Berkala Ilmiah Pendidikan Fisika
ISSN : 2337-604X (print)
ISSN : 2549-2764 (online)

Vol 8 No 1 2020
https://ppjp.ulm.ac.id/journal/index.php/bipf
page 50-58

Development of B D F-AR 2 (Physics Digital Book Based Augmented Reality) to train students' scientific literacy on Global Warming Material

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DOI:10.20527/bipf.v8i1.7881

Received : 30 January 2020 Accepted : 29 February 2020 Published : 29 February 2020

Abstract

There have been many developments in digital books, but they are different from BDF-AR2 (Physics Digital Book Based Augmented Reality), this is because the developed BDF-AR2 has features that can train the literacy skills of learners including Augmented Reality (AR) feature so that learning can be more real. The main objective of this research is to describe eligibility (validity, practicality and effectiveness) of BDF-AR2 media that has been developed This research employed Hannafin & Peck Model development design using by using instruments of media validation, learning completion and validated test instrument. Media validation was carried out by three media experts and resulted in the media B D F-AR 2 (Physics Digital Book Based Augmented Reality) on the global warming material is classified as very valid (93.5%). As for practicality (use BDF-AR2 media in learning) is obtained 83.29% and categorized very good. While for effectiveness (students' scientific literacy skills), it was found that students' scientific literacy skills for 36.67% students are in a good category, 56.67% student have an average level and 6.96% students had poor category for literacy competence science in explaining the phenomenon. As for scientific literacy competencies in interpreting data and evidence scientifically, 30% students have good grades, 66.67% had a fair grade and 3.33 had a poor grade. Referring to the results of validity, practicality and effectiveness of use BDF-AR2 in learning, it can be concluded that the developed BDF-AR2 is feasible to use in learning. The implication of this research is to present a media that supports 21st century learning that has been proclaimed by the government.

Keywords: BDF-AR2, 21st Century Learning, Science Literacy, Media Feasibility

How to cite: Kholiq, A. (2020). Development of BDF-AR2 (physics digital book based augmented reality) for upgrade practice scientific literacy of students on global warming materials. *Berkala Ilmiah Pendidikan Fisika,* 8(1), 50-58.

INTRODUCTION

21st Century learning implies the integration of scientific literacy skills, knowledge skills, skills and attitudes, and mastery of technology (Kemendikbud, 2017). The 21st century is also marked by very rapid technological developments, so science and technology are one of the important foundations in nation building (Kemendikbud, 2016). 21st century learning is a process-oriented learning,

problem solving, ability to adapt and work effectively in different situations (Revenscroft, Lindstaedt, Kloos, & Hernandez-Leo, 2012). In the 2013 revised curriculum, there are 3 things that must be achieved in learning, namely character, competence, and literacy (Harosid, 2018).

Safitri (2016) states that currently learning science still lacks emphasis on the process of using knowledge to explain scientific phenomena, write scientific questions for investigation, and draw conclusions based on facts. On the other side, Liliasari & Fitriana (2014) states that Indonesia's young generation must have literacy skills in order to live in society to face ASEAN Community. From the description above, it can be highlighted that it is very necessary to introduce scientific literacy to students in formal learning

Physics is a learning in schools that are close to daily life (Misbah, Hirani, Annur, Sulaeman, & Ibrahim, 2020;Wati, Hartini, Misbah, & Resy, 2016). Physics is a study of science regarding natural phenomena that are close to daily life and at an advanced level will be able to predict natural behavior that will occur (Oktaviana, Hartini, & Misbah, 2017; Hartini, Firdausi, Misbah, & Sulaeman, 2018) Physics lessons which is done can invite a learner to get accustomed to thinking and reasoning that can increase the ability of thinking and knowledge abilities (Supardi, Leonardi., Huri, & Rismurdiyanti, 2012). Therefore, it is mandatory to teach physics at school.

Science literacy according to the OECD (2019) is the ability of students to link issues or problems with scientific knowledge, science-based technology and scientific methods. Based on the results of research conducted, Program for International Student Assessment (PISA) in 2018 stated students' science literation of in Indonesia is 396 and it is in a low category spotting Indonesia is in lowest ranking group. According to Fitriani & Lestari (2014) and Haristy, Enawaty, & Lestari (2013) that in learning science, meaningfulness can be obtained if the students' scientific literacy skills are good. Meaningful learning can occur if students are able to connect new knowledge with previous knowledge

Learning with the purpose of getting students into the 21 century skills as one of which is the ability of scientific literacy should be use learning that is able to present physics phenomena that occur in everyday life contextually to students so that students can be well-literate and can take a meaningful learning experience. There are some physics materials that are difficult to present in learning contextual problems that occur such as how global warming can occur and how it effects on human life on earth.

