11 (2) (2022) 115-122

Unnes Science Education Journal

Accredited Sinta 3

https://journal.unnes.ac.id/sju/index.php/usej

Student Needs Analysis for The Development of Augmented Reality Integrated E-Modules about Particles in Science Learning

Ida Riyanti✉, Jimmi Copriady, Roza Linda

DOI: http://dx.doi.org/10.15294/usej.v11i2.58309

Universitas Riau, Indonesia

Article Info

Submitted 2022-03-26
Revised 2022-05-12
Accepted 2022-08-20

Keywords

needs analysis, augmented reality, e-modul, science learning, ADDIE model

Abstract

This research was the analysis phase of the first step in the research on the development of an integrated augmented reality e-module. The purpose of this study was to analyze the needs of students and to find out the responses of students and teachers if an integrated augmented reality e-module was developed in science learning. The method used in this analytical research was a survey method using questionnaires and interviews. Respondents were 32 junior high school students and 17 science teachers in Riau Province. Based on the result of data analysis, it was known that 56.3% of students consider the subject of particles, atoms, ions, molecules as difficult subjects because they were abstract and used many terms. Meanwhile, the result of interviews with science teachers showed that respondents only used government books as a source of student learning. The survey results showed 81.3% of students need learning resources in the form of e-modules that could be accessed from their Android so that it helped understand abstract concepts. Teachers who are willing to implement augmented reality integrated e-modules reached 100%. In conclusion, this analytical research needs to be continued to the design, development, implementation and evaluation stages based on research and development procedures, using the ADDIE model to develop an augmented reality integrated e-module about particles in science learning.

How to Cite

Riyanti, I., Copriady, J., & Linda, R. (2022). Student Needs Analysis for The Development of Augmented Reality Integrated E-Modules about Particles in Science Learning. *Unnes Science Education Journal*, 11(2), 115-122.

✉ Correspondence Author:
E-mail: idariyanti4@gmail.com

p-ISSN 2252-6617
e-ISSN 2502-6232

INTRODUCTION

Background behind from study this is source learning developed by teachers at SMP Negeri 2 Kandis has not yet integrate technology information as 21st century education paradigm. Curriculum education in Indonesia today this has adapt paradigm education 21st century where one _ features is information and resources study could obtained participant educate through various sources , from anywhere and anytime just even by computing with use internet network. Technology give big impact on Education (Benesova & Tupa , 2017). Even the rapid development of technology and its impact on the way we live, work and learn (Voogt & Roblin, 2010). Skills the 21st century including the ability solving problems, creativity and imagination (Erstad & Voogt, 2018), ability think critical thinking, collaboration and communication (van Laar, van Deursen, van Dijk, & de Haan, 2019). Learning is also directed for practice ability collaborate and communicate by effective use various media. Paradigm this the more strengthened with applied method Learning distance far by in network consequence The Covid-19 pandemic that has hit the world since end year 2019 to now . Learning distance far This can lead to academic setbacks such as loss of knowledge and skills of students which is often referred to as learning loss (Andriani, 2021). Learning loss was experienced by 7 out of 8 students during the COVID-19 pandemic (Donnelly & Patrinos, 2021). condition the could give impact negative, namely students find it difficult to catch up with lessons, decrease in learning outcomes, psychological health and loss of motivation to learn. Even the learning motivation of students can be lower if the learning media used by the teacher in distance learning is not innovative and does not match the characteristics of the learning material presented. In learning, motivation becomes a lighter for students in attracting attention to a material. Students with high motivation will have self-confidence and a great desire to learn, and vice versa (Sidiq, 2020)

