

Augmented Reality in Indonesia's Primary School: Systematic Mapping Study

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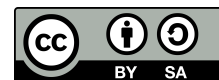
Systematic Mapping Study

ABSTRACT

Augmented reality is an increase trending technology in education. Research in the field of AR for Education is increasing every year. A large number of research reviews have focused on the use of AR in education worldwide and at all levels of education, but there have not been many reviews of the use of AR at the elementary school level in Indonesia. This study aims to determine the trends of using AR in elementary school in Indonesia. This research used a Systematic Mapping Study approach, which consists of the stages of definition research question, conduct research, screening papers, keywording using abstract, and data extraction and mapping process. Subjects of elementary education, grade, type of AR application, and research method and facets, have been used in classifying AR. Inclusion and exclusion criteria were used in determining the relevant papers. This study examining 42 articles containing "augmented reality," "elementary school," and "Indonesia" in their titles, abstracts, and keywords. Articles were published between 2017 and 2021. The results have shown that science learning is the most subject to be the object of AR research, followed by mathematics, language, and culture. Most of the AR implementations are implemented in class IV, V and VI. The most widely used type of AR application is marker-based AR. The most widely used research method is R&D which focuses on developing AR products.

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1. INTRODUCTION

Augmented Reality (AR) is a technology that has been predicted to have a major impact on education [1]. Augmented Reality is a technology that combines virtual objects into a real environment that can be seen by users in real time on a medium or space [2]. AR is like a graphical interface that has the ability to visualize information in real time [3], and interactive [4]. AR has an influence in changing the way technology is used for learning [5]. AR is an educational medium that is increasingly accessible to young users such as elementary school students [6]. AR is very interesting for students because it can display animated 2D and 3D objects, still images, audio, and video, so AR can motivate students to learn, increase student interaction with materials, allow students to recycle materials, and improve student learning progress [7], as well as being a solution for students to be able to repeat material anywhere and anytime in a fun way, especially for lessons that have limited face-to-face time in class [8]. AR is also proven to have pedagogical contributions and present pedagogical interactions such as enhanced enjoyment, increased learner engagement, fostered interest, provided collaborative opportunities, improved communication between learners and instructor, increased student interaction, and promoted self-learning [9].

The development of mobile computing causes AR systems to be integrated into mobile devices so that this technology is available to more users [10]. The implementation of AR in education follows a similar pattern to mobile learning [9]. AR learning applications is starting to be widely available in various applications for smartphones, and can be accessed via Google Play and the App Store. These applications are mostly aimed at learning specific materials, such as recognizing animals, letters, the solar system, which have not paid attention to the pedagogy aspect of education. In order to AR applications to be of value to education, the researchers suggest that AR is not solely based on the use of technology but is closely related to how AR is designed, implemented, and integrated into formal and informal learning settings [11].

Interest in AR to create effective learning experiences is increasing in the world [9]. In the literature, some researchers have drawn attention to the implementation of AR in education. A study reports, the number of research publications on AR in education is progressively increasing from year to year, where Science, Humanities and Arts are the fields that make the most use of AR [7]. The study also found that AR was most widely implemented in higher education, and the most widely used AR technology was marker-based AR.

A large number of research reviews have focused on the use of AR in education worldwide and at all levels of education, such as oleh Hartono et al [12], Saidin et al [13], Altinpuluk [14], Blanca and Delgado-Kloos [15], Chen et al [16], Alizkan et al [17], and Akcayr and Akcayr [18]. Until now, there have not been many reviews of the use of AR at the elementary school level in Indonesia. Will the trend be the same as the general AR trend ?. This study aims to determine the trends of using AR in elementary school in Indonesia by examining 42 articles containing "augmented reality" in their title and published between 2017 and 2021.

