Development of Web-Based Radioactivity Teaching Materials oriented-on Character Education for Highschool Student

Muhamad Gina Nugraha

Faculty of Education, Monash University, Australia
Correspondence: E-mail: muhamadginanugraha@gmail.com

A B S T R A C T S

The development of Information and Communication Technology (ICT) affects the learning process. So, this study aims to produce a product of web-based teaching materials on radioactivity-oriented character education materials that are tested for quality and feasibility and can help teachers and students in learning radioactivity materials. The research used a design-based research model, which used a 3-D technique (i.e. Define, Design, and Develop) to develop teaching materials in this study. The instrument used consisted of a web feasibility judgment sheet in facilitating character education, content feasibility, visual design feasibility, and navigation feasibility used in a limited trial through two stages, namely the expert test stage and the user test. The expert test was conducted by three material and media experts. The user test was conducted by three teachers and 30 students of senior high school students (grade 12). The results of the limited trial overall show that web-based teaching materials are feasible in terms of facilitating character education, content, visual design, and navigation.

A R T I C L E I N F O

1. INTRODUCTION

The development of Information and Communication Technology (ICT) affects all fields, including education. The development of ICT makes information easily accessible (Mohanty et al., 2016). For teachers, this is a demand as well as an opportunity to be able to develop new teaching material using ICT to bring new learning experience for their students and achieved learning goals, since teaching material as a learning resource has a great influenced for learning success (Sulyanah, 2021). This is in line with the Indonesian national curriculum, which requires the use of ICT in the learning process to achieve educational goals and compete with developed countries

ICT-based teaching materials include e-books, PowerPoint text (PPT), flash animations, simulations, videos, websites, etc. Many researchers have reported the influence of ICT-based teaching material on the student learning process and the enhancement of student competence. on computer simulation teaching material, researcher reported that computer simulation allows students to demonstrate (results) their learning in a context semi-actual world and "forces" students to demonstrate application skills, analysis, and synthesis (Akpan, 2002).

In addition, computer simulations can provide opportunities for students not only to develop understanding and strengthening concepts, but also develop abilities in authentic scientific exploration and investigation, inquiry, critical thinking skills, encourage student reflection and promote cognitive dissonance (Abdullah, 2008; Smetana, 2012; Nugraha, 2016; Suyatna, 2019). On video teaching material, researchers report that the implementation of video on learning process could have greater impact (Arvanitidou, 2015; Ahmad, 2015), and numerous other studies examining the advantages of employing ICT teaching resources in the educational process. Learning materials can be effectively delivered in accordance with the goals to be attained by using a variety of media that will be better received by students (Sulyanah, 2021). Thus, combining the ICT-based teaching material could be expected give a better result, such as a Web-based teaching material.

Web-based teaching material can display a variety of media (multimedia) such as text, images, audio, visuals, graphics, animations, video, simulation, etc. In comparison to desktop software that require installation and storage space, interactive websites are seen to be more effective learning tools. Furthermore, an interactive web-based teaching material could improve creative thinking skills (Serevina, 2022), enjoyable learning, also accessible for student anytime (Sulyanah, 2021), thus, student can learn apart from the limitations of time and place, which mean increasing the involvement of students in learning. Moreover, an interactive web-based teaching material could reduce the operational costs of learning and create a safer learning environment, particularly for high-risk teaching content, such as electricity, radioactive, etc.

The development of web-based teaching materials in this report focuses on radioactivity material. This material is considered difficult and abstract for students to learn. Keech et al, (2020) suggest that some materials do not allow students to observe physical directly, for instance, in the discussion of the solar system and galaxies. Teachers are unlikely to bring planets or comets into the classroom. In atomic theory, students cannot carry out experiments to find out or see real atomic phenomena. Materials regarding radioactivity from high school student textbooks are also still limited, so the existence of this web is expected to increase students' sources of knowledge.

