

PAPER • OPEN ACCESS

## Web Module with Image and Mathematical Representation as a Form of Optimization Ability of Creative Thinking and Conceptual Understanding

To cite this article: R M Ahmad and I Wilujeng 2018 *J. Phys.: Conf. Ser.* **1097** 012027

View the [article online](#) for updates and enhancements.



**IOP | ebooks™**

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

# Web Module with Image and Mathematical Representation as a Form of Optimization Ability of Creative Thinking and Conceptual Understanding

R M Ahmad <sup>1</sup> and I Wilujeng<sup>2</sup>

<sup>1</sup>Postgraduate of Physic Education, Universitas Negeri Yogyakarta, Jl. Colombo No.1, Catur Tunggal, Depok, Sleman, Daerah Istimewa Yogyakarta, 55281, Indonesia

<sup>2</sup>Postgraduate of Science Education, Universitas Negeri Yogyakarta, Jl. Colombo No.1, Catur Tunggal, Depok, Sleman, Daerah Istimewa Yogyakarta, 55281, Indonesia

[rbyamulyawati@gmail.com](mailto:rbyamulyawati@gmail.com)

**Abstract.** This study aims to produce a web module with image and mathematical representation that theoretically can optimize the ability of creative thinking and conceptual understanding. Method of this research is Research and Development using a four-D's model. Stages of this research are (1) define, (2) design, (3) develop 4) dissemination. The eligibility of the developed web module is analyzed in descriptions based on the assessment of material and media experts (lecturer), and practitioners (teachers). Data of the research in Likert scale then processed into a standard value of four-scale. The quality of the web module according to the expert both in terms of material completeness, material accuracy, and organization of presentation, general appearance, and grammar is in the category very good with the average score of 3.77. Web module quality according to media experts both in terms of web design and the effectiveness of its use in terms of a very good category with the average score of 3.6. Based on the results of research, the web module with image and mathematical representation is feasible to be used as a learning media to optimize the ability of creative thinking and conceptual understanding.

## 1. Introduction

Physics learning is one of the lessons that become an important foundation for developing science and technology [1]. Physics learning is also a fundamental study that studies the phenomena experienced by human senses either directly or instrumentally. Physics learning at this time is still considered difficult for most learners [2].

Physics learning in Indonesia has any problem. One of the problems is lacking resources learning. Resources learning for study physics forget customized by student need and characteristic of the materials [3]. The content in physics learning usually is abstract content [4]. The abstract material can be represented in the form of pictures and the mathematical equation. it can be easier to understand [5].

Web module with image and mathematical representation is one of an alternative source of physics learning. The web module is a flexible and unlimited resource for physics learning [6]. Using Web module in proses study in physics especially the abstracts material can improve student creative thinking skill and conceptual understanding [7].



Web module is a self-learning tool [8] [9]. The web Module can be used by training creative learning of student [10], Using representation in resources learning especially web module can enhance students' understanding of the concept [3], and the ability of students' creativity, because use web module as creative learning media can train students' creativity [11].

Creative thinking ability is the ability of individuals to use thinking to generate new ideas, new possibilities, and new discoveries [12] [13] [14] [15]. Every individual has different the ability to think creatively [16] Creative thinking skills can be developed through creative thinking learning activities, One of the alternatives creative thinking learning activities is using the web module [11].

Conceptual understanding is part of the changes in learning outcomes in the cognitive domains [17]. The ability to understand a concept can be seen from the ability to capture an understanding of a content [18]. Conceptual understanding of people marked by capable of expressing a material with image and mathematical representation [19].

Web module with image and mathematical representation is resources learning, by presents the material, questions and exercises and the shape of the image and the mathematical equation that can be a resource learning for study physics should be adjusted to student need and characteristics of the materials. Web module with a mathematical representation of the image can train students' ability to think creatively. This study aims to produce a web module with image and mathematical representation that theoretically can optimize the ability of creative thinking and conceptual understanding.

## **2. Method**

### *2.1 Type of Research*

This research was of the type known as R&D (Research and Development) using a four-D's model. Stage of the research are (1) define, (2) design, (3) develop, (4) dissemination [20] This research is raining to develop web module of physics learning with image and mathematical representation on Work and energy subject as a form of optimization of creative thinking and conceptual understanding. The research was chosen because the objective was to develop a source of learning (web module with image and mathematical representation) acquaint fine levels of appropriateness and quality thought proses of validation.

### *2.2 Procedure of Research*

Procedure developing web module with image and mathematical representation consists of four stages. The first stage is the define stage, this stage aims to determine and define the needs of the learning process and collect various information related to the product in the form of web module to be developed. In the stage consists of several steps: preliminary study, student analysis, task analysis, concept analysis, and web module specification.

