THE DEVELOPMENT OF AUGMENTED REALITY-BASED FLASHCARD MEDIA TO FACILITATE STUDENTS' CONCEPT MASTERY IN LEARNING EARTH'S LAYERS

RESEARCH PAPER

Submitted as Requirement to Degree of *Sarjana Pendidikan* in International Program on Science Education

Arranged by:

Lu'lu Halimatus Sa'adah

2109724

SCIENCE EDUCATION STUDY PROGRAM

FACULTY OF MATHEMATICS AND SCIENCE EDUCATION

UNIVERSITAS PENDIDIKAN INDONESIA

2025

THE DEVELOPMENT OF AUGMENTED REALITY-BASED FLASHCARD MEDIA TO FACILITATE STUDENTS' CONCEPT MASTERY IN LEARNING EARTH'S LAYERS

Arranged by:
Lu'lu Halimatus Sa'adah

This thesis was submitted as a requirement to obtain a Bachelor of Education Degree at the Faculty of Mathematics and Science Education

Universitas Pendidikan Indonesia
Juli 2025

APPROVAL SHEET

THE DEVELOPMENT OF AUGMENTED REALITY-BASED FLASHCARD MEDIA TO FACILITATE STUDENTS' CONCEPT MASTERY IN LEARNING EARTH'S LAYERS

By:

Lu'lu Halimatus Sa'adah

2109724

Approved and confirmed by:

Supervisor 1

Prof. Dr. Hj. Diana Rochintaniawati, M.Ed.
NIP. 196709191991032001

Supervisor II

Dr. Rika Rafikah Agustin, S.Pd.,M.Pd.
NIP. 198308032012122001

Perceived by,

Head of International Program on Science Education Study Program

Prof. Dr. H. Ari Widodo, M.Ed.
NIP. 196705271992031001

PLAGIARISM FREE DECLARATION

I, the undersigned below:

Name	: Lu'lu Halimatus Sa'adah
Student ID	: 2109724
Study Program	: International Program on Science Education (IPSE)
Tittle of Thesis	: The Development of Augmented Reality-Based Flashcard to Facilitate Students' Concept Mastery in Learning Earth Layer

Hereby declare that this thesis is my original work. I guarantee that the entire contents of this work, both in part and in whole, are not plagiarized from the work of others, except for those parts that have been quoted and clearly recognized as the source.

If in the future violations of academic ethics or plagiarism are found, I am willing to accept sanctions in accordance with applicable regulations at the Indonesian Education University.

Bandung, 12th August 2025

Lu'lu Halimatus Sa'adah

ACKNOWLEDGEMENTS

Praise and gratitude to Allah Subhanahu Wa Ta'ala for His blessings and mercy that have enabled this research to be completed. Greetings and blessings be upon to honorable Prophet Muhammad Shallahu 'alaihi wa salam, his family, his companions, and all of us as his followers.

With heartfelt gratitude and respect, I would like to express my deepest thanks to:

1. Prof. Dr. Hj. Diana Rochintaniawati, M.Ed. and Dr. Rika Rafikah Agustin, S.Pd., M.Pd., as my thesis advisors, for their invaluable guidance, encouragement, and support throughout the course of this research. Their expertise, patience, and insightful feedback have been instrumental in helping me complete this work. I am truly grateful for the time and effort they invested in mentoring me, and for the trust they placed in my abilities. It has been an honor and a privilege to learn under their supervision.
2. Dr. Eliyawati, S.Pd., M.Pd., as my academic supervisor, I extend my heartfelt gratitude for your kind guidance, support, and encouragement throughout my years of study. your advice and thoughtful insights have been invaluable in shaping both my academic journey and personal growth.
3. Prof. _Dr. Phil. Ari Widodo, M.Ed. as the head of the Department, for the invaluable support and encouragement I have received from the International Program on Science Education. I would also like to express my sincere thanks to Dr. Eka Cahya Prima, S.Pd, M.T., the secretary of the study program. His assistance and expertise have been instrumental in shaping this thesis.
4. All lecturers, teaching assistants, and administrative staff of the IPSE Program, with special thanks to Mrs. Lilit, Prof. Yayan (in loving memory), Mr. Nanang, Mrs. Resik, Mr. Latief, Mr. Andri, Mr. Ikmanda, Dr. Margi, Mrs. Amaira, Mr. Habib, Mr. Hanna, Ms. Riana, Ms. Hana, for support, dedication, and valuable and meaningful learning experiences.
5. My beloved parents, Mama and Abah, for endless prayers, love, sacrifices, and for always being there to listen and to understand. In every step of this

journey, you care has been my strength and your love my greatest blessing. I'm forever grateful, and I carry you love with me, always.