Based on results Interview with two teachers teaching eye science lessons at SMP Negeri 2 Kandis, shows that respondents only using work sheet or learning materials in the form of the module typed in the Microsoft word application then sent in pdf format and beyond printed for student who chooses study offline and sent through application *google classroom* for student who chooses study online. The work sheet without accompanied media modification in the form of video, sound , 3D images and animation. Temporary that demands of the revolution industry 4.0 moment this enter trend internet of things that is presenting object via the internet (Gamil, 2020). Plus characters of generation in that era who with easy absorb various information from the internet. So teachers should have competence in the field of information technology by integrating it in the manufacture of teaching materials, not only converting printed modules into electronic modules (e-modules) but by adding innovations in the form of video, sound, animation, 3D models and augmented reality (AR) models on e-module. E-module is form presentation source study self organized by systematic to in the learning unit certain, presented in electronic format, make students becomes more interactive with the program, equipped with presentation of video tutorials, animations, and audio for enrich experience study (Directorate High School Development, 2017).

Urgency from this study is ensure that students and teachers need media or source learn what you can visualize draft science abstract so that easy understood. Content learning science like draft about atoms, ions and molecules, is concept that is abstract and difficult understood without the existence of adequate learning media. Based on characteristics that, very suitable if use technology augmented reality, that is with presents 3D models of atoms, ions and molecules virtually, however impressed real in front student because could projected on walls, floors, tables and objects others around of students, so student could observing the 3D model from various side. *Augmented reality* is technology that projecting 3D models on the real world. Elements displayed in the real world the targeted use camera in multimedia forms such as text, images, videos and 3D animation. With use *augmented reality* as if object 3D animation, animals, plants or atomic model really be in front us, even could our set our put it on the table, wall or floor in front us (Saadon , 2020).

According to research previously related with learning media *augmented reality*, show that augmented reality can working as promising strategy for motivate student in study the chemical theory not only effect by direct but influence period long (Chen & Liu, 2020). Study similar has been done by Cagdas Erbas and Veysel Demirer (2019) which has been applying augmented reality to the classroom biology course and have state that with using augmented reality as a learning medium so learning will more fun and participant educate will more motivated (Erbas & Demirer, 2019).

Novelty value from this reserch is what makes the difference from research previously is augmented reality as a learning medium integrated in e-module so that the learning media the could accessed together with source study through their respective androids students. On the planned the e-module there are pictures visualization concepts science that when scanned will display augmented reality Based on this background, we have developed a preliminary study in an analytical research format, namely the first step of the research and development phase of the ADDIE model (analysis, design, development, implementation and evaluation). The purpose of this study was to analyze students' needs for learning resources and to find out the responses of students and teachers if an integrated augmented reality e-module was developed in science learning about particles, atoms, ions and molecules.

METHOD

This research is an analytical research which is the first stage of a series of processes in the research and development of the ADDIE model. The stages in research and development based on the ADDIE model include analysis, design, development, implementation and evaluation (Rusdi, 2019). Needs analysis in learning is an analysis of the gap between what students have and what is expected, including analysis of material that is considered difficult by students and requires media assistance and which sense stimuli are needed (Cahyadi, 2019). The analysis we do is in the form of an analysis of students' difficulties in studying atoms, ions and molecules, the availability of teaching materials that they have received so far, students' needs for teaching materials and learning media. In addition, we also analyze the response of science teachers if an integrated augmented reality e-module is developed. The method used is a survey using interviews and questionnaires. The steps in this analytical research can be presented in Figure 2. Respondents in this study were two science teachers with educational background in science teachers and 32 students at SMP Negeri 2 Kandis and 15 science teachers who were members of MGMP Rayon 5, Siak district. Data from interviews and questionnaires were analyzed and then categorized to obtain conclusions. This research was conducted in January 2022.