The second stage in research is a design. The design is a prose for developing the format of the web module. Format material of web module is adapted by curriculum 2013 and designing with image and mathematical representation of Work and energy subject . Design of content module is adapted by material preparation guide and a web-based instructional guide [21].

After design, developing of web module was conducted. The result of design and development was then evaluated in term its appropriateness and quality thought the stage of product validation and will be disseminated stage by way of being implemented in a classroom learning process if the developed web module has been declared eligible based on validation results

### *2.3 Data Collection Instruments*

The research data were collected using a questionnaire. The questionnaire is used to find information appropriateness and quality of web module both in terms of content and media. Questionnaire of web module validation by material experts cover by 2 aspects: consist of the suitability of web design and effectiveness of its use. Then questionnaire of web module validation by media experts cover by 6 aspects the suitability of material completeness, material accuracy, material

relevance, organizational presentation, general appearance, and language. The assessment was developed using a Likert scale of 1-4.

#### 2.4 Technique of Data Analysis

The research data was analyzed by descriptive analyses. The descriptive analysis was used to analyze the data of product validation. The analysis of data qualitative resulted from the web module validator was conducted by

$$\bar{X} = \frac{\sum x}{n} \dots\dots\dots(1)$$

With  $\bar{x}$  =average score of each indicator, n = number of appraisers, and  $\Sigma x$  = total score of each indicator then scores obtained from the Likert scale are analyzed and converted into the following four criteria and data classification into categories indicating level appropriateness and web module quality.

**TABLE 1.** Qualification of Score Quality [22]

No	Score Interval	Criteria
1	$X \geq Y_i + 1,8\mathbb{B}b_i$	Very good
2	$Y_i + 0,6\mathbb{B}b_i \leq X \leq 1,8\mathbb{B}b_i$	Good
3	$Y_i - 1,8\mathbb{B}b_i < X \leq Y_i - 0,6\mathbb{B}b_i$	Less
4	$X \leq Y_i - 1,8\mathbb{B}b_i$	Very less

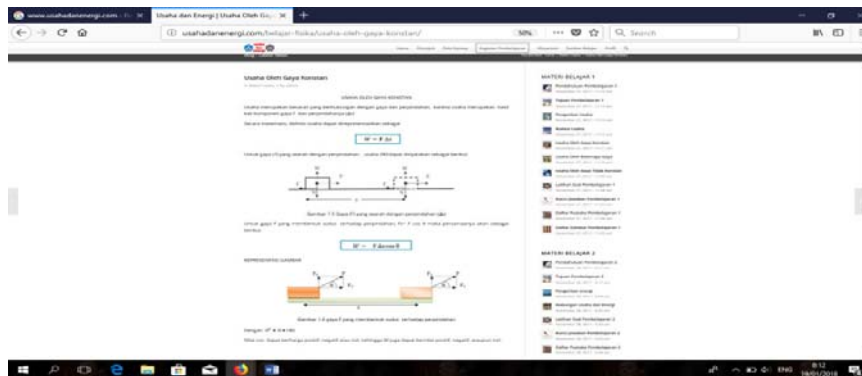
### 3. Result and Discussion

#### 3.1 Result

Web module developed is a learning resource that can be used with the aim of optimizing of creative thinking and conceptual understanding. The characteristics material of the developed Web module is adapted by Regulation of the Minister of Education and Culture no. 69 on the basic framework, structure of curriculum SMA / MA and age students senior high school. In addition, the developed Web module is packaged in accordance with material preparation guide 2008 and a web-based instructional guide 2010 [21]

Components in the web module are: Home, User Guide, Concept Maps, Learning activities contain about (material, sample questions, and exercise questions, answer key, bibliography, and list of images), Glossary, Other learning resources and Developer profile

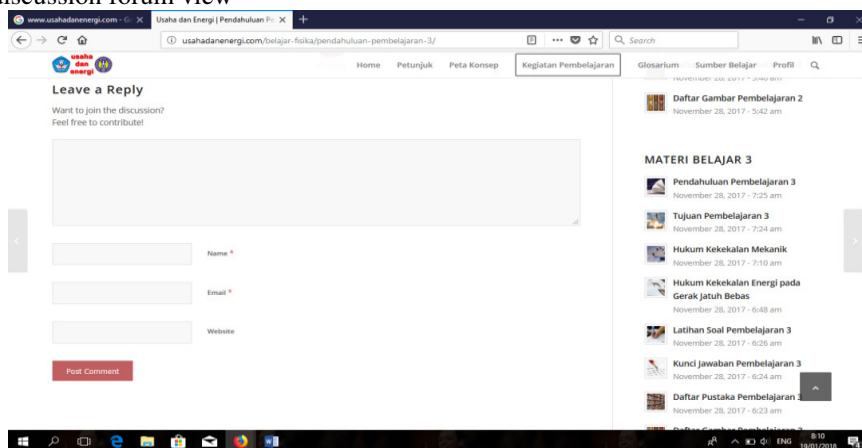
To support the optimization of creative thinking and conceptual understanding, the developed web module is complemented by image and mathematical representation. Representation is a tool for building and communicating an understanding through several ways eg through verbal, images and mathematical equations [5] [23]. Therefore the web module developed is a web module with image and mathematical representation that aims to help students to understand the especially for Work and energy content. In appearance, web module resulting from designing module with image and mathematical representation is a seen in figure 1