6. To my beloved siblings, Risyda, Ama, Leka, and teh Heni I am deeply thankful for your love, prayers, and constant encouragement. Your presence has brought joy and strength to my journey, and your support has meant the world to me throughout this process.
7. My dearest friends since junior high school, vira, kamila, and pika, thank you for your unwatering friendship and continuous support over the years. Amidst the busyness of life, your presence, understanding, and the quiet strength of our bond have been truly priceless and beyond what words can convey.
8. To my closest friend, syahaarah, thank you for being a constant source of strength and joy throughout these years. Even as life takes us on different paths, I believe our friendship will endure and continue to grow, no matter the distance.
9. To my dear Media Group members, Fani, Syaharah, Elfrida, Ayu, thank you from the bottom of my heart. Your support, companionship, and encouragement have been invaluable. Without meeting you and sharing this journey together, I might not have achieved what I have today.
10. And to my beloved classmates, IPSE 21 thank you for the friendship, support, and memorable experiences we have shared.
11. To my dear friend, Nida, thank you for being wonderful friend, your encouragement and companionship have brightened this journey in so many ways.
12. Lastly, I want to sincerely appreciate myself for never giving up, for staying disciplined, and for working hard despite the obstacles I encountered along the way. This research has been a journey of growth and learning, and I am proud of the persistence and determination that brought me to this point. It reminds me that with patience and commitment, nothing is impossible.

THE DEVELOPMENT OF AUGMENTED REALITY-BASED FLASHCARD MEDIA TO FACILITATE STUDENTS' CONCEPT MASTERY IN LEARNING EARTH'S LAYERS

Lu'lu Halimatus Sa'adah
International Program of Science Education
luluhalimatussaadah@upi.edu

ABSTRACT

Learning requires innovative media to help students understand and visualize material that cannot be observed directly, such as earth layers. One solution that can be developed is the use of Augmented Reality (AR) technology, which can display virtual objects in a real-world context, thereby enhancing students' learning experiences. This study aims to develop Augmented Reality-based flashcard to facilitate junior high school students in learning earth's layers. The research employed the ADDIE development model, which consist of five stages: analysis, design, development, implementation, and evaluation. Data were collected through expert validation of media and material, as well as student response questionnaires. The instrument used was a questionnaire adapted from the Learning Object Review Instrument (LORI). Validation involved five material and media experts, while the trial was conducted with 35 junior high school students. The results of the study indicate that the augmented reality-based flashcard learning media is valid and effective in helping students master the concepts related to the Earth's layers. The average validity scores for material and media were 0.88 and 0.85, which classify the media in the "High" category. This suggests that the media aligns with the science curriculum and serves as a visual aid that supports student learning. The study also collected responses from teachers and students regarding the AR-based flashcards. The average teacher response scores were 4.5 and 4.4, categorized as "Very Good." Additionally, the student responses averaged 4.7, also in the "very Good" category. Therefore, this AR-based learning media is considered highly appropriate and effective for teaching the concept of Earth's layers.

Keywords: Learning Media, Augmented Reality, Flashcard, Earth Layer, Concept Mastery

PENGEMBANGAN MEDIA KARTU BELAJAR BERBASIS AUGMENTED REALITY UNTUK MEMFASILITASI PENGUASAAN KONSEP SISWA DALAM PEMBELAJARAN LAPISAN BUMI