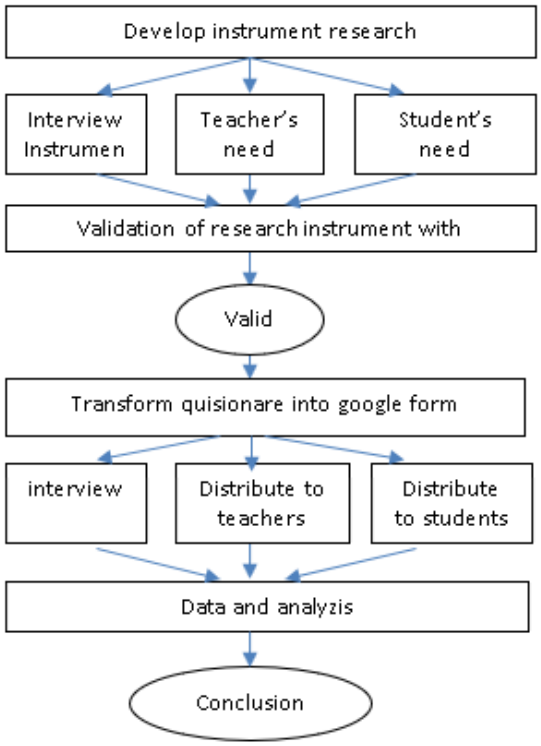


Figure 1. Research procedure

RESULT AND DISCUSSION

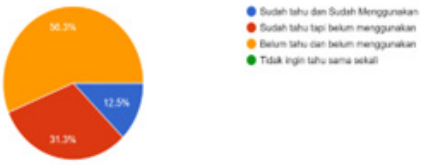
The research data that we have obtained are (1) data from interviews with teachers, (2) questionnaire data on teacher needs and (3) questionnaire data on teacher needs. Table 1 is data from interviews with science teachers at SMP Negeri 2 Kandis, which has been strengthened by the data in Table 2 regarding the teacher needs questionnaire in a wider scope, namely MGMP IPA Rayon 5 Siak district. Meanwhile, the student needs questionnaire data has been presented in Table 3.

Based on the results of interviews, respondents used student books and teacher books sourced from the Ministry of Education and Culture and for certain themes supported by modules. The types of modules used are printed modules for students who study offline and electronic modules for students who study online. The types of applications used to display the electronic module are Microsoft word and pdf files. It can be seen from these data that teachers have not innovated on e-modules used in distance learning.

Researchers have wanted to have obtained data on teaching materials or learning media used by other teachers in a wider scope, namely Rayon

5, Siak district (Minas and Kandis sub-districts). The summary of the results of the questionnaire analysis can be seen further in Table 2.

In the questionnaire data on teacher needs that have been filled out via google form, it has shown that only 37.5% of teachers in this digital era have used electronic modules. Among the teachers who have used the module, only 12.5% have integrated augmented reality. Even 56.2% of teachers do not know about augmented reality. Meanwhile, the teacher's response to the augmented reality integrated e-module is very good, it is proven that 100% of the respondents are willing to implement it in the classroom if an augmented reality integrated e-module is developed. This has provided an opportunity for the development of teaching materials or integrated augmented reality e-modules. Knowledge and teacher responses about augmented reality can be seen in the questionnaire data in Figure 2.



a

b

Figure 2. a) Teacher knowledge about augmented reality, b) teacher willingness to apply e- module integrated augmented reality

The learning and teaching process will run effectively if using the right learning methods and media (Jalmur, 2016). The selection of certain methods in learning will certainly affect the selection of the right learning media as well. On the other hand, each learning media is suitable for use in certain learning methods, so that learning objectives are achieved. Learning media is of course also greatly influenced by the development of the current era which has entered the era of the industrial revolution 4.0 that we have faced nowadays has triggered the development of digital and cyber technology which will affect all aspects of human life, including educational as-

Table 1. Summary of interviews with science teachers at SMP Negeri 2 Kandis

Question Interview	Answer respondent
What teaching materials is it that long ? this used for science learning ?	Ministry of Education and Culture's student Book Ministry of Education and Culture's Book Module
Type of Module used	Print and electronic modules
Type Electronic Module Applications used by teachers	Pdf and Microsoft word
Were included video or 3D images for support concept that is abstract ?	No.
Teacher Knowledge About Augmented Reality	know , but not yet use in learning
Teacher 's willingness to implement in class, if an integrated augmented reality e-module was developed	Ready use