Based on Indonesian national curriculum, the learning process in school must be carried out interactively, inspiring, fun, challenging, motivating students to participate actively, and providing sufficient space for initiative, creativity, and independence following talents,

interests, and developments for physical and psychological students (Ilhami & Syahrini, 2021). Moreover, learning process carried out to build, facilitate and enhance a good character student, i.e., curiosity; think logically, critically, creatively, and innovatively; honest; healthy lifestyle; self-confident; discipline; independent; responsible; favour science; appreciate diversity; and environmental awareness. In this report, the development of web-based teaching material is oriented on this character building. Education character in school could inculcate student's positive habituation to have a good value (Nourollah, 2015). Moreover, to develop students' good character, a character-based learning instrument must be included (Akhlis, 2019), because when students used the learning tool frequently, their attitudes would change (Kalayci & Humiston, 2015).

2. METHODS

The research method used in this study is a research and development method known as design-based research with a 4-D model that is reduced to 3-D. Research and development methods are research methods used to produce certain products and test their effectiveness of these products.

The design-based research method with a 4-D model that is reduced to 3-D consists of (1) Define, (2) Design, and (3) Develop. The definition stage is the initial stage where researchers begin to analyze problems, conduct literature studies, and analyze radioactivity material in the 2013 Curriculum Content Standards. Next is the design stage, in this stage researchers design web designs, compile content, and create teaching materials. This stage is carried out to produce the initial product of web-based teaching materials. Then the development stage, this stage is the last stage which aims to validate the initial product of web-based teaching materials. The validation results are used to revise the initial product which would become the final product of the research. This stage also determines whether web-based teaching materials are suitable for use or not.

The validation stage is carried out using expert tests and user tests. The expert test was conducted by three physics lecturers and the user test was conducted by three physics teachers and 30 students. The results of this trial would be analyzed to be used as conclusions in declaring the feasibility of teaching materials.

The feasibility of teaching materials in facilitating character education would be statistically processed to obtain conclusions. The feasibility of teaching materials in facilitating character education would be assessed for each character education value. On the web eligibility judgment sheet in facilitating character education, there are statements of "yes" and "no" selected by the expert, this statement would be converted into the number "1" if the expert states "yes" and "0" if the expert states "no". It aims to calculate the sum of each character education value as a result of an expert's judgment of each character education value contained in web teaching materials. Then the amount is presented using equation (1).

$$P = \frac{f}{n} \text{ x } 100 \text{ \%} \tag{1}$$

Information:
P = Percentage,
f = The total value of character education on the web-based on the results of judgment,
n = The number of character education values contained on the web.

The results of data processing from the formula are then qualified for the feasibility of teaching materials in facilitating character education based on **Table 1.** While the feasibility

of content, visual design, and navigation would be processed every aspect of content feasibility, visual design feasibility, and navigation. On the content, visual design, and navigation eligibility judgment sheets there are scores of 1-3, the scores of the judgment results are added up and averaged, then converts the average score into percentage form with the following equation (2).

$$\%Skor = \frac{Skor\ rata-rata}{Skor\ Max} \ x\ 100\% \tag{2}$$

The results of processing the formula data are described based on the qualifications for the feasibility of content, visual design, and navigation which would be shown in **Table 2**.

Table 1. Classification of Web-Based Teaching Materials in Facilitating Character Education.

No	Percentage of Each Character Education Value	Qualification	Appropriateness
1.	90% - 100%	Very good	proper
2.	75%-89%	Well	proper
3.	65%-74%	Enough	Not feasible
4.	55%-64%	Not enough	Not feasible
5.	0%-54%	Very less	Not feasible

Table 2. Eligibility qualification for web-based teaching materials.

% Score	Qualification	Appropriateness
68%-100%	Good	proper
34%-67%	Enough	Not feasible
0%-33%	Not enough	Not feasible

3. RESULTS AND DISCUSSION

The feasibility of teaching materials in facilitating character education based on expert judgment is said to be feasible to train ten of the total eleven-character education values contained in web-based teaching materials. The following results can be seen in **Table 3**.