Lu'lu Halimatus Sa'adah

International Program of Science Education

luluhalimatussaadah@upi.edu

ABSTRAK

Pembelajaran memerlukan media inovatif untuk membantu siswa memahami dan menggambarkan materi yang tidak dapat dilihat secara langsung, seperti lapisan bumi. Salah satu solusi yang dapat dikembangkan adalah penggunaan teknologi Augmented Reality (AR) yang mampu menampilkan objek virtual secara nyata sehingga meningkatkan pengalaman belajar siswa. Penelitian ini bertujuan untuk mengembangkan *Augmented Reality* berbasis kartu belajar untuk memfasilitasi siswa Sekolah Menengah Pertama (SMP) dalam mempelajari topik lapisan bumi. Penelitian ini menggunakan model pengembangan ADDIE yang terdiri dari lima tahap, yaitu analisis, desain, pengembangan, implementasi, dan evaluasi. Data penelitian diperoleh melalui validasi oleh para ahli media dan materi, serta angket respon siswa. Instrumen yang digunakan adalah angket yang diadaptasi dari *Learning Object Review Instrument (LORI)*. Validasi melibatkan lima ahli materi dan media, sedangkan uji coba melibatkan 35 siswa SMP. Hasil penelitian ini menunjukkan bahwa media pembelajaran *Augmented Reality* berbasis kartu belajar valid, dan efektif dalam membantu siswa untuk menguasai konsep yang ada pada topik lapisan bumi. Rata-rata validitas material dan media adalah 0,88 dan 0,85 yang mengidentifikasikan bahwa media ini termasuk ke dalam kategori "Tinggi". Ini memberikan asumsi bahwa media ini sejalan dengan kurikulum sains dan visual media yang dapat membantu siswa. Penelitian ini juga mengumpulkan respon guru dan siswa tentang AR-berbasis kartu bermain. Dengan rata-rata respon guru adalah 4,5 dan 4,4 yang dapat di definisikan "*very good*". Selain itu untuk respon siswa mendapatkan rata-rata 4,7 dengan kategori "*very good*". Dengan demikian, media pembelajaran berbasis AR ini dinilai sangat sesuai dan efektif untuk mengajarkan konsep lapisan bumi.

Kata kunci : Media Pembelajaran, *Augmented Reality, Flashcard*, Lapisan Bumi, Penguasaan Konsep

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

REFERENCES

Aditama, P. W., Adnyana, I. N. W., & Ariingsih, K. A. (2019, February). *View Of Augmented Reality Dalam Multimedi Pembelajaran*. https://eprosiding.idbbali.ac.id/index.php/senada/article/view/225/103

Amaliah, K., Ummi Sholikhah, A., & Kurniawan, A. (2022). Ethnoscience-Based Interactive E-Module: E-Module Development On Nonrenewable Resources Topic. *Indonesian Journal of Science and Mathematics Education*. https://doi.org/10.24042/ijsme.v5i2.13806

Aprinawati, I. (2017). Penggunaan Media Gambar Seri Untuk Meningkatkan Kemampuan Berbicara Anak Usia Dini. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *1*(1), 72. https://doi.org/10.31004/obsesi.v1i1.33

Arrum, A., & Fuada, S. (n.d.). *Pembelajaran Daring di SDN Jakasampurna V Kota Bekasi, Jawa Barat Menggunakan Media Pembelajaran Interaktif Berbasis Augmented Reality (AR)*. Retrieved August 22, 2025, from Jurnal Pengabdian Kepada Masyarakat

Boutsi, A. M., Ioannidis, C., & Verykokou, S. (2023). Multi-Resolution 3D Rendering for High-Performance Web AR. *Sensors*, *23*(15). https://doi.org/10.3390/s23156885

Branch, R. M. (2010). Instructional design: The ADDIE approach. In *Instructional Design: The ADDIE Approach*. Springer US. https://doi.org/10.1007/978-0-387-09506-6

Chang, H. Y., Binali, T., Liang, J. C., Chiou, G. L., Cheng, K. H., Lee, S. W. Y., & Tsai, C. C. (2022). Ten years of augmented reality in education: A meta-analysis of (quasi-) experimental studies to investigate the impact. *Computers and Education*, *191*. https://doi.org/10.1016/j.compedu.2022.104641

Chen, Y., Wang, Q., Chen, H., Song, X., Tang, H., & Tian, M. (2019). An overview of augmented reality technology. *Journal of Physics: Conference Series*, *1237*(2). https://doi.org/10.1088/1742-6596/1237/2/022082

Convergent Tectonic Plate Boundary by Science Photo Library. (n.d.). Retrieved August 22, 2025, from https://sciencephotogallery.com/featured/convergent-tectonic-plate-boundary-mark-garlickscience-photo-library.html

Divergent Tectonic Plate Boundary by Science Photo Library. (n.d.). Sciencephotogallery. Retrieved August 22, 2025, from https://sciencephotogallery.com/featured/divergent-tectonic-plate-boundary-mark-garlickscience-photo-library.html

Dutta, R., Mantri, A., & Singh, G. (2022). Evaluating system usability of mobile augmented reality application for teaching Karnaugh-Maps. *Smart Learning Environments*, *9*(1). https://doi.org/10.1186/s40561-022-00189-8

Fatimatuzzohrah, S., Jufri, A. W., & Mertha, I. W. (2020). Efektivitas Penerapan Model Pembelajaran POE (Predict-Observe-Explain) Untuk Meningkatkan Penguasaan Konsep IPA. *Jurnal Pijar Mipa*, *15*(4), 351–356. https://doi.org/10.29303/jpm.v15i4.1653