Table 2. Summary of the results of the questionnaire on teacher needs in Rayon 5, Siak district

Statement on the Use of E-modules and AR			
1	Type of module used	93.8% Printed module	37.5% Electronic module
2	Types of electronic module applications used by teachers	87% Powerpoint 56% word document 56% pdf files	18.8% video - integrated flipbook 12.5 AR terintegrasi integrated flipbook
3	Teacher knowledge About augmented reality	43.8% already know 12.5% already use AR	56.2% not yet know 87.5% Not yet use
4	Willingness for use module AR integrated		100% Ready

pect teaching (Herman, Dareng, & Bakri, 2020).

There are many kinds of learning media that can be used according to the character of the subject, the character of the learning material, the method used and the learning experience you want to train. Based on the form of information used by the media, we can group them into 5 types, namely: silent visual media, motion visual media, audio media, silent audio-visual media and motion audio-visual media (Riyana, 2021). Augmented Reality is a media display that combines text, graphics, images and sound media in a movement activity. Animations are created using computer software to create the images or characters that are displayed. The use of this animation is to describe a process or phenomenon that video cannot do. For example, the animation of the motion of electrons around the nucleus of an atom. This allows for the combination of digital and physical information in real time through various forms of technology such as tablets or smartphones to create new realities (Cabero-Almenara, Fernández-Batanero, & Barroso-Osuna, 2019).

The advantages of using augmented reality as a learning medium have been proven through several studies, including an increase in achievement and positive attitudes in science learning (Sahin & Yilmaz, 2020). Another advantage is that Augmented reality technology provides a better means for students learning in an interactive environment. It allows students interact while enabling social communication. It enhances the effectiveness and attractiveness of learning environment in a real world scenario (Weng, Bee, Yew, and Hsia, 2016)

There are several things that must be considered in the selection of media and learning resources, including the learning context, the characteristics of students and the expected response from students (Jalmur, 2016). Therefore, we have continued the survey on a questionnaire on the needs and responses of students via Google Form and obtained the results as shown in Table 3.

Based on the questionnaire, 81.3% of respondents have considered the subject matter of the particles that make up objects and living things which contains the concepts of atoms, ions and molecules and the nature of materials as difficult subject matter.

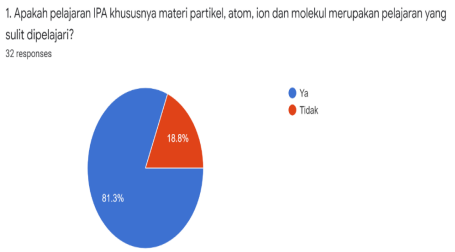


Figure 3. Material particles , atoms, ions and molecules considered difficult by 81.3% of respondents

Many students perceive school science

Table 3. Summary of the results of the student needs analysis questionnaire

Statement	Answer
The matter of particles, atoms, ions and molecules was a difficult subject to learn	81.3% Yes 18.7% No
The reason that has made the lesson difficult to learn	56.3% Many terms are not understandable and abstract 21.9 % Counts 12.5% How teachers teach not enough interesting 9.3% A lot of memorization
Learning resources have been used during science learning activities	0% electronic module 65.7% Printed module and or worksheet
Learning Media that has been used by teachers (according to students)	96.9% whiteboard 3.4% infocus and computer
Students' knowledge of Augmented Reality	78.1 don't know 21.9 already know
Student needs for science learning resources in the form of e-modules that can be accessed from each Android or school computer so that it helps understand the concept of particles making up objects and living things	81.3 : need 18.7 : no

as difficult. In science, there are many complex and abstract concepts to be learned, which puts high demands on students' abstraction capability (Swensen, 2016). Actually, this learning difficulty is in accordance with the character of science learning material which includes abstract and concrete concepts, theories, facts, discoveries and their application in the surrounding environment (Handayani, 2021). Based on the questionnaire distributed by the researchers, the reasons that caused the material to be considered difficult by students included: 9.4% memorized a lot, 12.5% teachers taught less interestingly, 21.9% counted a lot and 56.3% because the material contained a lot of terms and abstract. The data is clarified by the diagram in Figure 4 below.

