Tekno-Pedagogi 6 (1) (2016)
ISSN: 2088-205X | E-ISSN: 2715-7415
Tekno-Pedagogi : Jurnal Teknologi Pendidikan
https://online-journal.unja.ac.id/pedagogi
DOI: 10.22437/teknopedagogi.v6i1.7503

Development of a Professional 3D Pageflip Based E-Module on Radioactivity Material

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Info Article
Received: 5 Jan 2016
Revised: 12 Jan 2016
Accepted: 9 Feb 2016
OnlineVersion: 20 Mar 2016

Abstract
This research aims to determine the final product of a professional 3D Pageflip-based electronic module on radioactivity and nuclear reactions in the Atomic and Nuclear Physics course. This research is research and development research with a 4D development model. The stages in the 4D model development model are define, design, development, and disseminate. The research instruments used were observation, document review, student needs questionnaire, media expert validation questionnaire, and material expert validation questionnaire. Then the resulting data was analyzed using descriptive statistics. The resulting product has specifications including the final format of the program is exe, the program is equipped with colors, images, animation and video using Times New Romans font type, the module consists of an introductory, learning and closing section which includes material namely radioactivity and nuclear reactions and the level of media users, namely universities. The advantages of the electronic module include the language used which is easy to understand, the videos displayed are in 3D format, there is a separate answer sheet for answering practice questions and conclusions. Can be used remotely, students can see the scores obtained from the final test and can be used directly without having to have the application.

Keywords: 3D Pageflip Professional; Electronics module; Nuclear Reactions; Radioactivity

INTRODUCTION

To be able to produce quality human resources, the learning process must contain two very important elements, namely teaching methods and teaching materials. These two aspects are interrelated. The choice of a particular teaching method will influence the type of appropriate teaching materials. To achieve the excellence that students must have, quality teaching materials are needed. A good teaching material at least includes things like study instructions (student and lecturer instructions), competencies to be achieved, subject matter content, supporting information, exercises, work instructions, evaluations, as well as responses or feedback to the evaluation results (Utami & Syahri, 2007). Apart from that, good teaching materials use good and easy to understand language, are presented in an attractive manner and are equipped with pictures, meet the demands of a curriculum that adapts to the needs of student characteristics, as well as developments in science and technology (Ministry of National Education, 2008).

The achievement criteria for the Physics Education study program are that every Bachelor of Physics Education graduate must have good attitudes and values, mastery of knowledge, work skills

and managerial abilities. One of the mandatory courses in the Physics Education study program is Atomic and Nuclear Physics. The expected learning outcomes of the Atomic and Nuclear Physics course are for students to be able to discuss the history of the development of atomic theory, the concept of the hydrogen atomic model, quantum theory, basic concepts of nuclear physics, nuclear structure, radioactivity and nuclear reactions. From the description above, it can be seen that the Atomic and Nuclear Physics course requires students to master knowledge. But in reality, students' conceptual mastery of Atomic and Nuclear Physics material is still low, this is reinforced by the low learning outcomes in Atomic and Nuclear Physics courses. To obtain optimal achievement, an attractive learning environment is needed so that students can be actively involved in learning (Putra, Wirawan, & Pradnyana, 2017).

Based on the results of initial observations on independent physics education students in 2013, information was obtained that: students answered that the main subjects in the core physics course were more difficult than atomic physics with a percentage for core physics of 64% and 36% for atomic physics, the most difficult subject of the study. core physics is nuclear reactions with a percentage of 39%. In the learning process, around 64% of students use Power Point media in addition to reference books. About 95% of students also said that they still need other learning resources to support learning at home. According to the opinion of students who have contracted the Atomic and Nuclear Physics course, the average student answered that they were interested in e-modules compared to printed modules with a percentage for e-modules of 56%. One of the teaching materials used in learning Atomic and Nuclear Physics is printed books. Much of the material presented in printed teaching materials is abstract and complicated, so people are reluctant to read and study it (Kuswandari, 2013).