Judging from the total value of character education, there are ten of the total eleven values of character education that are feasible to use. Eligibility is obtained from the total feasibility score according to the expert, the minimum score for eligibility is two where the number two indicates that two of the three experts stated that it was feasible. On the contrary, there is one value of character education that does not appear in web-based teaching materials, namely respecting diversity. The main reason for the obtainment of the results is because the limitations of researchers in developing teaching materials and radioactivity materials affect the emergence of character education values. Thus, the web-based teaching materials developed are suitable to be used to train ten of the eleven values of character education intended.

Meanwhile, the feasibility of the content according to experts and teachers is said to be feasible. The results can be seen in **Table 4**. The assessment aspects were divided into two components, including content for eligibility with 5 aspects and language with 4 aspects. The feasibility of visual design according to experts and teachers is said to be feasible.

Table 3. Feasibility of teaching materials in facilitating character education.

No	Value of Character Education	Expert Eligibility			Appropriateness
		1	2	3	
1.	Curiosity	proper	proper	proper	proper
2.	Think logically, critically, creatively, and innovatively	proper	proper	proper	proper
3.	Honest	proper	proper	proper	proper
4.	Healthy lifestyle	proper	proper	proper	proper
5.	Self-confident	proper	proper	proper	proper
6.	Discipline	proper	proper	proper	proper
7.	Independent	proper	proper	proper	proper
8.	Responsible	proper	proper	proper	proper
9.	favour science	proper	proper	proper	proper
10.	Appreciate diversity	Not feasible	Not feasible	proper	Not feasible
11.	Environmental awareness	proper	proper	proper	proper

Table 4. Content feasibility according to experts and teachers.

No	Assessment Aspects	Qualification		Feasibility
		Expert	Teacher	
A	**Content for Eligibility**			
1.	Conformity of the material with Core Competencies and Basic Competencies	Good	Good	proper
2.	The material presented is interesting, informative, and appropriate.	Good	Good	proper
3.	The wholeness of the material.	Good	Good	proper
4.	The material is delivered systematically.	Good	Good	proper
5.	The media (images, videos, animations) used are relevant to the material.	Good	Good	proper
B	**Language**			
1.	Readability	Good	Good	proper
2.	Sentence structure	Good	Good	proper
3.	Language style	Good	Good	proper
4.	Clarity of information	Good	Good	proper

The results can be seen in **Table 5**. This table is divided into 3 aspects, including general design with 2 aspects, font design with 4 aspects, and media design with 3 aspects.

The feasibility of navigation according to experts, teachers, and students is said to be feasible. The results can be seen in **Table 6**. This table shows visual design feasibility according to experts, teachers, and students, according to seven assessment aspects.

Table 5. Feasibility of visual design according to experts and teachers.

No	Assessment Aspects	Qualification		Feasibility
		Expert	Teacher	
A	**General Design**			
1.	Web design is not arbitrary and looks common on all pages.	Good	Good	proper
2.	The web design is interactive and has an appeal that makes users want to see it.	Good	Good	proper

Table 5 (continue). Feasibility of visual design according to experts and teachers.

No	Assessment Aspects	Qualification		Feasibility
		Expert	Teacher	
B.	**Font Design**			
1.	Each web page does not display many typefaces	Good	Good	proper
2.	The font size used is suitable for easy reading.	Good	Good	proper
3.	Each page does not display too many letter colors.	Good	Good	proper
4.	The background color contrasts with the color of the letters so that the writing is legible.	Good	Good	proper
C.	**Media Design**	Good	Good	proper
1.	The quality of the displayed image is good and clear to look at.	Good	Good	proper
2.	The quality of the video displayed is good and clear to look at.	Good	Good	proper
3.	The quality of the animation displayed is good and clear to look at.	Good	Good	proper

Table 6. Visual design feasibility according to experts, teachers, and students.