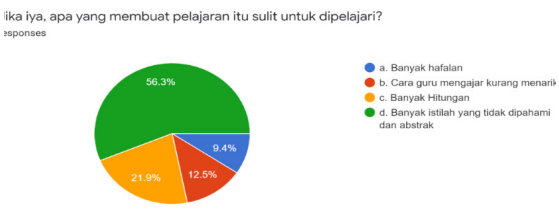


Figure 4. The reason the subject matter of atoms, ions and molecules is a difficult subject.

Based on students' learning difficulties in science learning, especially the concepts of particles, atoms, ions and molecules, the majority because the learning material is abstract and has a lot of memorization, it is necessary to have an appropriate solution, including the development of an integrated augmented reality e-module. The selection of e-modules as a solution to the problem of learning difficulties is in accordance with the opinion of Fausih and Danang in their research which explains that e-modules are electronic media that are effective, efficient, and prioritize students' independence in carrying out learning activities that contain one unit of teaching materials to help students. solve problems with their own abilities (Fausih & Danang, 2015). E-module is a learning resource that implements IT in its assembly and use. The advantages of implementation of IT in a field of learning is believed to be able to improve student's learning abilities (Ramdhani & Wulan, 2012). In addition, the Learning process by implementing IT will provide the learning materials using various media which will affect the student's learning achievement in a positive way (Ramdhani, & Muhammadiyah, 2015). And in the end, learning using multimedia has a positive effect on students' learning outcomes (Farida, Liliasari, Widyantoro, & Sopandi, 2009). Interactive e-module is a form of multimedia. Using multimedia can minimize the number of intrinsic and extrinsic cognitive burden so that it can facilitate the externalization of information thinking, memorizing and processing. Learning content becomes more dynamic, effective and enjoyable (Irwansyah, Lubab, Farida, & Ramdhani, 2017).

Meanwhile, the solution to the need for visualizing abstract concepts can be used augmented reality, because our augmented reality can be used for visualizing models of a system and process, presenting details about complex objects and visualizing abstract objects (Kravtsov and Pulinets, 2020). Augmented reality (AR) is a technology that shows potential in regard to help students with among others things abstraction of science concepts. AR expand/ modify the user's perception of reality (Swensen, 2016). AR affords greater ability to visualize details and hidden information to help students learn the science (Yoon, Anderson, Lin, & Elinich, 2017). In addition, the reason for using augmented reality is based on the opinion that the attractiveness of AR as a teaching tool is its ability to deliver a blended learning experience created from the mixing of the virtual and real environments or materials in the classroom (Barrow, Sands, O'Hare). , & Hurst, 2019). The AR experience helped the students in visualizing the abstract concepts and enhanced their understanding (Faridi, Tuli, Mantri, Singh, & Gargrish, 2021)

We have combined the two solutions, namely e-modules and augmented reality in a design of teaching materials, namely augmented reality integrated e-modules. With the augmented reality integrated e-module, students will be able to learn independently whenever and wherever through their smartphones and they will be able to scan QR markers that have been linked to the images on the e-module to obtain augmented reality visualizations of particles, atoms and molecules as well as processes. related chemistry.

The idea of developing an e-module was positively welcomed by respondents, it was proven that 81.3% of respondents needed an e-module that could be accessed from their smartphone while at the same time being able to visualize abstract concepts of particles, atoms, ions and molecules so that it seemed real and easy to understand.