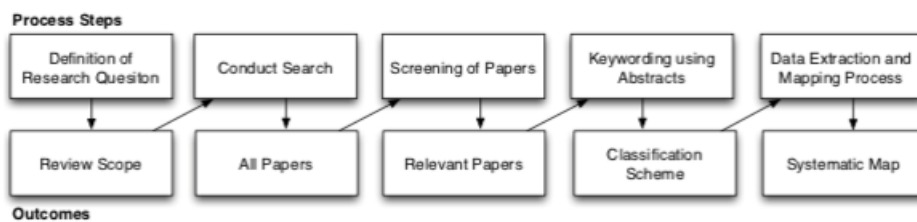


Figure 1. Steps of Systematic Mapping Study

2. RESEARCH METHOD

This research uses a Systematic Mapping Study approach. The Systematic Mapping Study is designed to provide a broad overview of the research area, to determine whether research evidence exists on a topic and provide an indication of the quantity of research evidence [19]. This allows the identification of clusters to direct the focus of future research and to identify the main areas of study to be carried out. Figure 1 illustrates the steps in conducting a Systematic Mapping Study [20].

2.1. Definitions of Research Question

The main purpose of a systematic mapping study is to provide an overview of a research area and identify the amount and type of research and the results available within it [19]. The research question of this study is:

Q1: What subjects are the most focused on AR research?

Q2: What grade are AR applications widely used?

Q3: What the type of Augmented Reality application are the mostly used?

Q4: Which research methods and research facet are the most widely used?

2.2. Conduct Search

development or use of Augmented Reality in elementary schools in Indonesia. The search includes various journal publications and conference proceedings accessed via the Google Scholar search engine. The publication period is between 2017 and 2021. The search string used is "augmented reality" AND "elementary school" AND "Indonesia" OR "Primary School" OR "Sekolah Dasar."

2.3. Screening of Papers

Inclusion and exclusion criteria were used in determining the relevant papers. Inclusion criteria are criteria that must be met by relevant research, while exclusion criteria are criteria for research that cannot be taken as a sample [20]. The inclusion and exclusion criteria were derived from the research question. The inclusion criteria used were: 1) Only research papers published by accredited journals or conference proceedings 2) Only research papers related to the Augmented Reality theme in the title or abstract or keywords; 3) Only research papers that describe AR used in elementary schools in Indonesia in the title or abstract or keywords; 4) Only research published between 2017 and 2021. While the exclusion criteria are: 1) The paper mentions Augmented Reality in the title or abstract or keywords but the output is not a product that is implemented in elementary schools in Indonesia. 2) The paper is a review study.

2.4. Keywording using Abstracts

The purpose of keywording is to obtain a classification scheme [20]. The steps taken are to read the abstract and look for keywords and concepts that describe the contribution of the paper and identify the context of the research. At this stage the research classification is obtained on the dimensions or categories, namely: education level/grade, subject, research's method, and type of AR application.

2.5. Data Extraction and Mapping Process

Data extraction was carried out by sorting all relevant papers. In the first stage the paper is extracted using the term "Augmented Reality". The next stage of extraction is done using the research classification dimensions. Then the mapping process is carried out by distributing papers on each classification dimension. Analysis of the mapping results presents the frequency of papers for each category or dimension. From the mapping, it will be seen which categories or dimensions have been the focus of previous research so that gaps will be known that are of concern for future research [20].