	Assessment Aspects	Expert Score			Feasibility
		Expert	Teacher	Learners	
1.	The web home page clearly shows the general web content information	Good	Good	Good	proper
2.	The navigation design is easy to understand and easy to use.	Good	Good	Good	proper
3.	The navigation design does not change on every page	Good	Good	Good	proper
4.	The size of the navigation buttons corresponds to the size of the web page	Good	Good	Good	proper
5.	Each page has a navigation button back to the main page (home)	Good	Good	Good	proper
6.	Text links and icon links are easy to identify	Good	Good	Good	proper
7.	All navigation links work (not off/error)	Good	Good	Good	proper

4. CONCLUSION

Based on the results of data processing, it was found that the quality of web-based teaching materials oriented to character education on radioactivity material was suitable for use in the learning process. However, this web-based teaching material can train ten of the total eleven values of character education.

5. ACKNOWLEDGMENT

6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

7. REFERENCES

Abdullah, S., and Shariff, A. (2008). The effects of inquiry-based computer simulation with cooperative learning on scientific thinking and conceptual understanding of gas laws. *Eurasia Journal of Mathematics, Science and Technology Education, 4*(4), 387-398.

Ahmad, J., Sritharan, G., and Nasir, N. N. A. M. (2015). The effectiveness of video and pamphlets in influencing youth on environmental education. *Jurnal Komunikasi: Malaysian Journal of Communication, 31*(1), 281-296.

Akhlis, I., and Wahyuni, S. (2019, October). The development of web-based multimedia physic learning tool to enhance student's character. *Journal of Physics: Conference Series, 1321*(3), 032083.

Akpan, J. P. (2002). Which comes first: computer simulation of dissection or a traditional laboratory practical method of dissection. *Electronic Journal of Science Education, 6*(4).

Arvanitidou, V., Antoniou, P., Michalopoulou, M., Diggelidis, N., and Serbezis, G. (2015). YouTube: an educational tool in environmental education. *International Journal of Education and Research, 3*(4), 81-92.

Ilhami, R., and Syahrani, S. (2021). Pendalaman materi standar isi dan standar proses kurikulum pendidikan Indonesia. *Educational Journal: General and Specific Research, 1*(1), 93-99.

Kalayci, S., and Humiston, K. R. (2015). Students' attitudes towards collaborative tools in a virtual learning environment. *Educational Process: International Journal, 4*(1), 6.

Keech, J. J., Cole, K. L., Hagger, M. S., and Hamilton, K. (2020). The association between stress mindset and physical and psychological wellbeing: Testing a stress beliefs model in police officers. *Psychology and Health, 35*(11), 1306-1325.

Mohanty, S. P., Choppali, U., and Kougianos, E. (2016). Everything you wanted to know about smart cities: The Internet of things is the backbone. *IEEE Consumer Electronics Magazine, 5*(3), 60-70.

Nourollah, M., Fatemeh, M., and Farhad, J. (2015). A study of factors affecting juvenile delinquency. *Biomedical and Pharmacology Journal, 8*, 25-30.

Nugraha, M. G., Kaniawati, I., Rusdiana, D., and Kirana, K. H. (2016). Combination of inquiry learning model and computer simulation to improve mastery concept and the correlation with critical thinking skills (CTS). *AIP Conference Proceedings, 1708*(1), 070008.

Serevina, V., Koul, R., Morales, M. P., and Nugroho, D. A. (2022). Influence of website-based E-learning in the pandemic era: Improving students' creative thinking skills through educational management. *International Journal on E-Learning, 21*(1), 39-60.

Smetana, L. K., and Bell, R. L. (2012). Computer simulations to support science instruction and learning: A critical review of the literature. *International Journal of Science Education, 34*(9), 1337-1370.

Sulyanah, S., Hasanah, F. N., and Rahmania, S. U. (2021). Application of web based learning to measure students learning interest. *Journal of Physics: Conference Series, 1764*(1), 012099.

Suyatna, A., Nugraha, M. G., and Rakhmawati, I. (2019). ICT media utilization model to increase science process skills on natural science lessons in junior high school. *Journal of Physics: Conference Series, 1280*(5) 052004.