Development of protein metabolism electronic module by flip PDF professional application

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Abstract. The 21st century learning innovations must be optimized using appropriate media and learning resources. The use of technology has become an efficient alternative in the implementation of learning. This research aims to produce electronic-modules (e-modules) as teaching materials for protein metabolism using Flip PDF Professional application. The method used refers to research and development. The contents of the module are developed based upon the learning design in the Biomolecular Metabolism course according to the curriculum of the Chemistry Education undergraduate study program. In addition, the e-module is equipped with videos, images, animations, links to various main sources and formative tests on each material in accordance with the learning outcomes over the course. Product validation is carried out by material, language and media experts using standard instruments with the Likert scale. The results of expert validation of the developed e-modules show well to very good at interpretations. Based on the results from the validation it can be concluded that the electronic metabolism protein module is ready to be used as a learning material in supporting the improvement of students’ critical thinking. Dissemination of the e-modules in the biochemical learning process is being carried out and will be published in the next article.

1. Introduction
The development of science and technology increasingly encourages reform efforts in the utilization of technology in the learning process [1]. Along with the development of the field of computing technology, the representation of the diverse interactions of physical quantities in a phenomenon can be presented using a dynamic format in the form of animation and simulation [2]. Chemistry can represent a variety of perspectives of life on earth by showing the important role of various metabolic reactions in the energy cycle and the elements of the earth. The problem is in the teaching of chemistry, many abstract activities, for example, in chemical reactions that break down the concept of understanding the learners and is unable to explain the exact role of chemistry [3]. Therefore, the required materials can give a concrete picture of the chemical reactions that occur. One of the materials in the relevant chemical to be developed from the teaching materials is Protein Metabolism topic. This topic includes many abstract concepts based on the principles and processes. Moreover, the metabolism of protein material is closely related to daily life, such as protein diet plays an important role in physiological processes in the body countless [4].

The use of teaching materials enabled learners to understand the material in a shorter time and more fun [5]. One of the teaching materials used in schools is modules. Learning module is designed learning resources systematically by field of study in accordance with the rules of innovative experts with the
aim of improving the effectiveness, efficiency, and increase the interest of students to continue learning [6]. The purpose of this module is to facilitate the learning process without regular supervision, all the elements of a course given by teachers usually must be formed into a set of printed materials, audiovisual, or computer-based (or combination thereof) [7]. Liu et al., revealed features in an innovative e-modules and the use of technology in learning becomes a priority for the needs of educators in the 21st century learning [8]. One of the applications that are used to create the e-module is Flip PDF Professional. Making the e-modules using a Flip PDF Professional software because it has the advantages of teaching materials produced can be inserted into images, videos, animations, and simulations that could make it an attractive media interactive learning so that learning becomes monotonous [9]. E-module will then be applied in the course of Biomolecular Metabolism. E-Module will complement previous research on Carbohydrate Metabolism and Lipid Metabolism to provide alternative teaching materials to improve the quality of graduate study program Chemistry and Chemical Education at Bachelor level.

2. Methods

2.1. Preliminary studies
At this stage, needs analysis, the literature study and the Forum Group discussion in small groups. Introductory research was conducted at Faculty of Mathematics and Science, Universitas Negeri Jakarta involving students and lecturers. This step is performed to obtain the information needs of students and faculty with a preliminary analysis of questionnaires distributed to students who already have Biomolecular Metabolism course.

2.2. Planning research
The research planning will begin with the early product development of the e-module made in accordance learning design in the Biomolecular Metabolism course on protein metabolism materials and the results of the preliminary analysis, including the creation of an instrument to get feedback from users. After that the product was validated by experts or experts to get feedback and advice from specialists or experts are subject matter experts, language, and media experts. Further revisions and validated to modules developed judged to be ready for use for the learning process.