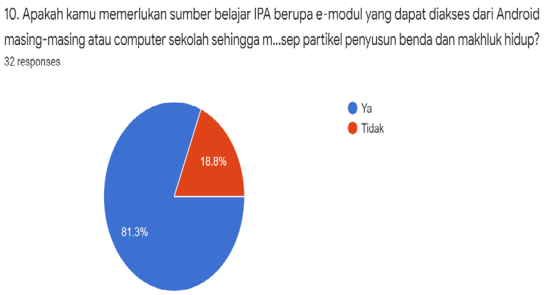


Figure 5. Student needs for e-modules that can be accessed from their respective androids.

Based on the data analysis of the needs of students and teachers as well as their responses to the development of an integrated augmented reality e-module, it can be concluded that this analytical research can proceed to the design, development, implementation and evaluation stages to test the feasibility of an augmented reality integrated e-module in science learning.

CONCLUSION

Based on the results of data analysis and related references, it can be concluded that 81.3% of respondents have considered the concept of particles, atoms, ions and molecules as well as material properties as difficult subject matter, for several reasons including 9.4% memorized a lot, 12.5 % of teachers teaching less interesting, 21.9% counting a lot and 56.3% because the material contains many terms and is abstract. Based on the results of data analysis, it has also been obtained that 81.3% of students need learning resources in the form of e-modules that can be accessed from their Androids as well as help understand abstract concepts. Teachers who have been willing to implement augmented reality integrated e-modules reached 100%. In conclusion, this analytical research needs to be continued to the design, development, implementation and evaluation stages based on research procedures and the development of the ADDIE model to develop an augmented reality integrated e-module in science learning on the subject of particles making up objects and living things.

REFERENCE

Andriani, W., Subandowo, M., Karyono, H., & Gunawan, W. (2021, August). Learning loss dalam pembelajaran daring di masa pandemi corona. In *Seminar Nasional Teknologi Pembelajaran* (Vol. 1, No. 1, pp. 484-501).Cahyadi, Ani. (2019). *Pengembangan Media dan Sumber Belajar*. Banjarmasin: Laksita.

Barrow, J., Forker, C., Sands, A., O'Hare, D., & Hurst, W. (2019). Augmented reality for enhancing life science education.

Benešová, A., & Tupa, J. (2017). Requirements for education and qualification of people in Industry 4.0. *Procedia manufacturing*, *11*, 2195-2202.

Cabero-Almenara, J., Fernández-Batanero, J. M., & Barroso-Osuna, J. (2019). Adoption of augmented reality technology by university students. *Heliyon*, *5*(5), e01597.

Chen, S. Y., & Liu, S. Y. (2020). Using augmented reality to experiment with elements in a chemistry course. *Computers in Human Behavior*, *111*, 106418.

Direktorat Pembinaan Sekolah Menengah Atas. (2020). *Petunjuk teknis Pengembangan Bahan Ajar*. Jakarta: Depdiknas.

Donnelly, R., & Patrinos, H. A. (2021). Learning loss during COVID-19: An early systematic review. *Prospects*, 1-9.

Erbas, C., & Demirer, V. (2019). The effects of augmented reality on students' academic achievement and motivation in a biology course. *Journal of Computer Assisted Learning*, *35*(3), 450-458.

Erstad, O., & Voogt, J. (2018). The twenty-first century curriculum: issues and challenges. *Springer International Handbooks of Education*, 19-36.

Farida, I., Liliasari, L., Widyantoro, D. H., & Sopandi, W. (2009, October). The importance of development of representational competence in chemical problem solving using interactive multimedia. In *Proceeding of The Third International Seminar on Science Education* (pp. 259-277). UPI.

Faridi, H., Tuli, N., Mantri, A., Singh, G., & Gargrish, S. (2021). A framework utilizing augmented reality to improve critical thinking ability and learning gain of the students in Physics. *Computer Applications in Engineering Education*, *29*(1), 258-273.

Fausih, M & Danang, T. (2015). Pengembangan Media E-modul Mata Pelajaran Produktif Pokok Bahasan "Instalasi Jaringan LAN (Local Area Network)" Untuk Siswa Kelas XI Jurusan Teknik Komputer Jaringan di SMK Negeri 1 Labang Bangkalan Madura. *Jurnal UNESA*, 1(1), 1-9.