3. RESULT AND ANALYSIS

There are 42 augmented reality studies analyzed from 27 journals and 6 conferences (International Online Journal of Primary Education, Jurnal Penelitian Pendidikan IPA, Professional Journal of English Education, International Journal of Interactive Mobile Technologies, Journal of Engineering Science and Technology, Graphics and Multimedia, Mimbar Sekolah Dasar, International Journal of Instruction, Jurnal TECHNO Nusa Mandiri, International Journal of Education in Mathematics, Science and Technology, Indonesian Journal of Curriculum and Educational Technology Studies, International Journal of Applied Information Technology, International Journal of Advanced Science and Technology, Jurnal Pendidikan Tambusai, Telkonnika, Journal Of Education Technology, Jurnal Ilmiah PGMI, International Journal of Engineering & Technology, Heliyon, Journal of Education and e-Learning Research, Al-Ishlah: Jurnal Pendidikan, Jurnal Teknik Informatika, Jurnal Edukasi Elektro, Child Education Journal, Journal Of Development Research, Journal of Information Technology and Computer Science, Jurnal Edutech Undiksha, Journal of Physics : conference series, IOP Conference Series: Materials Science and Engineering, The East Indonesia Conference on Computer and Information Technology, Advances in Social Science, Education and Humanities Research, Advances in Intelligent Systems Research, and Seminar Nasional Industri dan Teknologi). The findings of the content analysis are presented in 5 sub-headings within the framework of the research objectives and research questions.

3.1. Subject of Education

Based on the mapping results, it is known that Augmented Reality research in Indonesia is mostly implemented in Science Learning subjects, which is 45%, followed by mathematics (21%), culture (17%), language (14%), and character education, as shown in Figure 2. In this review, AR research has not been found in Social Learning and History subjects.

3.2. Type of AR Application

Augmented Reality is divided into 3 levels based on the complexity of the technology, namely level 0 physical world hyper linking, level 1 marker based AR, level 2 markerless based AR, and level 3 immerse augmented vision [21]. The results of the mapping show that marker based AR is the technology that is mostly used. There are still very few studies that develop markerless

based AR, and AR applications that use immerse augmented vision have not been found (Figure 3).

3.3. Grade

This category is the level where Augmented Reality is used. Elementary school in Indonesia consists of 6 levels. Based on the mapping results, it is known that AR is mostly implemented in grades IV, V, and VI, on the other hand, AR is still not widely implemented in lower grades (Figure 4). There are 23.8% of papers that do not know the target of using AR applications, and it is suspected that they can be used by all elementary school levels.

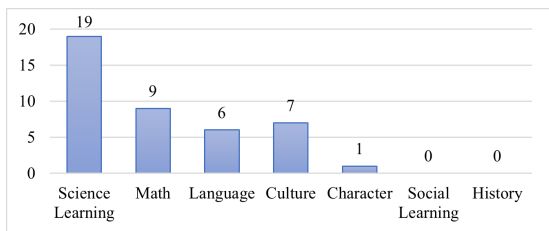


Figure 2. Number of AR papers per subject of education

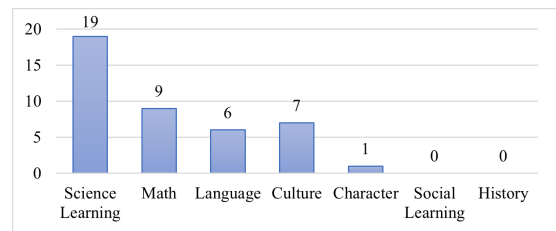


Figure 3. Work distribution by type of AR application

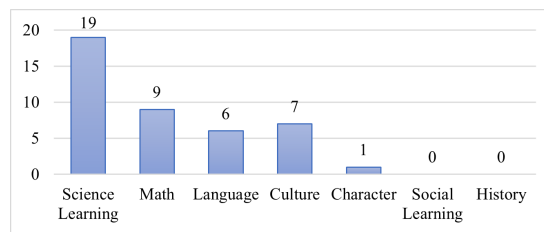


Figure 4. Work distribution by grade

3.4. Research Method used in AR papers

When the methods used in 42 papers related to the AR are examined (Figure 5), it is seen that most of the studies were conducted with research and development (R&D) method (30) or 71,43% of total studies. The most research facet is evaluation research (30) consist of 12 papers of quantitative research and 18 papers of R&D.

