using Flip PDF Professional software. This module will be used as a teaching material during the Covid-19 pandemic. Specifically, this article will discuss the validation of the e-module being developed.

2. Method
This research utilizes research and development method. The final product of this study is in the form of an e-module for the introductory course to nuclear physics using Flip PDF Professional software with the use of ASSURE model. The ASSURE stages in this research consists of analyze learner, state objectives, selection of media and materials, and utilization of instructional materials. The development steps used in this research can be seen in Figure 1.
The feasibility of the product is assessed through validity process. The developments of e-modules in this research utilized construct validity, which was assessed by 3 experts who were physics education lecturers with the use of a validation questionnaire.

The validation questionnaire is divided into two aspects, namely the content aspect and the display aspect. The content aspect is separated into four indicators, respectively software engineering, material organization, language, and evaluation. Engineering software is related to the functionality of the device when it is accessed using some specific hardware. An example of the functionality is the easiness in loading the program, navigation function, as well as the user interface error. Organizational indicator is related to the arrangement of the order of the materials presented in the module. Then, the linguistic indicator discusses the accuracy and effectiveness of Indonesian terms used in the module. Finally, the evaluation indicator is related to the accuracy of the formative tests given in each chapter.

In addition, the display aspect is also divided into four indicators, namely visual communication, display format, attractiveness, and font style. Visual communication indicator is in connection with animation and color layout used. The format indicator assesses the components that the module should have. The attractiveness indicator discusses the accuracy and suitability of images which display information. The font style indicator relates to the appropriate shape and font size used in the module. The results of experts’ judgments are expressed in percentage. The results of the validity test obtained are then categorized to the categories [25] in Table 1 below.

| No. | Average Score       | Category       |
|-----|---------------------|----------------|
| 1   | 80.01% - 100.00%    | Very valid     |
| 2   | 60.01% - 80.00%     | Valid          |
| 3   | 40.01% - 60.00%     | Sufficiently valid |
| 4   | 20.01% - 40.00%     | Less valid     |
| 5   | 01.00% - 20.00%     | Invalid        |
The reliability test for the three validators' assessments of the electronic module was calculated using Cronbach Alpha. The reliability coefficients obtained were then categorized [26], as shown in Table 2.

| No | Reliability Coefficients | Category   |
|----|--------------------------|------------|
| 1  | 0.80 – 1.00              | Very High  |
| 2  | 0.60 – 0.80              | High       |
| 3  | 0.40 – 0.60              | Medium     |
| 4  | 0.20 – 0.40              | Low        |
| 5  | 0.00 – 0.20              | Very Low   |

### 3. Results and Discussion

The electronic module (e-module) developed will be used by students in every meeting of the nuclear physics introductory course as a reference and students’ learning resource. Researchers developed the e-module which consists of a front cover, preface, table of content, instructions for use, learning objectives, material descriptions, sample questions, exercises, information corners, scientists’ profiles, answer key, and bibliography. Attached below are the display examples of the e-module of Introduction to Nuclear Physics using Flip PDF Professional in Figure 2.

![Figure 2. Cover, Table of Contents, Instructions](image)

The data of the e-module validation test as reviewed by experts are presented in Table 3.

| No   | Validation Aspects               | Average Score | Category     |
|------|----------------------------------|---------------|--------------|
| 1    | Content Aspect Validity          | 89.44%        | Very Valid   |
| 2    | The Validity of the Display Aspect | 79.16%      | Valid        |
|      | Validity of Average              | 83.80%        | Very Valid   |
|      | Reliability                      | 0.89          | Very high    |

Table 3 shows that the average results of the e-module on the Introduction to Nuclear Physics validation aspect obtained a score of 83.80%, which fell in the very valid category. Moreover, the reliability of teaching materials gained a score of 0.89, which belonged in the very high category. In addition, the content aspect placed a higher category level than the display aspect. This is reasonable as the validator argues that the display aspect requires more revision than the content aspect. The indicators
included in the content aspect are software engineering, organization, language, and evaluation, while the indicators for display aspects are visual communication, format, attractiveness, and the shape and size of the letters. The validator states that there are no revisions for the indicators of software engineering, organization, and evaluation in the content aspect. There are only a few typing errors that need to be corrected referring to the language indicator.