Franke, J., Wang, L., Bock, K., & Wilde, J. (2021). Electronic module assembly. *CIRP annals*, *70*(2), 471-493.

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational research: An introduction*. Longman Publishing.

Gamil, Y., Abdullah, M. A., Abd Rahman, I., & Asad, M. M. (2020). Internet of things in construction industry revolution 4.0: Recent trends and challenges in the Malaysian context. *Journal of Engineering, Design and Technology*.

Handayani, Novia Amarta; Jumadi. (2021). Analisis Pembelajaran IPA Secara Daring pada Masa

Pandemi Covid-19. *Jurnal Pendidikan Sains Indonesia*, 9(2),217-233

Herman, T., Dareng, S. Y., & Bakri, Z. (2020). Education for industry revolution 4.0: using flipped classroom in mathematics learning as alternative. In *Journal of Physics: Conference Series* (Vol. 1521, No. 3, p. 032038). IOP Publishing.

Irwansyah, F. S., Lubab, I., Farida, I., & Ramdhani, M. A. (2017, September). Designing interactive electronic module in chemistry lessons. In *Journal of Physics: Conference Series* (Vol. 895, No. 1, p. 012009). IOP Publishing.

Jalmur, N. (2016). *Media dan sumber pembelajaran*. Jakarta: Kencana.

Kravtsov, Hennadiy; Pulinet, Anastasia. (2020). Interactive Augmented Reality Technologies for Model Visualization in the School Textbook. *EasyChair Preprint Kherson State University, Ukraine,*4536.

Ramdhani, M. A., & Muhammadiyah, H. (2015). The criteria of learning media selection for character education in higher education.

Ramdhani, M. A., & Wulan, E. R. (2012). The analysis of determinant factors in software design for computer assisted instruction. *International Journal of Scientific and Technology Research*, *1*(8), 69-73.

Riyana, C. (2012). *Media pembelajaran*. Jakarta: Direktorat Jenderal Pendidikan Islam Kementerian Agama RI.

Rusdi. (2018). *Penelitian Desain dan Pengembangan Kependidikan*. Depok: Rajawali Pers.

Saadon, Nur Farah Syuhada, et all. (2019). The Implementation of Augmented Reality in Increasing Student Motivation: Sistematic Literature Review. *IOP Conference Series: Materials Science and Engineering*, Volume 854.

Sahin, D., & Yilmaz, R. M. (2020). The effect of Augmented Reality Technology on middle school students' achievements and attitudes towards science education. *Computers & Education*, *144*, 103710.

Shidik, M. A. (2020). Hubungan Antara Motivasi Belajar Dengan Pemahaman Konsep Fisika Peserta Didik Man Baraka. *Jurnal Kumparan Fisika*, *3*(2), 91-98.

Swensen, H. (2016). Potential of augmented reality in sciences education. A literature review.

van Laar, E., van Deursen, A. J., van Dijk, J. A., & de Haan, J. (2019). Determinants of 21st-century digital skills: A large-scale survey among working professionals. *Computers in human behavior*, *100*, 93-104.

Voogt, J., & Roblin, N. P. (2010). 21st century skills. *Discussienota. Zoetermeer: The Netherlands: Kennisnet*, *23*(03), 2000.

Weng, N. G., Bee, O. Y., Yew, L. H., & Hsia, T. E. (2016). An augmented reality system for biology science education in Malaysia. *International Journal of Innovative Computing*, *6*(2).

Yoon, S., Anderson, E., Lin, J., & Elinich, K. (2017). How augmented reality enables conceptual understanding of challenging science content. *Journal of Educational Technology & Society*, *20*(1), 156-168.

Yustiqvar, M., Gunawan, G., & Hadisaputra, S. (2019, December). Green chemistry based interactive multimedia on acid-base concept. In *Journal of Physics: Conference Series* (Vol. 1364, No. 1, p. 012006). IOP Publishing.