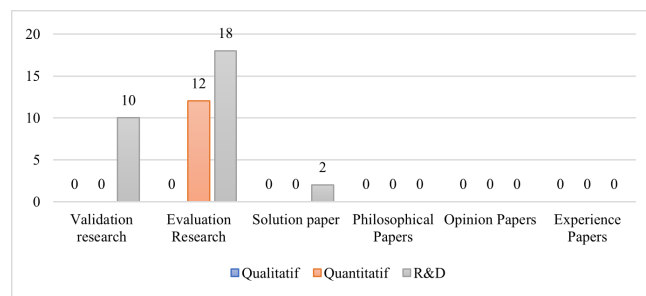


Figure 5. Research method and research facet used in AR papers

4. CONCLUSION

Research in the field of AR has increased from year to year. The aim of this study is to review the direction and trends of AR research in primary education in Indonesia. This study uses 4 categories in classifying AR research, namely subjects of elementary education, grade, type of AR application, and research method and facet. There are 42 papers that have been reviewed, obtained from various journal publications and conference proceedings accessed via the Google Scholar search engine. Based on a systematic mapping study, it is known that science learning is the most subject to be the object of AR research. Most of the AR implementations

are implemented in class IV, V and VI. The most widely used type of AR application is marker-based AR. The most widely used research method is R&D which focuses on developing AR products.

5. DECLARATIONS

AUTHOR CONTRIBUTION

Author contributed to the writing of this article.

FUNDING STATEMENT

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COMPETING INTEREST

The author declares no conflict of interest in this article.

REFERENCES

- [1] M. Roblyer, *Integrating Educational Technology into Teaching 7th edition*. Pearson, 2016.
- [2] R. T. Azuma, "Making Augmented Reality a Reality," in *Applied Industrial Optics: Spectroscopy, Imaging and Metrology*. Optical Society of America, 2017, pp. JT1F-1.
- [3] G. Kipper and J. Rampolla, "Augmented Reality, An Emerging Technology Guide to AR," *Waltham MA: Elsevier Inc*, 2013.
- [4] A. B. Craig, *Understanding Augmented Reality: Concepts and Applications*. Newnes, 2013.
- [5] M. Kesim and Y. Ozarslan, "Augmented Reality in Education: Current Technologies and the Potential for Education," *Procedia-social and behavioral sciences*, vol. 47, pp. 297-302, 2012.
- [6] I. Radu, "Augmented Reality in Education: a Meta-Review and Cross-Media Analysis," *Personal and Ubiquitous Computing*, vol. 18, no. 6, pp. 1533-1543, 2014.
- [7] J. L. Bacca Acosta, S. M. Baldiris Navarro, R. Fabregat Gesa, S. Graf, and Kinshuk, "Augmented Reality Trends in Education: A Systematic Review of Research and Applications," *Educational Technology & Society*, vol. 17, no. 4, pp. 1176-3647, oct 2014.
- [8] D. S. C. Saputri, Z. Syahrial, and Khaerudin, "Design of Augmented Reality-Based Learning Media for English Vocabulary Learning at Elementary School," *International Journal of Advanced Science and Technology*, vol. 29, no. 5s, 2020.
- [9] M. Wang, V. Callaghan, J. Bernhardt, K. White, and A. PenaRios, "Augmented reality in education and training: pedagogical approaches and illustrative case studies," *J Ambient Intell Human Comput*, 2017.
- [10] M. Bower, C. Howe, N. McCredie, A. Robinson, and D. Grover, "Augmented Reality in Education Cases, Places and Potentials," *Educational Media International*, vol. 51, no. 1, pp. 1-15, 2014.
- [11] M. Kljun, V. Geroimenko, and K. C. Pucihar, "Augmented Reality in Education: Current Status and Advancement of the Field," in *Augmented Reality in Education A New Technology for Teaching and Learning*. UK: Springer, 2020, ch. Part I Gen, pp. 3-22.
- [12] B. S. Hantono, L. E. Nugroho, and P. I. Santosa, "Meta-Review of Augmented Reality in Education," in *10th International Conference on Information Technology and Electrical Engineering (ICITEE)*, 2018, pp. 312-315.
- [13] N. F. Saidin, N. D. A. Halim, and N. Yahaya, "A Review of Research on Augmented Reality in Education: Advantages and Applications," *International Education Studies*, vol. 8, no. 13, 2015.
- [14] H. Altinpulluk, "Determining the trends of using augmented reality in education between 2006-2016," *Education and Information Technologies*, 2018.
- [15] M.-B. Ibanez and C. Delgado-Kloos, "Augmented reality for STEM learning: A systematic review," *Computers & Education*, 2018.
- [16] P. Chen, X. Liu, W. Cheng, and R. Huang, "A review of using Augmented Reality in Education from 2011 to 2016," *Innovations in Smart Learning*, 2017.

