Knowledge E
enriching | engaging | empowering

Research Article

Mathematical Problem Solving Through Mobile Learning Development Based on Assemblr Edu

Ilham Mahendra Halim, Wati Susilawati, and Hamdan Sugilar

Faculty of Tarbiyah and Teacher Training, Universitas Islam Negeri, Sunan Gunung Djati, Jl. Cimencrang, Gedebage, Bandung, Indonesia

ORCID
Ilham Mahendra Halim: https://orcid.org/0009-0004-2983-0315

Abstract.
Assemblr EDU based on mobile learning as a learning resource can be accessed anytime and anywhere. However, the utilization of these learning resources has not been optimal, so it has an impact on the quality of mathematical problem–solving abilities that need to be improved. The purpose of this research is the development of teaching materials through mobile learning based on EDU Assemblr. The method used is the development of the ADDIE model. Collecting data through observation techniques, interviews, studies from linguists, media design experts, content experts, tests, and questionnaires. The implementation phase of the trial has been carried out on students of class XI MIPA 7 State Senior High School in Bandung, Indonesia. In data analysis, the problem–solving ability test was analyzed quantitatively, and the questionnaire was analyzed qualitatively. The development of mobile learning based on Assemblr EDU received proper criteria from experts. The level of effectiveness and practicality of teaching material products is categorized as sufficient, so that it gets a good attitude from teachers and students. The development of mobile learning based on EDU assemblr as a learning resource facilitates the process of concept construction, interaction, and reflection so that there is an increase in students' mathematical problem-solving abilities.

Keywords: mathematical, problem solving, mobile learning, assemblr edu

🔓 **OPEN ACCESS**

1. INTRODUCTION

Online learning during COVID - 19 has become a challenge for the world of education in solving technological, content, knowledge, domestic, pedagogical, personal and assessment problems, for the implementation of interactive learning that can arouse student interest and motivation in the online learning process, interesting to do because learning can be carried out wherever, and whenever without limits [1]. The ever-growing variety of mobile devices that are trending in the implementation of the learning process provide new capabilities that are attracting the attention of educators around the word. Advances in technology are driving educators to develop new tools used in the classroom to produce digital interactive learning resources. The effectiveness of

developing learning resources that can provide a broader learning experience can assist that can encourage students to work together to solve abstract mathematical problems into concrete, and assist educators in designing more exciting activities with 3D & AR that can turn boring learning activities into fun through the development of Assemblr Edu-based on mobile learning [2, 3]. So, the digital interactive resource Assemblr Edu has a very important role to facilitate the learning process in modeling abstract mathematical problem-solving.

Empirically, the process of implementing online learning in parts of Indonesia has various obstacles for educators and students, due to limitations in verbal communication, accessibility of materials, time management, electricity disturbances, and internet network facilities, as well as financial problems in purchasing quotas. [4–8]. Educators and students need a long time to prepare, to adapt to technological literacy. Research results [9–11] revealed that some students almost have general difficulties in carrying out the mathematics learning process at home, cannot understand abstract mathematical concepts, have difficulty thinking in solving non-routine mathematical problems, cannot read and formulate problems comprehensively, have difficulty in modeling and planning mathematical problem-solving strategies for which the solution is not yet known, as well as completing a problem-solving ability test with high levels of stress and anxiety. On the other hand, learning is still a teacher centered, so knowledge transfer is not optimal [12]. Thus, the complexity of the problems in the world of education requires educators to always be creative in facilitating the implementation of the learning process so that students can think critically in solving math problems.

The complexity of the problem demands that the facilities and infrastructure in the online learning process be improved, which is an interesting thing to observe. One alternative that can facilitate this problem is the development of digital mobile learning teaching materials based on Assemblr Edu Which are designed through smartphones with the use of attractive Augmented Reality (AR). Research results [13–15] revealed that mobile learning changes the pedagogical paradigm of traditional teaching into innovative learning. Because it challenges educators to create interactive storyboards, physical, cognitive, and collaborative challenges, which provide experiences beyond the 3D, according to 21st – century skills development, this model is much more interactive and engaging than pictures in textbooks, facilitating teaching materials through Assemblr Edu-based mobile learning can change the critical insight of students to receive and store information and can dig deeper into content and develop a more detailed understanding of concepts to solve mathematical problems.