2.3. Initial product development
Design e-module is built on the Microsoft Word application to be stored in a .pdf format. Modules in .pdf format are then incorporated into applications Flip PDF Professional to the outcome of the e-module in the form of a flip page. Additional media to complete a module, such as audio, video, and web links about the formative entered using the application. Contents created are developed based upon the learning design in the Biomolecular Metabolism course on material protein metabolism. The material of protein metabolism is taken from several books on biochemistry and organic chemistry, including Kuchel and Ralston, Lehninger, Bourke, Nelson et al., Murray and Yeum, the once compiled is the e-modules tested for feasibility to get feedback and advice from subject matter experts, media, and Language [10].

2.4. Small-scale field test
The e-module product is completed; the next is carried out early trials that expert assessment related to the field of technology (media expert) and chemistry (subject matter and language experts).

2.5. Revised small-scale field-test results
The next stage is the improvement of the product in accordance with the data and suggestions obtained from small-scale field test. Advice from experts is used to improve products.
3. Results and discussion
The results of this study are protein metabolism e-modules using Flip PDF Professional application. E-module was developed as a guide and a source of self-study student [11]. The E-module was validated by subject matter experts, language and media. Percentage value validation and interpretation were obtained by taking the interval with Likert scale. The expert validation results are presented in Table 1. According to Table 1, linguists give a rating of 80.56% with an excellent interpretation and subject matter experts give a rating of 72.22% with good interpretation. Linguists provide suggestions for the use of capital letters in the answer options should be consistent and added discussion of the e-module. While the subject matter experts provide advice to make sure the material used genetic code utilizing a new concept, and before the exercises should be given examples of problem-solving, as well as the need to reproduce the problem.

Table 2 shows the results of a media expert validation calculations, the value of 94.64% with a very good interpretation. After validation of the linguists, materials, and media researchers make revisions that are tailored to the advice of experts. Media experts provide advice to the start page, writing headlines is more proportional; each made good paragraph justified, given the identity of each picture image, and made a drawing table. Based on advice from media experts, the inscription on the cover proportionately less (figure 1) and yet there is the logo of the institution. Researchers make revisions shown in Figure 2 to replace the letter title of the e-module with a more proportional and add the logo of the institution. In figure 3 the content of the e-module portion, media experts claim that use fewer suitable backgrounds and covered most of the writing. Researchers revise to replace the background more appropriate by not covering some writing (figure 4).

### Table 1. The results of calculations of material and language expert validation.

| No. | Indicator assessed                                                                 | Linguist | Material Expert | Total score | Percentage (%) | Interpretation |
|-----|-------------------------------------------------------------------------------------|----------|-----------------|-------------|----------------|----------------|
| 1   | Topics on the e-module in accordance with the material of protein                    | 4        | 4               | 8           | 100            | Strongly agree |
| 2   | Media content in accordance with the Course Learning Outcomes (CPMK) to be achieved in the material metabolism of proteins | 4        | 4               | 8           | 100            | Strongly agree |
| 3   | Material and problems developed in the e-module has represented the material indicators of achievement in protein metabolism | 3        | 3               | 6           | 75             | Strongly agree |
| 4   | Questions contained in the e-module was clear                                       | 3        | 3               | 6           | 75             | Strongly agree |
| 5   | Questions contained in the e-modules are applied                                    | 3        | 3               | 6           | 75             | Strongly agree |
| 6   | The material contained in the e-module is easy to understand                        | 3        | 3               | 6           | 75             | Strongly agree |
| 7   | There is discussion of the matter in the e-module on protein metabolism             | 2        | 2               | 4           | 50             | Agree          |
| 8   | The discussion in accordance with the matter contained in the e-module media on protein metabolism material | 3        | 2               | 5           | 62.5           | Agree          |
| 9   | Questions and discussion in the media using simple language and communicative       | 4        | 2               | 6           | 50             | Agree          |
|     | Total                                                                               | 29       | 26              |             | 80.56          | Very good      |

**Interpretation**

- 80.56% very good
- 72.22% good
Table 2. Media expert validation calculation results.