- [17] U. Alizkan, F. C. Wibowo, L. Sanjaya, B. R. Kurniawan, and B. K. Prahani, "Trends of Augmented Reality in Science Learning: A Review of the Literature," in *The 10th National Physics Seminar (SNF)*, 2021.
- [18] M. Akcayr and G. Akcayr, "Advantages and challenges associated with augmented reality for education: A systematic review of the literature," *Educational Research Review*, 2016.
- [19] B. Kitchenham and S. Charters, "Guidelines for performing Systematic Literature Reviews in Software Engineering," 2007.
- [20] K. Petersen, R. Feldt, S. Mujtaba, and M. Mattsson, "Systematic Mapping Studies in Software Engineering," in *EASE '08: Proceedings of the 12th International Conference on Evaluation and Assessment in Software Engineering*, Italy, 2008.
- [21] A. Castellanos and C. Perez, "New Challenge in Education: Enhancing Student's Knowledge through Augmented Reality," in *Augmented Reality*, J. M. Ariso, Ed. Germany: de Gruyter, 2017, pp. 273–294.
- [22] Fakhrudin, "Implementation of Augmented Reality Techology in Natural Sciences Learning of Elementary School to Optimize the Students' Learning Result," *International Online Journal of Primary Education*, 2017.
- [23] A. Syawaludin, Gunarhadi, and P. Rintayati, "Enhancing Elementary School Students' Abstract Reasoning In Science Learning Through Augmented Reality-Based Interactive Multimedia," *Jurnal Pendidikan IPA Indonesia*, vol. 8, no. 2, 2019.
- [24] I. S. Sadikin and E. Martyani, "Integrating Augmented Reality (Ar) In Efl Class For Teaching Vocabulary," *Professional Journal of English Education*, vol. 3, no. 2, 2020.
- [25] Y. A. Suryani, S. Utaminingsih, and A. H. Madjdi, "Needs analysis of picture story book using augmented reality technology," *Journal of Physics: Conference Series*, 2021.
- [26] P. Sulistyowati, N. S. Ananda, and M. N. Hudha, "Developing an instructional media based on Augmented Reality animation for 3R topic (Reduce, Reuse, and Recycle) of thematic learning," in *The 5th Annual Applied Science and Engineering Conference (AASEC 2020)*, 2020.
- [27] B. Sobandi, S. C. Wibawa, T. Triyanto, S. Syakir, A. Pandanwangi, S. Suryadi, A. Nursalim, and H. Santosa, "Batik AR ver.1.0: Augmented Reality application as gamification of batik design using waterfall method," *Journal of Physics: Conference Series*, 2021.
- [28] I. P. Sari, F. C. Permana, F. H. Firmansyah, and A. H. Hernawan, "Computer-based learning: 3D visualization and animation as content development for digital learning materials for traditional Indonesian cloth (Songket Palembang)," *Journal of Physics: Conference Series*, 2021.
- [29] I. F. Rozi, E. Larasati, and V. A. Lestari, "Developing vocabulary card base on Augmented Reality (AR) for learning English," *IOP Conference Series: Materials Science and Engineering*, 2021.
- [30] A. H. Lubis and M. N. Wangid, "Augmented Reality-assisted Pictorial Storybook: Media to Enhance Discipline Character of Primary School Students," *Mimbar Sekolah Dasar*, vol. 6, no. 1, 2019.
- [31] I. WIDIATY1, L. S. RIZA, A. A. DANUWIJAYA, R. HURRIYATI, and S. R. MUBAROQ, "Mobile-Based Augmented Reality For Learning 3-Dimensional Spatial Batik-Based Objects," *Journal of Engineering Science and Technology*, no. 10, 2017.
- [32] L. Husniah, Y. B. S. Nugraha, A. S. Kholimi, U. L. Yuhana, E. M. Yuniarno, and M. H. Purnomo, "GemAR: Geometry Augmented Reality Application for Elementary School Students," *IEEE Graphics and Multimedia (GAME)*, 2020.
- [33] F. Hendajani, A. Hakim, S. A. Sudiro, G. E. Saputra, and A. P. Ramadhana, "Tracking Visualization Of 3 Dimensional Object Natural Science Learning Media In Elementary School With Markerless Augmented Reality Based On Android," in *The 2nd International Conference on Data and Information Science*, 2019.
- [34] F. H. Firmansyah, I. P. Sari, F. C. Permana, and D. Rinjani, "Development of interactive learning multimedia for mathematics subjects for grade 5 elementary schools," *Journal of Physics: Conference Series*, 2021.
- [35] Y. Wahyu, I. W. Suastra, I. W. Sadia, and N. K. Suarni, "The Effectiveness of Mobile Augmented Reality Assisted STEM-Based Learning on Scientific Literacy and Students' Achievement," *International Journal of Instruction*, vol. 13, no. 3, 2020.