KnE Social Sciences

Some research results are related to mobile learning and mathematical problem-solving skills [5, 16–20] that mobile learning is important to maximize critical thinking skills cooperatively in solving math problems. [21] revealing that the actual new rise of AR and VR in education will meet the learning needs of the 21st century. [22] revealed that the performance of male students who used VR tools increased significantly compared to female students. [23] revealed that the combination of two new technologies Augmented Reality and Virtual Reality is easy to use so has a positive influence on the teaching and learning process of mathematics. Thus, educators are required and recommended to follow the latest technological advances in the online learning preparation process.

There is an opportunity to complement the results of previous research that the development of learning resources through Assemblr Edu-based mobile learning needs to be followed up to meet the needs of teaching materials in the world of education because it is easier to use than other applications, makes higher-order/non-routine thinking questions and discussions, and can improve some points that have not been maximized, so that it can help students solve unstructured abstract mathematical problems. Thus, the purpose of this study is to develop teaching materials through mobile learning based on assemblr edu to improve students' mathematical problem-solving abilities.

2. RESEARCH METHOD

Classroom action research method, the type of research R & D/Research and Development using the model: Analysis, Design, Development, Implementation, Evaluation (ADDIE). The steps are as follows:

1. Analysis, namely analyzing the characteristics of students in class XI MIPA 7 SMA in Bandung Indonesia, analyzes the curriculum and mathematics learning tools, analyzes the content that will be used as teaching materials, analyzes and observes the learning process carried out by mathematics teachers through the application of online and offline blended learning in the classroom and students are allowed to bring cellphones to school, so that they are more confident to use Assemblr EDU-based Mobile learning as a learning resource, so that students do not feel bored learning with the fun Augmented Reality feature, and can generate interest in learning.

2. Design, at the stage of designing Mobile learning content based on Assemblr EDU which will be developed. starting with the creation of an Assemblr EDU-based Mobile learning development flow, to the determination of the learning path. Then plan the content of Mobile learning teaching materials based on Assemblr EDU. There are several steps in the preparation of teaching materials, namely:

3. Material adjustments: Materials that have been adapted to the curriculum are arithmetic sequences and series, constructing material files, video links, then Augmented Reality content as learning triggers to improve math problem-solving skills. Next, validate the validator, one material expert, Mrs. Tutut, and the validator, two language experts, Mrs. Wike

4. Validator 1 : Mrs T. Tutut Widiastuti. A, M.Pd

Profession : Mathematics Education Lecturer

Questionnaire score : 93%

Average valuea : 4,65

Criteria : Worthy

Notes:

1. Complete the curriculum such as KI, KD, indicators and learning objectives

2. Questions are not varied, the quality of the score is low, medium, high

3. Questions are not contextual according to the characteristics of students

Repair:

After validating the material, improvements were made to the curriculum, teaching materials and instruments.

1. Validator 2 : Mrs. Wike Rahmawati, S.Pd

Profession : Math teacherin senior high school

Questionnaire Score : 91%

Average value : 4.55

Criteria : Worthy

Note: there are some languages that are less flexible in the curriculum and instruments.

Improvements: Language in curriculum and instruments

1. Media adjustment

The results of the analysis: students always bring cellphones every day to school which are used for school pick-up communication. Students are asked to install Mobile learning based on Assemblr EDU on the play store on their respective cellphones.
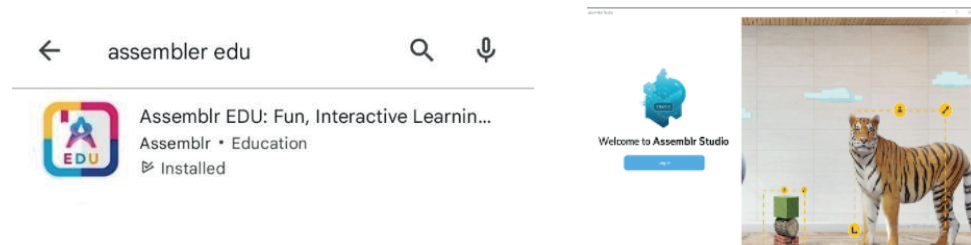

Figure 1: Assemblr EDU on play store and assemblr studio.