**FIGURE 1.** Appearing Image and Mathematical Representation in The Web Module

Web module developed is flexible and easy to access web module because this web module can be accessed through [www.usahadanenergi.com](http://www.usahadanenergi.com) page from PC, Handphone, and Android connected to the internet network.

The advantage of the developed web module is to provide an interactive environment similar to the class but show the needs of each student because the web module comes with a discussion forum. Here is a discussion forum view



**FIGURE 2.** Appearing Discussion Forum in The Web Module

The development of web-based technology can be used in the creative learning process in the web module developed also trying to form a close relationship between creative learning with the web module to the creativity of learners, whereby using web module more students can improve the ability of creative thinking

The developed web module is equipped with creative thinking exercises that can train students' creative thinking skills. Where students' creative thinking ability can be judged by the ability of students to use their minds to generate new ideas and new discoveries in both image and mathematical representations.

Web-based modules are designed can help students build mental relationships to strengthen the logical framework of their conceptual understanding [24] and to achieve a higher level of mastery of a conceptual understanding by providing an interactive environment similar to the class but exposing the needs of each student.

The level of appropriates and quality of web module resulting from development was then measured. The level of appropriateness was measured thought validation by an expert in learning physics and media while the level quality the material was measured thought by two Expert material

who is a Graduate Lecturer of Yogyakarta State University, and a practitioner consisting of 3 teachers of SMA Negeri 1 Kupang. Based on the conversion of Likert scales by Widoyoko, the results of the following scoring categories are obtained

The result of validation by an expert can be seen in table 2

**TABLE 2.** Material Validation Results

No	Aspect	Mean score	Category
1	Material completeness	4,00	Very good
2	Material Accuracy	3,60	Very good
3	Material Upgrade	3,53	Very good
4	Organization of general presentation	4,00	Very good
5	General display	3,80	Very good
6	Linguistic	3,73	Very good
	Total	3,77	Very good

Based on the web module assessment in terms of material, the web module developed got the final average score of 3.77, so it can be categorized that the web module developed very well and feasible to use in terms of material presented in the web module.

This test involves one media expert who is a graduate lecturer at Yogyakarta State University, and a practitioner consisting of 3 lecturers from the Department of Computer Science of Nusa Cendana University. Based on the conversion of Likert scale by Widoyoko, the result of the following scoring categories

**TABLE 3.** Media Validation Results

No	Aspect	Mean score	Category
1	Web design	3,58	Very good
2	Effectiveness of use	3,62	Very good
	Total	3,60	Very good

Based on the web module's assessment in terms of media, the developed web module earned an average final score of 3.6, so it can be categorized that the web module developed is very good and feasible to use in terms of design and effectiveness of its use

### 3.2 Discussion

One way to solve the problem of physics learning especially abstract learning material is by using web module [25] Web module with image and mathematical representation, is a new, original and innovative self-learning tool [26].The Web module can be used as a means of conveying and means of obtaining information to help students apply cognition, and imagination skills to find acceptable, understandable facts, problems, and ideas [27]

Creativity thinks students can be trained with learning by web module, web module can be used as a means of practicing, means of the problem- solving, and as a guide or reference in understanding a problem [28]. One advantage of web module can create an experience learning and a learning community that can help in facilitating the development of thinking, the means to develop skills and thinking strategies, as well as a means to feel the thinking processes of individuals and others as a form of optimizing the ability of creative thinking and conceptual understanding.

The form of representation used in the delivery of material in the web module can assist students in concepts conveyed in various formats especially image and mathematical representation, with the reproduction of material in a memorable and understandable form understanding of student concepts will increase [29]. The presentation of material in the form of a creative thinking tool [3] can help students solve problems through creative thinking and understanding more concepts and can help solve a problem [18] [30].