- [36] B. Cahyono, M. B. Firdaus, E. Budiman, and M. Wati, "Augmented Reality Applied to Geometry Education," in *The 2nd East Indonesia Conference on Computer and Information Technology (EIConCIT)*, 2018, pp. 299–303.
- [37] P. S. Darmawel, "Usability Analysis On The Endangered Indonesian Animals and Plants Augmented Reality Application," *Jurnal TECHNO Nusa Mandiri*, vol. 17, no. 2, 2020.
- [38] A. H. Lubis and M. N. Wangid, "Augmented Reality Story Book: Innovative Media on Primary School Mathematics Learning," *International Journal of Education in Mathematics, Science and Technology (IJEMST)*.
- [39] E. Danik, Sarwi, and I. Wiwik, "Media Development of Water Cycle Augmented Reality Media Based on ICT of Scientific Approach for Grade V," *Advances in Social Science, Education and Humanities Research*, vol. 433, 2019.
- [40] M. Septiani, M. M. Nurzaelani, M. I. Pahlevi, and P. E. Sevtiyuni, "Augmented Reality Learning Media Based on Android for Sciences in Elementary Schools," *Advances in Intelligent Systems Research*, vol. 117, 2020.
- [41] U. M. W. Wahyudi and Y. B. Arwansyah, "Developing Augmented Reality-based Learning Media to Improve Student Visual Spatial Intelligence," *Indonesian Journal of Curriculum and Educational Technology Studies*, vol. 7, no. 2, 2019.
- [42] A. H. Fauzi, R. Wijaya, A. A. Gozali, E. W. Wardana, A. Prasetyo, and N. Aqila, "FloNa: Children Educational App for Indonesian Endangered Species Based on Augmented Reality," *International Journal of Applied Information Technology*, vol. 3, no. 2, 2019.
- [43] Marsono, Mulyanto, and Isfarudi, "Pengaruh Pembelajaran Menggunakan Augmented Reality Smartbook terhadap Minat dan Hasil Belajar IPA pada Siswa SDN 2 Waluyo Kecamatan Buluspesantren," *Jurnal Pendidikan Tambusai*, vol. 5, no. 2, 2021.
- [44] R. Andrea, S. Lailiyah, F. Agus, and Ramadiani, "Magic Boosed an elementary school geometry textbook with marker-based augmented reality," *TELKOMNIKA*, vol. 17, no. 3, 2019.
- [45] I. N. I. S. R. R. Ningsih, "The Use of Augmented Reality Cards to Improve Science Learning Outcomes About the Effect of Force on The Shape and Motion of Objects," *Journal Of Education Technology*, vol. 4, no. 3, 2020.
- [46] K. E. Putri and F. A. Wiguna, "Augmented Reality Based Learning Media In Fotosynthesis Material," *Jurnal Penelitian Pendidikan IPA*, vol. 5, no. 1, 2020.
- [47] Istiningsih, F. D. Mukti, and E. Y. N. S. Santoso, "Development Of Augmented Reality (Ar) Learning Media Of Natural Science Subject On Subject Matter Of Water Cycle For Mi Grade V Students," *Jurnal Ilmiah PGMI*, vol. 6, no. 1, 2020.
- [48] N. P. Dinayusadewi and G. N. S. Agustika, "Development Of Augmented Reality Application As A Mathematics Learning Media In Elementary School Geometry Materials," *Journal of Education Technology*, vol. 4, no. 2, pp. 204–210, 2020.
- [49] E. Sudarmilah, N. Ustia, and D. N. Bakhtiar, "Learning Media based on Augmented Reality Game," *International Journal of Engineering & Technology*, vol. 8, no. 1.1, pp. 154–157, 2019.
- [50] S. Septinaningrum, K. A. Hakam, W. Setiawan, M. Agustin, W. Sopandi, and A. S. Surur, "Technology of Holobox Augmented Reality Grebeg Pancasila rite for Mathematics learning in Elementary School," *Journal of Physics: Conference Series*, 2021.
- [51] M. F. Amir, N. Fediyanto, H. E. Rudyanto, D. S. N. Afifah, and H. S. Tortop, "Elementary students' perceptions of 3Dmetric: A cross-sectional study," *Heliyon*, vol. 6, 2020.
- [52] E. W. Winarni and E. P. Purwandari, "The Effectiveness of Turtle Mobile Learning Application for Scientific Literacy in Elementary School," *Journal of Education and e-Learning Research*, vol. 6, no. 4, 2019.
- [53] I. R. W. Atmojo, R. Ardiansyah, D. Y. Saputri, and F. P. Adi, "The Effectiveness of STEAM-Based Augmented Reality Media in Improving the Quality of Natural Science Learning in Elementary School," *Al-Ishlah: Jurnal Pendidikan*, vol. 13, no. 2, 2021.
- [54] M. F. Mokodompit, S. D. Paturusi, and V. Tulenan, "Augmented Reality Applications For Learning English In Elementary School Children," *Jurnal Teknik Informatika*, vol. 16, no. 2, 2021.