Install the Assemblr EDU studio application to develop existing content on Assemblr EDU-based Mobile learning. The explanation for all students to create an account first, which is the free package, so it is necessary to maximize the available storage capacity of 8mb.

The development of this Assemblr studio as a tool to develop content that did not exist before and make learning resources on Barisan and Sequence material by usingindividual cell phones.

1. Development Stage

This stage is the process of developing Mobile learning content, when uploading the Assemblr Project there is no content for arithmetic sequences and series material.

(Before validation to media expert lecturers)

Project Assemblr development steps:

1. Sign in first using a google account after you finish downloading Assemblr studio on a PC.

2. Maximize the available features with a maximum capacity of 8mb for account storage that chooses not to pay.

3. Choose to create a new project because it doesn't exist before

1. Use a blank template for an unpaid account then write the title of the project to be created

2. There are area markers that can be used to develop content on Assemblr edu and finish.
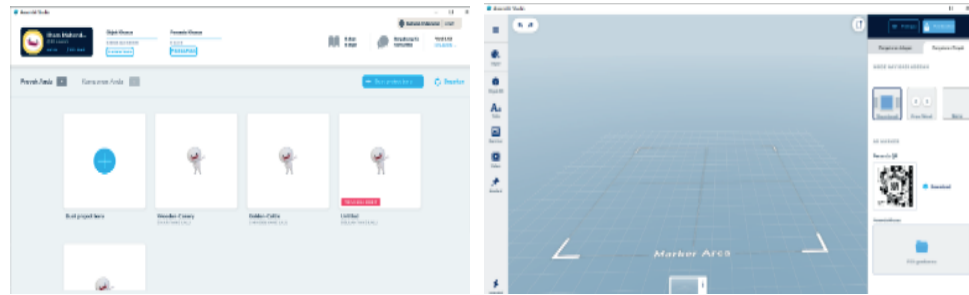
Figure 2: View before selecting new project and marker area.

After finishing uploading teaching materials on Assemblr edu. Validation for media experts includes: video supporting Assemblr edu, and content on Assemblr edu that has been developed.

Media Expert Validator

Validator

Name : Hamdan Sugilar,M.Pd

Profession : Mathematics Education Lecturer

Questionnaire Score : 59%

Average value : 2.95

Criteria : Enough

Notes : -

1. Material presented in a variety of contexts and from various sources

2. Present the steps to operate Assemblr Edu and other instructions so that this application is easier to use than other applications.

3. Present high-level/non-routine questions and discuss them.

4. Fix the points that have not been maximized.

After validating with sufficient criteria, the next action is to improve the content of the notes that have been given by the media validator. Finally, EDU-based Assemblr Mobile learning is created as a fun learning resource

After the repairs were completed, the implementation of learning was continued to class XI MIPA 7 students who had received all the explanations.

1. Implementation stage: Assemblr EDU-based mobile learning teaching materials are implemented to students in the mathematics learning process for three meetings. Ended with a test of mathematical problem-solving skills.

Figure 3: Examples of sequences and series problems.

Checks on students, including:

1. Students are ensured to have installed the application on their mobile phone personally.

2. Ensuring students can use Assemblr edu-based mobile learning.

3. Directing students to be able to access learning resources anywhere and anytime.

4. Make students interested and motivated to learn anywhere and anytime.

The following is the documentation of several students accessing Assemblr edu-based mobile learning resources on the topic of arithmetic sequences and series.