The display aspect requires improvements in all indicators. In regards with visual communication indicator, the validator states that the animations on alpha, beta, and gamma decay are unclear. When accessed via laptops, the animations appear too small, whereas when accessed via smartphone, the navigation panels are cut off the display. Moreover, the source from where the images are taken is not included, thus additional texts regarding the images reference shall be added. The validator adds that in the criterion of the indicator format, the sample questions given are still insufficient. The provided sample questions focus on solving problems by applying formulas. The validator argues that it will be better if the sample questions also discuss theories. Apart from the sample questions, several page numbers are not visible as they are covered. In regards with the attractiveness aspect, the cover of the module needs to be revised. The validator argues that the cover used is common and it does not contain any nuclear physics characteristics and that it tends to be similar with earth-related and space-related courses. As for the last aspect, namely the font, the validator argues that the shape and size of the letters are illegible when accessed via laptop. In addition, if it is read through a smartphone, the distance between the lines is too wide. Some parts of the module also contain uppercase and lowercase letters mixed errors. Then, the validator also asks to review the bibliography writing format. Various comments from the validator then become the main input in improving the e-module on Introduction to Nuclear Physics. The difference between the unrevised version and the revised e-module is displayed in Table 4 below.

Table 4. Differences in the Unrevised Version and the Revised E-Modules

| Before | After |
|--------|-------|
| ![Before Cover](image1.png) | ![After Cover](image2.png) |

**Cover**
The final assessment given by the validator was in the form of criticism and suggestions regarding several technical improvements on the use of e-modules in various devices. The results of the revised final product with the use of Flip PDF Professional advance in the aspects of an attractive appearance, a tidier writing format, and a denser content. In addition, embedding videos is a distinct advancement of this e-module as students can see atomic core modeling through realistic animations. Video display provides richer information contextually than static images.

Based on the results of the validity, the average score on the content aspect is 89.44%, which is categorized as very valid. The content aspect has four points of assessments, namely software engineering, organization, language, and evaluation, all of which are categorized as very valid. Consequently, the content of the e-module developed is suitable for learning purposes. Referring the results of the average validity test on the display aspects, the score obtained is 79.16%, which is also categorized as valid. The display aspect has four points of assessment, namely visual communication,
format, attractiveness, and the shape and size of the letters, all of which are categorized as very valid. To conclude, the improved e-module’s display aspects developed are also suitable for learning purposes.

Electronic modules have advantages in terms of flexibility in use so that students can take advantage of this electronic module in conditions and times that are not specified. Also, this electronic module can improve students’ mastery of IT use [14]. In the electronic module, there is a learning video that can help clarify the material so that it can be visualized clearly [15]. The development of e-modules using Flip PDF Professional is one of the solutions in answering the challenges of education in the era of Industrial Revolution 4.0 [27]. The e-module in the form of a flipbook has a page edit function and can create interactive book pages by inserting images, videos from YouTube, MP4, audio-video, hyperlinks, quizzes, flash, etc. This learning media is worthy of being used as an innovation in the world of industrial revolution 4.0 and 21st-century learning. The Flip Professional application is easy to use as it is operable for beginners who do not know the HTML programming language. Besides, this medium is effective and efficient for use as independent learning [22,23,28]. Nowadays, teachers are demanded to adapt to technological developments. These technologies can be used for various activities in the classroom, such as communicating with students [8], delivering materials [5,7], to conducting experiments. The use of technology in learning and teaching is to help facilitate learning activities with the focus of enhancing students’ motivation.

4. Conclusion

Referring to the results of the product’s development and testing, it can then be concluded that the e-module of Introduction to Nuclear Physics using Flip PDF Professional is feasible as a learning resource for students, moreover during the Covid-19 pandemic.