- [55] A. C. Nugraha, K. H. Bachmid, K. Rahmawati, N. Putri, A. R. N. Hasanah, and F. A. Rahmat, "Rancang Bangun Media Pembelajaran Berbasis Augmented Reality Untuk Pembelajaran Tematik Kelas 5 Sekolah Dasar," *Jurnal Edukasi Elektro*, vol. 5, no. 2, 2021.
- [56] Z. Jannah, N. Fauziah, T. N. Ningsih, R. F. K. Ayu, Manilaturrohmah, D. A. Suryadi, R. P. N. Budiarti, and F. K. Fitriyah, "No Title Planetarium Glass Based on Augmented Reality to Improve Science Literacy Knowledge in Madura Primary Schools," *Child Education Journal (CEJ)*, vol. 3, no. 1, 2021.
- [57] W. Pujianti, M. Nasir, and S. Mawarni, "Perancangan Aplikasi Pembelajaran Arab Melayu Berbasis Augmented Reality Untuk Siswa Tingkat Sekolah Dasar," in *Seminar Nasional Industri dan Teknologi (SNIT), Politeknik Negeri Bengkalis*, 2019.
- [58] F. Permana, R. Dermawi, and S. Izzaty, "Development of Augmented Reality for Children Book Lutung Kasarung," *Journal Of Development Research*, vol. 5, no. 2, 2021.
- [59] M. Hasbi, H. Tolle, and A. A. Supianto, "The Development of Augmented Reality Educational Media Using Think-Pair-Share Learning Model For Studying Buginese Language," *Journal of Information Technology and Computer Science*, vol. 5, no. 1, 2020.
- [60] B. G. Nirwanto, Murtono, and I. Fathurrohman, "Media Puzzle Berbantu Augmented Reality pada Muatan Pelajaran IPA Tema Ekosistem," *Jurnal Edutech Undiksha*, vol. 9, no. 2, 2021.
- [61] N. S. Wulan and R. Rahma, "Augmented Reality-Based Multimedia in Early Reading Learning: Introduction of ICT to Children," *Journal of Physics: Conference Series*, 2020.