The problem was able to be overcome by the presence of supporting facilities and supporting more advanced learning, so that the material could help the teacher in delivering learning material and making teaching methods more varied. Supporting facilities and supporting learning is the appropriate learning media (Laksita, Supurwoko, & Budiawanti, 2013; Zainuddin, Hasanah, Salam, Misbah, & Mahtari, 2019). In general, the learning media is as a learning aid, a medium for channeling information, and helps and strengthens instructors to deliver material accurately, clearly, and interestingly (Hartini, Misbah, Dewantara, Oktovian, & Aisyah, 2017; Kustandi & Sutjipto, 2013; Mahyuddin, Wati, & Misbah, 2017).

There have been various kinds of media to support learning, one of which is printed media. Printed media includes materials prepared on paper for teaching and information. Besides textbooks or textbooks (Arsyad, 2011). Text books to date are the main source of information

in the learning process, both for teachers and students. Textbooks that are commonly circulated have a large size so it will be difficult to carry it (Laksita et al., 2013). Students are required not only to carry textbooks for one subject only. Some textbooks even contain relatively long material on each page with a display that is less interesting to study.

According to the research results, pocket book media can grow the students' potency to become independent students because pocket book media is used to deliver information about subject matter and others that are one-way. With display material that is concise and clear and supplemented with questions that are able to train students' knowledge (Sulistyani, Jamzuri, & Raharjo, 2013).

Along with the development of the current era, learning media that uses non- print media is increasingly interesting and creative, and can facilitate students in learning or carrying it; those of which are digital books. Digital books / e-books are electronic versions of printed books and can be read with a device or computer device for specific purposes (Siegenthaler, Bochud, & W, 2010). In contrast to printed books in general, which consists of a collection of paper that can contain text or images, e-Books contain digital information that can also be in the form of text or images and even animation. There are various popular e-Book formats, including plain text, pdf, jpeg, doc, lit, exe and html with advantages and disadvantages of each. In reality there are students who prefer reading with brief explanations and lots of pictures and colors. With the color is able to be an intermediary to deliver messages briefly and meaningfully (Laksita et al., 2013).

In addition to the development of print media, currently the 21st century is era is also known as the era of information and communication technology. This also happens to education in Indonesia which has experienced many developments and advances in the use of technology in the learning process. To achieve the predetermined targets, teaching in advanced schools uses technology with a variety of types and forms, one of which is Augmented Reality technology.

Augmented Reality in principle is to create a three-dimensional image that seems real. According to Hidayat, Kuswandi, & Ulfa (2018); Wahyudi, (2014); Hidayat & Mujahiduddien (2017) Augmented Reality realizes the integration of virtual objects (text, images, and animations) into the real world. Augmented Reality is the term for a computer superficial process that makes real world and the virtual world has a slight limit so it looks more real (Efendi, Wira, & Khoirunnisa, 2016; Jiwatama & Gonydjaja, 2012; Saputri, Fitriani Eka and Annisa, Muhsinah and Kusnandi, 2018; Sukma, Adistya, & Pamudji, 2017). The use of technology of Augmented Reality needs a help of mobile phone that uses an Android operating system.

This study focuses on analyzing the feasibility (validity, practicality and effectiveness) of BDF-AR2 (Physics Digital Book based Augmented Reality) which has been developed to train students' scientific literacy on global warming material.

METHOD

This research is a type of development research using Hannafin & Peck's Model. This instructional design consists of three main processes, namely the needs assessment phase, followed by the design phase and finally the development and implementation stages. All stages involve an evaluation and revision process as shown in Figure 1.

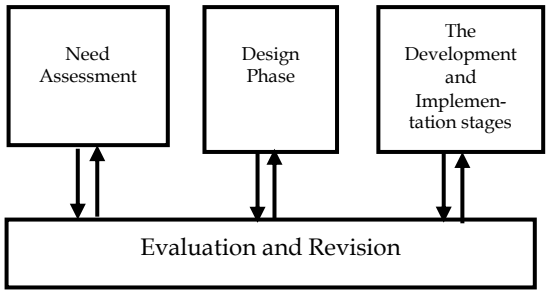


Figure 1 Model Hannafin & Peck (Tegeh, Jampel, & Pudjawan, 2014)

This research focuses on quantitatively analyzing the feasibility of developed media based on aspects of validity, practicality and effectiveness with criteria> 60% get good enough grades. The filling of instrument validation and practicality using Likert Scale as shown in Tabel 1 below.

Table 1 Validity Sheet Score Criteria

Score	Criteria
4	Very good
3	Good
2	Avarage
1	Poor

(Riduwan, 2010)

The results of the validity sheet analysis are used to determine the validity of B D F-AR 2 with the score interpretation criteria as Table 2.