References

[1] Ali M, Adawiah R, Juniati S, F. and Nurulfitawa D 2018 Pengembangan Bahan Ajar Berbasis Video Pembelajaran Pada Mata Kuliah Pemecahan Masalah Nats. Conf. Math. Sci. Educ. NACOMSE 1 287–294.
[2] Dewantara D, Wati M, Misbah M, Mahtari S and Haryandi S 2020 The effectiveness of game based learning on the logic gate topics J. Phys. Conf. Ser. 1491 012045 1-5
[3] Dewantara D, Mahtari S, Misbah M and Haryandi S 2019 Student Responses in Biology Physics Courses Use Worksheets Based on Scientific Literacy Prism. Sains J. Pengkaj. Ilmu dan Pembelajaran Mat. dan IPA IKIP Mataram 7 2 192–197
[4] Saregar A, Zubaedi Z, Parmin P, Jamaludin W and Septiani R 2019 Feasibility Test of Mobile Learning with Schoology: Efforts to Foster the Students’ Learning Interest on Magnetism J. Phys. Conf. Ser. 1155 012060 1-8
[5] Hartini S, Misbah M, Dewantara D, Oktovian R A and Aisyah N 2017 Developing learning media using online prezi into materials about optical equipments J. Pendidik. IPA Indones. 6 2 313–317
[6] Mahyuddin R S, Wati M and Misbah M 2017 Pengembangan Media Pembelajaran Fisika Berbasis Zoomable Presentation Berbantuan Software Prezi pada Pokok Bahasan Listrik Dinamis Berk. Ilm. Pendidik. Fis. 5 2 229–240
[7] Zainuddin Z, Hasanah A R, Salam M A, Misbah M and Mahtari S 2019 Developing the interactive multimedia in physics learning J. Phys. Conf. Ser. 1171 012019 1-5
[8] Misbah M, Pratama W A, Hartini S and Dewantara D 2018 Pengembangan e-learning berbasis schoology pada materi impuls dan momentum untuk melatihkan literasi digital PSEJ (Pancasakti Sci. Educ. Journal) 3 2 109–114
[9] Saregar A, Hadiati E, Syaf’ai I, Septiani R and Widayanti W 2019 Developing Web-Enhanced Course in Basic Electronic Course J. Phys. Conf. Ser. 1155 012094 1-9
[10] Prastowo 2015 Panduan Kreatif Membuat Bahan Ajar Inovatif (Banjarmasin: Diva Press)
[11] Yulastri A and Hidayat H 2017 Developing an Entrepreneurship Module by Using Product-Based Learning Approach in Vocational Education Int. J. Environ. Sci. Educ. 12 5 1097–1109
[12] Rufii R 2015 Developing module on constructivist learning strategies to promote students’ independence and performance Int. J. Educ. 7 1 18
[13] Ferdianto F and Nurulfatwa D 2019 3D page flip professional: Enhance of representation mathematical ability on linear equation in one variable J. Phys. Conf. Ser. 1188 012043 1-9
[14] Cahyanto B and Afifulloh M 2020 Electronic Module (E-Module) Berbasis Component Display Theory (CDT) Untuk Matakuliah Pembelajaran Terpada. JINOTEP (Jurnal Inovasi dan Teknologi Pembelajaran) 7 1 49–56
[15] Sriwahyuni I, Risdianto E and Johan H 2019 Pengembangan Bahan Ajar Elektronik Menggunakan Flip Pdf Professional pada Materi Alat-Alat Optik di SMA J. Kumparan Fis. 2 3 145–152
[16] Triyono M B 2015 The Indicators of instructional design for e-learning in Indonesian vocational high schools Procedia-Social Behav. Sci. 204 1 54–61
[17] Ningtyas R K and Jati H 2018 Project-Based Electronic Module Development As A Supporting Learning Media For Basic Programming Learning J. Educ. Sci. Technol. (EST 1 1 221–227
[18] Solihudin T 2018 Pengembangan E-module Berbasis Web untuk Meningkatkan Pencapaian Kompetensi Pengetahuan Fisika pada Materi Listrik Statis dan Dinamis SMA J. Wahana Pendidik. Fis. 3 2 51–61
[19] Rusman 2012 Belajar dan Pembelajaran Berbasis Komputer (Bandung: Alfabeta)
[20] Sulistyarini E 2015 Pengembangan bahan ajar fisika SMA materi gelombang bunyi berbasis interactive PDF (Doctoral dissertation, Universitas Negeri Semarang) (Universitas Negeri Semarang)
[21] Komikesari H, Mutoharoh M, Dewi P S, Utami G N, Anggraini W and Himmah E F 2020 Development of e-module using flip pdf professional on temperature and heat material J. Phys. Conf. Ser. 1572 12017 1-10
[22] Professional F P D F, Flip W, Professional P D F, Windows F, Service O and Upgrade P 2019 Flip PDF Professional Interactive publishing - add video, image, link and. Available: https://www.pdf-flip.com
[23] Seruni R, Munawaroah S, Kurniadewi F and Nurjayadi M 2019 Pengembangan modul elektronik (e-module) biokimia pada materi metabolisme lipid menggunakan Flip PDF Professional J. Tadris Kim. 4 1 48–56
[24] Arsal M, Danial M and Hala Y 2019 Pengembangan Media Pembelajaran E-Modul Materi Sistem Peredaran Darah Pada Kelas XI MIPA SMAN 6 BARRU Prosiding Seminar Nasional Biologi VI 434–42
[25] Akbar S 2016 Instrumen Perangkat Pembelajaran (Bandung: PT Remaja Rosdakarya)
[26] Arikunto S 2013 Prosedur Penelitian Suatu Pendekatan Praktik (Jakarta: Rineka Cipta)
[27] Dewantara D, Misbah M and Wati M 2020 The implementation of blended learning in analog electronic learning Journal of Physics: Conference Series 1422 012002 1-5
[28] Seruni R, Munawaroah S, Kurniadewi F and Nurjayadi M 2020 Implementation of e-module flip PDF professional to improve students’ critical thinking skills through problem based learning J. Phys. Conf. Ser. 1521 42085 1-5