Firmadani, F. (2021). *Media Pembelajaran Berbasis Teknologi Sebagai Inovasi Pembelajaran Era Revolusi Industri 4.0.*

Fitri, S., Rubiani, H., Akasah, M. G., Riki, C., Tasikmalaya, U. M., Tamansari, J., Tasikmalaya, K., & Barat, J. (n.d.). *Perancangan Media Pembelajaran Digital Mata Pelajaran Teknologi Informasi Dan Komunikasi Berbasis Web*. http://ejournal.mandalanursa.org/index.php/JUPE/index

Garzón, J. (2021). An overview of twenty-five years of augmented reality in education. In *Multimodal Technologies and Interaction* (Vol. 5, Issue 7). MDPI AG. https://doi.org/10.3390/mti5070037

Gufron, M., Suryani, M. V., & Nurfitriana, Z. (2019). Transformasi Media Pembelajaran Konvensional Pengenalan Alat Laboratorium Kimia menjadi Chem-Leb berbasis Augmented Reality Android. *Prosiding Seminar Nasional Mahasiswa Unimus*, *2*(0). https://prosiding.unimus.ac.id/index.php/mahasiswa/article/view/502

Gustiani, S., & Sriwjaya, P. N. (2019). RESEARCH And Development (R&D) Methods As A Model Design In Educational Research And Its Alternatives. *HOLISTICS JOURNAL*, *11*(2).

Hermawan, A., & Hadi, S. (2024). Realitas Pengaruh Penggunaan Teknologi Augmented Reality dalam Pembelajaran terhadap Pemahaman Konsep Siswa. *Jurnal Simki Pedagogia*, *7*(1), 328–340. https://jiped.org/index.php/JSP

Herskovitz, J., Wu, J., White, S., Pavel, A., Reyes, G., Guo, A., & Bigham, J. P. (2020, October 26). Making Mobile Augmented Reality Applications Accessible. *ASSETS 2020 - 22nd International ACM SIGACCESS Conference on Computers and Accessibility*. https://doi.org/10.1145/3373625.3417006

Izzati, L. N., & Kamaludin, A. (2024). *Indonesian Journal of Science and Mathematics Education Augmented reality-based flashcard media to improve students' concept understanding in chemistry learning Article Info ABSTRACT*. https://doi.org/10.24042/ijsme.v5i1.20975

Jufrida, Basuki, F. R., Rinaldo, F., & Purnawati, H. (2020). Analisis Permasalahan Pembelajaran IPA: Studi Kasus Di SMPN 7 Muaro Jambi. *Jurnal Pendidikan Sains*, *8*, 50–58.

Latief, M. (2009). *Penelitian Pengembangan*.

Lenni, J. D., & Rohman, F. (2025). Revolutionizing Learning Engagement. *Journal of Innovation and Research in Primary Education*, *4*(2), 111–119. https://doi.org/10.56916/jirpe.v4i2.1199

Lidiawati, L., Heliawati, L., & Pursitasari, I. D. (2021). The Effectiveness of Contextual Research-Based Teaching Materials on Students' Learning Independence and Concept Mastery. *JPI (Jurnal Pendidikan Indonesia)*, *10*(4). https://doi.org/10.23887/jpi-undiksha.v10i4.34244

Mardiani, E., Fujiono, Hanayanti, C. S., Lestari, N. C., & Hutauruk, T. L. (2024). Exploration augmented reality-based flashcards as a teaching tool to improve children's cognitive ability. *Jurnal Scientia*, *13*.

Mulyawati, L., & Nana. (2020). *Penerapan Model POE2WE melalui Pendekatan Konflik Kognitif untuk Mengurangi Miskonsepsi pada Materi Kesetimbangan Benda Tegar*. https://doi.org/10.31219/osf.io/s65xd

Nesbit, J. C., & Leacock, T. L. (2009). *Collaborative Argumentation in Learning Resource Evaluation and Design*.

Novianingsih, Y. (2021, June 10). *Mengenal Struktur Lapisan Bumi, Berikut Pengertian dan Susunan Kimianya - TribunNews.com*. Tribunnews.Com. https://www.tribunnews.com/sains/2021/06/10/mengenal-struktur-lapisan-bumi-berikut-pengertian-dan-susunan-kimianya?lgn_method=google&google_btn=onetap

Novita, E. N., Sukmawati, R. A., & Mahardika, A. I. (2022). Pengembangan Media Pembelajaran Interaktif Berbasis Web Pada Materi Lapisan Bumi Kelas Vii Dengan Metode Tutorial. In *Computer Science Education Journal (CSEJ)* (Vol. 2, Issue 2).