APPENDIX

Papers	Grade	Subjects	Type of AR Application	Research Method	Research Facet
[22]	V	Science	Marker based	R&D	Evaluation Research
[23]	V	Science	Marker based	R&D	Evaluation Research
[24]	II	Language : English	Marker based	Quantitative	Evaluation Research
[25]	IV	Culture	Marker based	R&D	Solution Proposal
[26]	N/A	Science	Marker based	R&D	Evaluation Research
[27]	N/A	Culture	Marker based	R&D	Evaluation Research
[28]	N/A	Culture	Marker based	R&D	Validation Research
[29]	N/A	Language : English	Marker based	R&D	Validation Research
[30]	IV	Mathematic	Marker based	Quantitative	Evaluation Research
[31]	N/A	Cultural	Marker based	R&D	Evaluation Research
[32]	VI	Mathematic	Markerless based	Quantitative	Evaluation Research
[33]	III	Science	Markerless based	R&D	Validation Research
[34]	V	Mathematic	Marker based	R&D	Validation Research
[30]	IV	Character	Marker based	Quantitative	Evaluation Research
[35]	IV	Science	Marker based	Quantitative	Evaluation Research
[36]	IV, V, VI	Mathematic	Marker based	R&D	Validation Research
[37]	N/A	Science	Marker based	Quantitative	Evaluation Research
[38]	IV	Mathematic	Marker based	Quantitative	Evaluation Research
[39]	V	Science	Marker based	R&D	Validation Research
[40]	VI	Science	Marker based	R&D	Evaluation Research
[41]	VI	Science	Marker based	R&D	Evaluation Research
[42]	IV, V	Science	Marker based	R&D	Evaluation Research
[8]	IV	Language : English	Marker based	R&D	Validation Research
[43]	VI	Science	Marker based	Quantitative	Evaluation Research
[44]	IV	Mathematic	Marker based	Quantitative	Evaluation Research
[45]	IV	Science	Marker based	Quantitative	Evaluation Research
[46]	N/A	Science	Marker based	R&D	Evaluation Research
[47]	V	Science	Marker based	R&D	Evaluation Research
[48]	V	Mathematic	Marker based	R&D	Evaluation Research
[49]	IV	Culture	Marker based	R&D	Evaluation Research
[50]	III	Mathematic	Marker based	R&D	Validation Research
[51]	IV	Mathematic	Marker based	R&D	Evaluation Research
[52]	IV, V	Science	Marker based	R&D	Evaluation Research
[53]	VI	Science	Marker based	Quantitative	Evaluation Research
[54]	I	Language : English	Marker based	R&D	Evaluation Research
[55]	V	Science	Marker based	R&D	Evaluation Research
[56]	VI	Science	Marker based	R&D	Evaluation Research
[57]	N/A	Language : Bahasa	Marker based	R&D	Solution Proposal
[58]	N/A	Culture	Marker based	R&D	Validation Research
[59]	N/A	Culture	Marker based	R&D	Validation Research
[60]	V	Science	Marker based	R&D	Evaluation Research
[61]	I	Language : Bahasa	Marker based	R&D	Evaluation Research