Table 2 Criteria for validity scores

Percentage	Information
$0\% < x \leq 20\%$	Very less
$21\% < x \leq 40\%$	Less
$41\% < x \leq 60\%$	Enough
$61\% < x \leq 80\%$	Good / Valid
$81\% < x \leq 100\%$	Very Good / Very valid

(Riduwan, 2010)

Based on these criteria, BDF-AR2 (Physics Book-Based Augmented Reality) on global warming material in this study is said to be valid if the percentage is > 61%. As for the effectiveness aspect, an assessment of test results based scientific literacy is conducted.

RESULT AND DISCUSSION

Digital books produced by researchers are named BDF-AR2 (Physics Digital Book Based Augmented Reality) on the subject of global warming. This digital book was developed to have several features that can train students' scientific literacy in the form of images, videos, and the most interesting is the Augmented Reality feature that can describe in real terms how the process of global warming occurs. As for the description of BDF-AR2 produced either in the form of cover BDF-AR2, the BDF-AR2 logo and also features of BDF-AR2 can be seen in the Figure 2, Figure 3, and Figure 4.

Figure 2 BDF-AR2 Cover (Physics Book Based *Augmented Reality*

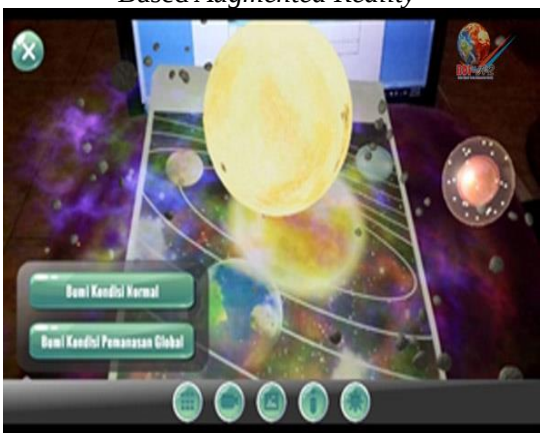


Figure 3 *AR* (*Augmented Reality*) in BDF-AR2

Figure 4 BDF-AR2 Logo

Based on data that has been obtained that BDF-AR2 (Physics Digital Books Based Augmented Reality) have validity as Table 3 follows.

Table 3 Media Validation Results

No	Aspect	Average (%)	Criteria
1	Learning Conformities related to BDF-AR2	83.30%	Very Valid
2	Theory Compliance with material criteria BDF-AR2	100.00%	Very Valid
3	Linguistic Conformity with criteria related to deep linguistics BDF-AR2	91.65%	Very Valid
4	Media Work Process Compliance with criteria related to media work processes BDF-AR2	91.60%	Very Valid
5	Media Display Compliance with criteria related to media display BDF-AR2	92.60%	Very Valid
6	Media Engineering Aspects The suitability of the media as a medium for learning Physics in form BDF-AR2	97.20 %	Very Valid
	Average	92.70%	Very Valid

Table 3 shows that BDF-AR2 (Physics Digital Book based Augmented Reality) has validity on aspects (1) conformity with learning 83.3% with very valid criteria, on aspect (2) material 100% with very valid criteria, in aspect (3) linguistics 83.3% with very valid criteria, in aspect (4) media work processes 91.6% with very valid criteria, in aspects (5) of media display 92.6% with very valid criteria, in the aspect (6) engineering media 97.2% with very valid criteria, so it is obtained the overall average 9 2 , 7 % and has criteria very valid.