1. Evaluation Stage

After conducting the trial and ending with the distribution of questionnaires to teachers and students, the results of the questionnaire were analyzed showing that the quality of mobile learning based on assemblr edu was feasible. These stages were passed well so as to produce a mobile learning learning resource based on Assemblr EDU

Data collection techniques were carried out through: interviews, observation, documentation, content expert studies, media experts and linguists, math problem solving ability tests, questionnaires. Data analysis was carried out quantitatively for the results of the mathematical problem-solving ability test, and the questionnaire analysis was converted through MSI qualitatively and then described.

Figure 4: Students are studying teaching materials.

3. RESULTS AND DISCUSSION

The results of the stages of developing assemble Edu-based mobile learning teaching materials consist of:

1. Pre-production

Before the production, stage is carried out, first analyze the results of interviews and observations. From the results of interviews and observations, it was found that mathematics teachers were allowed to develop mobile learning teaching materials based on assemblr edu, and were willing to become language validators for content. Every student is allowed to bring a cell phone in the mathematics learning process by the means of developing mobile learning teaching materials. Then the developer begins to work on preparing documents that will be used for the development of teaching materials both manually and digitally through assemblr edu-based mobile learning. The manual step is to create a storyboard, while the digital step is to design the appearance of the edu assembler program following up on the story board to the coloring process.

1. Production

2. Install the Assemblr EDU studio application to develop existing content on Assemblr EDU-based Mobile learning and then create an account.

3. Preparation of story boards in Assemblr studio. to develop content that did not exist before.

4. Setting the background to develop content that did not exist before. and make teaching materials on the material of Sequences and Series

5. Digital image editing

6. Giving color digitally with the aim that the image attracts students' interest in learning.

7. Post-production, improvements are made to all teaching materials for Edu-based assemblr mobile learning. The feasibility test was carried out by an expert review consisting of content experts, linguists, and media design experts, the three experts each having their respective views as follows: 93% of the criteria are feasible, 91% are eligible, and 59% are sufficient. Students with different backgrounds in cognitive aspects, as the object of the user giving a view of 85% are said to be worthy and good. In the effectiveness test, the developer conducted a trial on 25 students by holding a pre-test and post-test through a problem-solving ability test on the concept of Barisan and Sequence. The results of the analysis using the N gain test, the results obtained were 0.3 N-gain < 0.7 with a moderate increase. It can be concluded that the effectiveness of Mobile learning based on Assemblr EDU as a learning resource can improve mathematical problem-solving abilities in the medium category. More clearly the increase in mathematical problem-solving ability can be seen in the graph below:
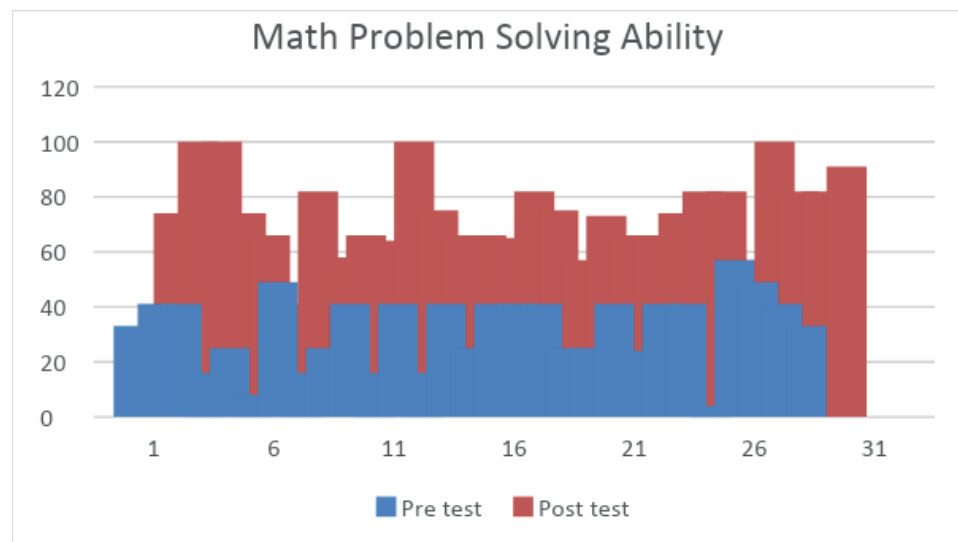

Figure 5: The results of increasing students' mathematical problem-solving abilities.