Web module is well-structured learning media, in terms of both material and media structured. The web module can reinforce logical thinking, and conceptual understanding, because the web module with image and mathematical representation has passed the validation stage and giving suggestions and assessments from the experts, which based on the assessment of experts shows that the web module is categorized as a very good media and feasible to use. Then web module developed can be used in the learning process as a means of optimizing the ability to think creatively and conceptual understanding both in terms of material and media

Web module is well-structured learning media because by using of web module with image representation and mathematical, students are trained to use their cognitive thinking skills to understand abstractly material through material translation, sample questions and practice questions presented in the web module. Representation in web module is a tool for building and communicating understanding through several ways eg verbal, images and mathematical equations.

In addition, the use of web module which is one learning resource that is arranged interactively, flexible, and unlimited, makes it easier for students to access their learning resources and also as a place to exchange information both between students and with student teachers will be easier to develop creative mindset and understand the material presented in the web module.

#### 4. Conclusion

Web module is a self-learning tool. Web module with image and mathematical representation is one of an alternative source of physics learning. The aim of developing web module is a develop an alternative source of physics learning to optimize the ability of creative thinking and conceptual understanding. The quality of the web module according to the expert both in terms of material completeness, material accuracy, an organization of presentation, general appearance, and grammar in the category is very good with the average score of 3.77. Web module quality according to media experts both in terms of web design and the effectiveness of its use in terms of a very good category with the average score of 3.6. Based on the results of research, the web module with image and mathematical representation is feasible to be used as a learning media to optimize the ability of creative thinking and conceptual understanding because the web module is very good category source of physics learning, teachers can use the web module as a learning resource that is easily accessible and used in the learning process more interactively through the discussion column, and teachers also need to do further development with similar web module on different learning materials

#### References

- [1] Ramma N 2017 *Education Inquiry* 1-9
- [2] Chiou T G 2013 *Research in Science & Technological Education* **31**
- [3] Carolan J 2010 *Res Sci Educ* **40** 65–80
- [4] Devecioglu Y 2010 "Student teachers' levels of understanding and model of understanding

- about Newton's laws of motion," *HKIED APFSLT* **11**(1)
- [5] Finkelstein D 2008 *Phys. Rev. ST Phys. Educ. Res* **4**
- [6] Oreta 2000 "Developing a Web-Based Learning Module in a Basic Civil Engineering Course," *computer applications in engineering* 235-243
- [7] Arasasingham R D 2005 "Assessing the Effect of Web-Based Learning Tools on Student Understanding of Stoichiometry Using Knowledge Space Theory," **8**(82) 1251-1262
- [8] Kaithari A B 2017 *Humanities & Social Science Reviews*, **5**(2) 141-148
- [9] Khan A 2017 *International Journal of Medical Education* **8** 421-422
- [10] Meltzer D E 2005 "Multiple Representations in Physics Education: Recent Developments and Questions for Future Work,"
- [11] Lin C S 2016 *Eurasia Journal of Mathematics, Science & Technology Education* **6**(12) 1675
- [12] Daud 2012 *Procedia - Social and Behavioral Sciences*, 56 467 – 474
- [13] Kim K H 2006 *Creativity Research Journal* **18**(1) 3-14
- [14] Ulger K 2016 *H. U. Journal of Education* **31**(4) 695-710
- [15] Bakır S 2014 *Journal of Baltic Science Education* **13**(2) 231-242
- [16] Gökdere M 2015 *International Journal of Education and Research* **3**(3)
- [17] Hamalik 2004 *Proses belajar mengajar*, Bandung: Bumi Aksara
- [18] Darren Wong 2011 "Learning with multiple representations: an example of a revision lesson in mechanics," Physics- Education
- [19] Krathwohl 2001 *A taxonomy for learning, teaching, and assessing: a revision of Bloom's taxonomy of educational objectives* New York: Longman
- [20] Thiagarajan 1974 *Instructional for training teacher of exceptional children*. Minnesota: Indiona University
- [21] Depdiknas 2010 *Panduan pembuatan bahan ajar berbasis web* Jakarta
- [22] Widoyoko E 2010 *Evaluasi program pembelajaran* Yogyakarta : Pustaka Belajar
- [23] Hwang Y W Y 2007 *Educational Technology & Society* 191-212
- [24] McMurtrey M 2013 *Journal of SOUTHERN, assosiation for information system* **1**(1) 14-25
- [25] P. P.V 2015 *International Journal of Education and Psychological Research* **4**(2) 44-46
- [26] Liu G Z 2011 *Computers & Education* **56**(1) 65-79
- [27] Huang D R T 2011 *British Journal of Educational Technology*
- [28] Stelzer B T 2008 "Comparing the e cacy of multimedia modules with traditional,"
- [29] Verplank B B 2011 "Can Haptics make New Music? - Fader and Plank Demos,"
- [30] Nguyen D H 2009 "Facilitating Students' Problem Solving across Multiple Representations in Introductory Mechanics,"