Based on the results of the observations above, it is necessary to innovate learning by developing teaching materials that are easier for students to understand and have an attractive appearance. One of the teaching materials that can be used is non-printed teaching materials that use electronic media, namely electronic modules or e-modules (Syahrowardi & Permana, 2016). Electronic modules are independent learning media that are arranged in a structured manner to make it easier for students to understand study material at home, on campus or anywhere else well. Apart from the language used being easy to understand, it is also equipped with attractive colors, pictures, animations and videos so that it attracts students' interest. to learn it (Rachmah, Rosha, & Vani, 2017). This electronic module uses the 3D PageFlip Professional application in its creation. 3D PageFlip Professional is software that can be used to create teaching materials in the form of digital ebooks with 3D effects. This software is capable of changing PDF teaching materials into stunning 3D flash ebooks in various formats such as Exe, Zip, Html, 3DP, screen saver and others (Amalia, 2015). This research is expected to produce a 3D PageFlip Professional-based electronic module on radioactivity and nuclear reactions in the Atomic and Nuclear Physics course.

RESEARCH METHODS

The research carried out is in the form of research and development or in English it is called Research and Development (R&D). Research and Development (R&D) is a process or steps to develop a new product or improve an existing product, which can be accounted for (Sukmadinata, 2013). The development model used in this development research is a model 4D. This research has 3 stages, namely the definition stage, the design stage and the development stage.

The research instruments used to assess professional 3D pageflip-based electronic modules on radioactivity and nuclear reactions include a student needs questionnaire which contains aspects related to the state of learning nuclear atomic physics as well as things needed in learning Atomic and Nuclear Physics. A questionnaire is a data collection method using a set of written statements for respondents to provide responses according to user requests (Widoyoko, 2016). Next is a validation questionnaire for media experts and material experts containing aspects related to the electronic module material.

Data analysis techniques in quantitative research use descriptive statistics, namely statistics used to analyze data by describing or illustrating the data that has been collected as it is without intending to

draw conclusions that apply to the general public (Sugiyono, 2016). Quantitative data analysis was taken from media expert validation questionnaire scores, material expert validation questionnaires, and student perception questionnaires. The data obtained was assessed using a Likert scale. The Likert scale is a scale that measures attitudes towards something which is expressed through a series of statements about a tendency, thing, object, situation and so on and asks the respondent to give an answer whether the respondent strongly agrees, agrees, disagrees or strongly don't agree. (Setyosari, 2015).

RESULTS AND DISCUSSION

The results of the development of the electronic module for Atomic and Nuclear Physics using the 3D PageFlip Professional application on the material Radioactivity and Nuclear Reactions obtained research results that refer to the 4D development model. The 4D stages according to Thiagarajan (1974) are define, design, develop and disseminate. In this research, the stages used were only up to the develop stage. The electronic module design looks like the image below:

Figure 1. Cover

Figure 2. Table of Contents

Figure 3. Material

The results of the validity of media experts and material experts are shown in table 1. And table 2. In table 1. There are material expert validation results in stage II after revising the validation results from stage I.

Table 1. Results of Stage II Material Expert Validation for Each Assessment Indicator

No.	Assessment Indicator	Assessment	Score	Description
1.	Suitability of material to learning objectives	1. The material is prepared completely and in accordance with the learning objectives	7,5	Very good
		2. The material is arranged broadly and in depth and in accordance with learning objectives		
2.	Accuracy of material and content	3. The facts, concepts, principles, laws and theories explained are precise and accurate.		
		4. Procedures/methods are precise and accurate.		
		5. The examples of questions used are correct.		
		6. The competency test that has been prepared is able to measure indicators of learning achievement.	22,5	Very good
		7. The images and graphics used are appropriate to the material.		

		8. The animations and videos used are appropriate to the material.		
3.	Material Updates	9. The material presented is in accordance with developments in science	3,5	Very good
4.	Linguistic component	10. The language used is communicative.		
		11. The language and spelling used are in accordance with correct Indonesian language rules.		
		12. The sentence structure is correct and the terms used are standard.	18,5	Very good
		13. Consistent use of terms and symbols/symbols.		
		14. Links between chapters/ sub-chapters/ paragraphs		
Overall Indicator			52,0	

After making revisions according to the validator's suggestions in stage I, stage II validation was carried out again. In stage II validation, the media expert validator stated that the electronic module could be tested. Result of validation of electronic module based on 3D PageFlip Professional material on Radioactivity and Nuclear Reactions in the Atomic and Nuclear Physics course by a team of media experts in stage II can be seen in table 2 below:

Table 2. Results of Phase II Media Expert Validation for Each Assessment Indicator

No.	Assessment Indicator	Assessment	Score	Description
1.	Module Cover Design	1. Design an attractive cover layout and use the right color combination.	13,7	Very good
		2. The size and layout of the writing is correct.		
		3. The image display used is attractive and clear.		
		4. Layout and images are relevant to the title.		
2.	Design the module contents	5. Consistency of the layout of the module contents.		
		6. Consistency of colors used in the module content.		
		7. Design an attractive layout and use the right colors.		
		8. The size and layout of the writing is correct.	26	Very good
		9. Display images and graphics in accordance with the material.		
		10. The display of images and graphics is clear and attractive.		
		11. Display videos and animations in accordance with the material.		
		12. Video displays and animations are clear and attractive.		
3.	Software Module Design	13. The module display is relevant to the software layout.		

		14. The software layout design is attractive and uses the right colors. 15. Buttons on the software display make it easier to use e-module. 16. The sound displayed on the e-module is clear.	13,3	Very good
4.	Presentation Components	17. Consistency and orderliness of presentation. 18. There is a foreword, table of contents, concept map, glossary, introduction, list of natural constants and bibliography. 19. Learning objectives at the beginning of each learning activity. 20. Example questions, formative tests, and summaries at the end of each learning activity. 21. Formative test answer key at the end of the e-module.	18,3	Very good
5.	Ease of Operation	22. Clarity of instructions for using e-modules and software.	3,3	Very good
Overall Indicator			52,0	Very good

In picture 1) The electronic module cover displays the title of the electronic module, a cover image representing the contents of the electronic module, the name of the publishing university and the Jambi University logo. 2) The table of contents displays the title and description of the contents of the electronic module, 3) The learning (material) section displays the title, description/explanation and equations using equation 3.0.

The results of media expert validation show that the validation results of the 3D PageFlip Professional-based electronic module in the Radioactivity and Nuclear Reactions material in the Atomic and Nuclear Physics course by the expert team in stage I are the average overall indicator score given based on the assessment of media expert validation in stage I is 58.3 which is categorized as good. After carrying out revisions according to the validator's suggestions in stage I, it can be concluded that the results of the validation of the 3D PageFlip Professional based electronic module on Radioactivity material and Nuclear Reactions in the Atomic and Nuclear Physics course by a team of media experts in stage II with a score of 75 which is categorized as very good. Meanwhile, the average score for each indicator includes the module cover design indicator is 13.7 which is categorized as very good, the module content design indicator is 26 which is categorized as very good, the module software design indicator is 13.7 which is categorized as very good, the indicator the presentation component is 18.3 which is categorized as very good, and the ease of presentation indicator is 3.3 which is categorized as very good.

The results of the validation of the 3D PageFlip Professional-based electronic module in the Radioactivity and Nuclear Reactions material in the Atomic and Nuclear Physics course by a team of material experts in stage I, namely the average score of the overall indicator given based on the assessment of the material expert validation in stage I was 39.5 which is categorized as good. After making revisions according to the validator's suggestions in stage I, stage II validation was carried out again. Based on table 1, it can be concluded that the results of the validation of the 3D PageFlip Professional-based electronic module in the Radioactivity and Nuclear Reactions material in the Atomic and Nuclear Physics course by the material expert team in stage II are the average overall indicator score given based on the assessment of the material expert validation in stage II is 52 which is categorized as very good. The advantages of electronic modules include the language used which is easy to understand,

the videos displayed are in three-dimensional form and animations are displayed directly on the screen, there are answer sheets which can be typed to answer formative tests and write conclusions and the answers can be printed, can be used for learning remotely, students can see the scores obtained from the final test taken directly and the 3D PageFlip Professional-based electronic module can be used directly without having to have the application.

CONCLUSION

Based on the results of the development and trials that have been carried out, it can be concluded that the electronic module based on 3D PageFlip Professional on radioactivity and nuclear reactions in the atomic and nuclear physics course is valid and suitable for use. with a material expert score of 52 and a media expert score of 75 which is included in the very good category.

ACKNOWLEDGMENTS

I would like to wholeheartedly thank all the researchers who have given their time, energy and knowledge to this project. Your hard work and passion have brought new light to the world of research, and I am very grateful for the contributions you have made.

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