The development of teaching materials through Mobile learning based on Assemblr EDU based on a literature study found several facts that assembler edu can be used

as an alternative for developing teaching materials through mobile learning. Following the results of research [1, 24] regarding the development of learning resources or teaching materials using mobile learning is quite effective in improving student learning outcomes. [15] that learning augmented reality can effectively improves student achievement, motivation, and activities during the mathematics learning process. [25] reveals the influence of apps augmented reality and virtual reality improve the quality of education. According to research results. [23] that augmented reality and virtual reality applications can be effectively used in the learning process of mathematics. [24] that mobile learning through Augmented reality is effectively used in the field of education.[26]that Virtual reality can make it easier for teachers to facilitate the learning process .

Judging from the background of students with online learning during the COVID-19 pandemic and hybrid learning trials, innovations are needed to support learning so that there is an increase in students' mathematical problem – solving abilities. As with research [24, 26] regarding the analysis of mathematical problem-solving abilities, it was found that some of the students' problems were of low quality, namely, they could not plan mathematical problem-solving strategies, could not solve non-routine structural problems for which there was no way to solve the problem, could not carry out feedback proving through other solutions with the same solution single solution with many solutions, and cannot find multiple solutions with clear reasoning that distinguishes them.

4. CONCLUSION

Based on the results of the development with a series of evaluations and revisions from the test results both through expert reviews and students, it can be said that it is feasible, with average criteria. Meanwhile, in terms of effectiveness and practicality through field tests, teaching materials through assemblr edu-based mobile learning can be said to be quite effective.

ACKNOWLEDGMENTS

References

[1] Susilawati W. Mathematical communications through project based learning based on android. J Phys Conf Ser. 2021;1869(1):012128.

[2] Vafa S, Richardson R, Murphree C. "Integrating technology and literacy: Creating an interactive storytelling experience with augmented reality.," In: J. Johnston, Ed. *Proceedings of EdMedia 2017*. pp. 1286–1291. *Washington, DC*: *Association for the Advancement of Computing in Education* (AACE), Washington, DC (2017).

[3] I.M. Halim., H. Sugilar., and W. Susilawati, "Pengembangan mobile learning berbasis assemblr edu sebagai sumber belajar untuk meningkatkan kemampuan pemecahan masalah matematis dan kemandirian belajar siswa," (2022).

[4] Statistik BP. Statistik Indonesia, statistical year book of Indonesia. CV. Jakarta: Dharmaputra; 2018.

[5] Khalil R, Mansour AE, Fadda WA, Almisnid K, Aldamegh M, Al-Nafeesah A, et al. The sudden transition to synchronized online learning during the COVID-19 pandemic in Saudi Arabia: a qualitative study exploring medical students' perspectives. BMC Med Educ. 2020 Aug;20(1):285.

[6] Demuyakor J. Coronavirus (COVID-19) and online learning in higher institutions of education: A survey of the perceptions of Ghanaian International students in China. Online J Commun Media Technol. 2020;10(3):1–9.

[7] [7] H. Sarwar, H. Akhtar, M.M. Naeem, et al., "Self-reported effectiveness of e-learning classes during Covid-19 pandemic: A nation-wide survey of Pakistani undergraduate dentistry students.," *European Journal of Dentistry*. vol. 14, no. S 01, pp. S34–S43, 2020. https://doi.org/10.1055/s-0040-1717000.

[8] Adnan M. Online learning amid the COVID-19 pandemic: students perspectives. Journal of Pedagogical Sociology and Psychology. 2020;2(1):45–51.

[9] Repanda Sayoga PE. "The analysis of the three dimensional material observed from the mathematical critical thinking ability of high school students by applying brain based learning.," *Journal Of Innovative Mathematics Learning*. vol. 2, no. 4, p. 2019.