Panji, F. (2022). Pengembangan Sistem Informasi Kehadiran Siswa Berbasis Website. *Juwara Jurnal Wawasan Dan Aksara*, *2*, 136–145. https://doi.org/10.58740/juwara.v2i2.44

Permana, R., Mandala, W., Putri, D. E., & Yanto, M. (2022). Penerapan Teknologi Augmented Reality dan Virtual Reality dalam Peningkatan Pembelajaran Siswa Sekolah Dasar. *Majalah Ilmiah UPI YPTK*, 7–12. https://doi.org/10.35134/JMI.V29I1.90

Pham, T., Vermeulen, J., Tang, A., & Vermeulen, L. M. D. (2018). Scale impacts elicited gestures for manipulating holograms: Implications for AR gesture design. *DIS 2018 - Proceedings of the 2018 Designing Interactive Systems Conference*, 227–240. https://doi.org/10.1145/3196709.3196719

Purnama, S. (2013). Metode Penelitian Dan Pengembangan (Pengenalan Untuk Mengembangkan Produk Pembelajaran Bahasa Arab). *Produk Pembelajaran Bahasa Arab*, *IV*.

Richey, & Rita C. (1994). *Developmental Research: The Definition and Scope*.

Sari, I. P., Batubara, I. H., Hazidar, A. H., & Basri, M. (2022). Pengenalan Bangun Ruang Menggunakan Augmented Reality sebagai Media Pembelajaran. *Hello World Jurnal Ilmu Komputer*, *1*(4), 209–215. https://doi.org/10.56211/helloworld.v1i4.142

Sintiawati, R., Sinaga, P., & Karim, S. (2021). Strategi Writing to Learn pada Pembelajaran IPA SMP untuk Meningkatkan Penguasaan Konsep dan Keterampilan Komunikasi Siswa pada Materi Tata Surya. In *Journal of Natural Science and Integration* (Vol. 4, Issue 1).

Soraya, S. (2022). Implementation of Augmented Reality (AR) using Assembler in High School Applied Physics Education with the ADDIE Model Approach. *Journal of Physics: Conference Series*, *2377*(1). https://doi.org/10.1088/1742-6596/2377/1/012072

Spatioti, A. G., Kazanidis, I., & Pange, J. (2022). A Comparative Study of the ADDIE Instructional Design Model in Distance Education. In *Information (Switzerland)* (Vol. 13). MDPI. https://doi.org/10.3390/info13090402

Sugiyono. (2021). *Metode Penelitian Kuantitatif Kualitatif Dan R&D*.

Syarifah, S., Bahtiar, Y., & Fikri, A. K. (2022). Designing Learning Media for The Effectiveness of Vocabulary Junior High School. *APPLICATION: Applied Science in Learning Research*, *1*(3), 173–178. https://doi.org/10.32764/application.v1i3.1786

Tectonics - Transform Boundary Art Print by Mark Garlick/science Photo Library - Science Photo Gallery. (n.d.). Retrieved August 22, 2025, from https://sciencephotogallery.com/featured/tectonics-transform-boundary-mark-garlickscience-photo-library.html?product=art-print

Uda, S. K., Prasetyo, D., Dopo, E. S. E. B., Uda, S. A. K. A., & Basrowi. (2024). Development of Mobile Learning Application System for Environmental Science Material (SARITHA-Apps). *International Journal of Information and Education Technology*, *14*(3), 452–463. https://doi.org/10.18178/ijiet.2024.14.3.2066

Utami, F., Rukiyah, R., & Andika, W. D. (2021). Pengembangan Media Flashcard Berbasis Augmented Reality pada Materi Mengenal Binatang Laut. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *5*(2), 1718–1728. https://doi.org/10.31004/obsesi.v5i2.933

Vallejo-Correa, P., Monsalve-Pulido, J., & Tabares-Betancur, M. (2021). Systematic mapping review of context-aware analysis and its approach to mobile learning and ubiquitous learning processe. In *Computer Science Review* (Vol. 39). Elsevier Ireland Ltd. https://doi.org/10.1016/j.cosrev.2020.100335

Wu, H. K., Lee, S. W. Y., Chang, H. Y., & Liang, J. C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers and Education*, *62*, 41–49. https://doi.org/10.1016/j.compedu.2012.10.024

Zamsiswaya, Syawaluddin, & Syahrizul. (2024). *Pengembangan Model ADDIE (Analisys, Design, Development, Implemetation, Evaluation)* (Vol. 8).