| No. | Indicator assessed                                      | Media Expert | Score (%) | Interpretation |
|-----|--------------------------------------------------------|--------------|-----------|----------------|
| 1.  | Selection of layout is appropriate                     | 4            | 100       | Strongly agree |
| 2.  | The layout is neat and orderly layout                  | 3            | 75        | Strongly agree |
| 3.  | Background is correct and appropriate                  | 3            | 75        | Strongly agree |
| 4.  | The proportion of colors used in compliance            | 3            | 75        | Strongly agree |
| 5.  | The displayed image is clear                           | 4            | 100       | Strongly agree |
| 6.  | Posts that are used have a clear                       | 4            | 100       | Strongly agree |
| 7.  | Font used is simple and easy to read                   | 4            | 100       | Strongly agree |
| 8.  | The size of the font used in accordance with the layout| 4            | 100       | Strongly agree |
| 9.  | Sounds or music being used in compliance               | 4            | 100       | Strongly agree |
| 10. | Media can be used repeatedly                           | 4            | 100       | Strongly agree |
| 11. | Function easy to operate on media                      | 4            | 100       | Strongly agree |
| 12. | Media usage instructions are clear                     | 3            | 75        | Strongly agree |
| 13. | Media easy to operate                                 | 4            | 100       | Strongly agree |
| 14. | The resulting media quality has been good              | 4            | 100       | Strongly agree |

Total: 53
Percentage (%): 94.64
Interpretation: Very good

*The percentage of the value obtained from:
Y = The highest score x The number of respondents
X = The lowest score x The number of respondents
Total score/ Y x 100%

Figure 1. The initial design of the e-module cover.

Figure 2. Final design of E-module cover.
The developments of e-modules were created by utilizing information and communication technology such as computers and special software. Information and communication technology thus has a great effect to overcome the limitations of the learning media [7]. For Lecturer, making learning media becomes relatively easier when the development of this technology is implemented optimally in the learning process in the classroom. Educators can integrate educational technology that enables academic learning efficiency [12]. In addition, the media are considered to be effective and efficient to use self-learning is an electronic module.

Learning to use the e-module is practical and requires storage space a lighter so it can be taken anywhere and anytime. The e-module content more dynamic and interactive. This is according to research conducted by Asri et al., titled "Development of Electronic Module Text Writing Procedure for Discovery Based Learning in High School" [13]. In the study states basically e-module is intended for students to learn independently. Similarly, the e-module of protein metabolism can be used by students anywhere and anytime because students just copy the e-module file and then use it on their respective computers. The links contained in the e-module make it easy for users easily refer to certain information or access any part of the e-module. E-module is highly integrated with multimedia elements, such as audio, back sound, animation and video that make reading not only more attractive but more easily understood [14-17].

The development of e-module protein metabolism is part of Team E-Module Chemistry UNJ. The other e-module have been produced previously published by Seruni et al., entitled "Development of Biochemical E-Modules on Lipid Metabolism Materials using Flip PDF Professional" [16]. She is also stated that the media that were considered effective and efficient for independent learning where e-modules learning would be more meaningful if the use of electronic modules, besides according to the research conducted by Pilt et al., entitled "Tool for creating learning modules developed based on open-source software Open Sources "[18]. Evaluation the effectiveness of e-modules that researchers make to improve critical-thinking skills is being implemented and will be published in the next article.

4. Conclusion
The results showed the Protein Metabolism e-module obtain the value of subject matter experts 72.22% with a good interpretation, linguists 80.56% with a very good interpretation and media experts 94.64% with a very good interpretation. From these results we concluded that the product development of e-module that is suitable for use in protein metabolism of the learning process.

Acknowledgment
Our gratitude goes to the Chairperson of LPPM UNI for providing the opportunity to submit a 2020 Masters Grant proposal. Director General of Higher-Education grant funding which has facilitated the Masters in 2020 with a contract number: 13/SP2H/DRPM/LPPM/III/2020. This assistance is very useful in supporting software facilities, publication processes, and other activities so that this thesis research can be completed. I would also like to thank the expert team which took their time, students of the
Chemistry Study Program and Chemical Education, and the UNJ Chemistry E-Module Team for their good cooperation.

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