[10] Sutrisno H, Kharisudin I. Problem solving ability with mathematical modeling strategy in term of mathematics self-efficacy on generative learning model. Unnes Journal of Mathematics Education. 2020;9(1):43–52.

[11] R. Ratnasari and D.S. TLS, "Common difficulties of 8th grade students when solving non-routine problems.," *Jurnal Pendidikan MIPA*. vol. 23, no. 1, pp. 67–77, 2022.

[12] Susilawati W, Rachmawati TK, Nuraida I. Adaptive reasoning based on microsoft mathematics [Jurnal Teori dan Aplikasi Matematika]. JTAM. 2021;5(1):216.

[13] Cavus N. "A Study to investigate the opinions of instructors on mobile learning.," In: International Future-Learning Conference on Innovations in Learning for The Future 2010: e-Learning (FL2010). https://www.learntechlib.org/j/2010/v/2010/n/1/ (2010).

[14] Crompton H. "Educators' self-identified mobile learning training needs: a qualitative study involving educators from 12 diverse North American States," In: M. Searson and M. Ochoa, Eds. *Proceedings of SITE 2014–Society for Information Technology & Teacher Education International Conference*. pp. 8–11. *Association*, Jacksonville, Florida, United States (2014).

[15] Estapa A, Nadolny L. The effect of an augmented reality enhanced mathematics lesson on student achievement and motivation. J STEM Educ. 2015;16(3):40–8.

[16] Jihad A, Susilawati W, Sobarningsih N. Improving mathematical understanding ability student through study of mobile learning mathematics base on the Android. IOP Conf Series Mater Sci Eng. 2018;434(1):012008.

[17] Samo DD, Darhim D, Kartasasmita B. "Culture-based contextual learning to increase problem-solving ability of first year university student culture-based contextual learning to increase problem-solving ability of first year university student.," *Journal on Mathematics Education*. vol. 9, no. 1, p. 2017.

[18] Son AL, Darhim D, Fatimah S. Darhim, and S. Fatimah, "Students' mathematical problem-solving ability based on teaching models intervention and cognitive style,". Journal on Mathematics Education. 2020;11(2):209–22.

[19] Bringula R, Reguyal JJ, Tan DD, Ulfa S. Mathematics self-concept and challenges of learners in an online learning environment during COVID-19 pandemic. Smart Learning Environments. 2021;8(1):22.

[20] Klang N, Karlsson N, Kilborn W, Eriksson P, Karlberg M. "Mathematical problem-solving through cooperative learning—the importance of peer acceptance and friendships.," *Frontiers in Education*. vol. 6, no. 710296, p. 2021. https://doi.org/10.3389/feduc.2021.710296.

[21] Elmqaddem N. Augmented reality and virtual reality in education. Myth or reality? Int J Emerg Technol Learn. 2019;14(3):234–42.

[22] Kariapper RK, Pirapuraj P, Suhail Razeeth MS, Nafrees AC, Fathima Roshan M. "Adaption of smart devices and Virtual Reality (VR) in secondary education.," In: *in secondary education. proceedings of congress on intelligent systems. P.* pp. 553–565 (2021). https://doi.org/10.1007/978-981-33-4582-9_43.

[23] Cabero-Almenara J, Barroso-Osuna J, Martinez-Roig R. Mixed, augmented and virtual, reality applied to the teaching of mathematics for architects. Appl Sci (Basel). 2021;11(15):7125.

[24] Kariadinata R. Students' reflective abstraction ability on linear algebra problem solving and relationship with prerequisite knowledge. Infinity Journal. 2020;10(1):1.

[25] McCarthy CJ, Uppot RN. Advances in virtual and augmented reality—exploring the role in health-care education. J Radiol Nurs. 2019;38(2):104–5.

[26] Farlina E, Susilawati I, Juariah J, Kariadinata R. "Confidence, flexibility and studentrs appreciation in solving mathematic problems through resource-based learning.," In: *Proceedings of the International Conference on Islamic Education (ICIE 2018)*. pp. 84–88. *Atlantis Press*, Paris, France (2018).