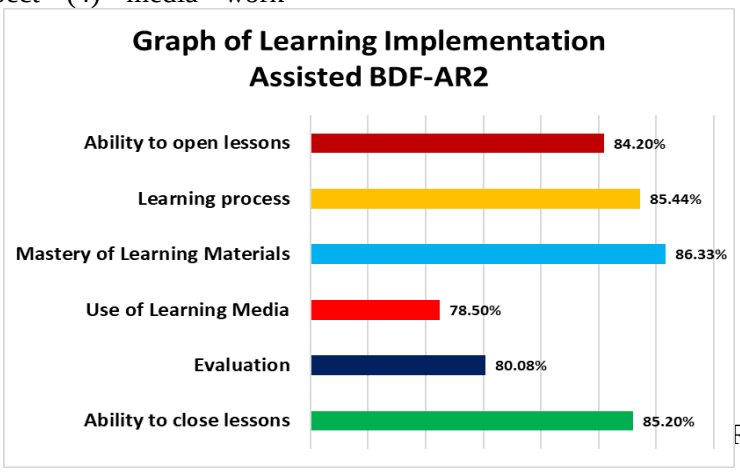
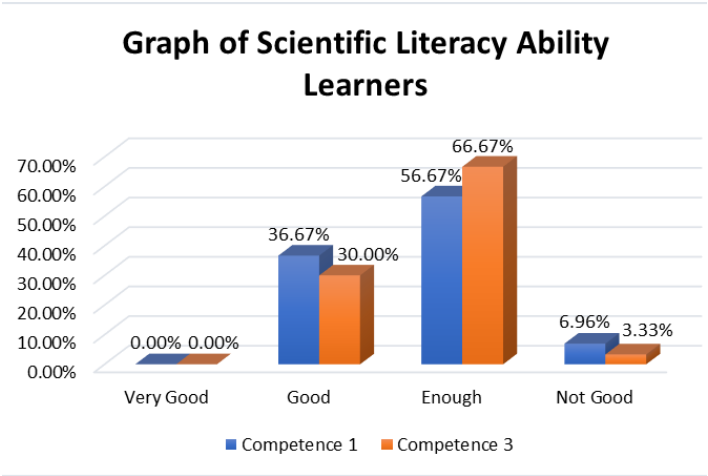


Figure 5 R2

Based on the results of the evaluation of students' scientific literacy abilities after the discussion learning be conducted BDF-AR2 assistance, the following results are obtained as Figure 6.



Infomation
Competence 3:Interpetaion of Data and Scientific evidence

Figure 6 Graph of scientific literacy skills of students

BDF-AR2 (Physics Book Based ugmented Reality) is a physics book in digital form equipped with image illustration features with AR technology (Augmented Reality) so it is expected that students who use BDF-AR2 will be more contextual and realistic in understanding and analyzing concepts global warming. This is in line with the 2013 curriculum which proclaims 21st century skills that must be possessed by students. This research is supported and in line with research conducted by Wahyudi, 2014 that Augmented Reality realizes the integration of virtual objects (text, images, and animations) into the real world. This research also supports the six main elements of scientific literacy; they are (1) science as discovery; (2) scientific content; (3) science and technology; (4) science in personal and social perspectives; (5) history and nature of science; (6) the unification of concepts and processes is very beneficial for students to take personal decisions, participation in social and culture, as well as economic productivity and scientific literacy can be trained by applying BDR-AR2 in learning.

The results of this study is in line with the research conducted by (Udompong, Duangkamol, & Sumiwon, 2013) which states that the skills in utilizing internet and computer media both for students and teachers in the learning process are factors that can affect the level of science literacy skills. The relevance of the research to be carried out is the use of *e-Book* media developed using computer devices so that it can display moving images, audio, and video that can create learning activities that are more tangible so that it can train students' scientific literacy, and also parallel with the research of Ghofur & Kustijono (2015) entitled "Development of the *e-Book* based *Flash KV isoft Flip Book* on Straight Motion Kinematics Material as a Learning Facility for Students Class X ". The research carried out aims to test the feasibility of *e-Books* which are reviewed based on validity, practicality, and effectiveness. The results of the study showed that the *e-Book* developed was very appropriate as a learning

medium for students. The relevance of the research to be carried out is the similarity in the development of *e-Books* as a learning medium.

The results of this study are students' scientific literacy skills. This is also supported and in line with research conducted by Toharudin, Hendrawan, & Rustaman (2011) which states that someone already has ability scientific literation with characteristics: can understand science, communicating science (oral and written), and applying scientific knowledge to solve problems so that they have a high attitude and sensitivity towards themselves and the environment in making decisions based on scientific considerations. This is also expressed by (Yager, 2000) that One characteristic of individuals with high scientific literacy ability is being able to master concepts and being able to understand their application in life and technology. The results of this study are also in line with previous research results which show that electronic media can support and improve learning outcomes (Hidayat, Hakim, & Lia, 2019; Ngurahrai, Farmaryanti, & Nurhidayati, 2019; Sari, Riswanto, & Partono, 2019)

CONCLUSION

BDF-AR2 (Physics Digital Book Based Augmented Reality) which has been developed has an overall validity 92.7% with very valid criteria , an average practicality 83.29% and effectiveness can be seen from students' scientific literacy skills obtained with elaboration 36.67% students have good grades, 56.67% students have avarage grades and 6.96% students have poor grades for scientific literacy competence to explain phenomena while 30 % students have good grades, 66.67% have average grades and 3.33 have poor grades is at a good level and good enough for scientific literacy competencies to explain phenomena and interpret data and evidence scientifically. This means after learning by applying BDF-AR2, students have the ability of literacy. It can be concluded that BDF-AR2 which was developed feasibly can be used in supporting physics learning to train students' scientific literacy especially in the theme of global warming.

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