



RESEARCH ARTICLE

The Development of Mobile Learning Based on Augmented Reality to Strengthen Student Digital Ethics in Surakarta

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ABSTRACT

Indonesia experiences low levels of digital civility, especially in Surakarta, where students are vulnerable to fake news and hate speech due to limited critical thinking skills. Digital ethics refers to safe, responsible, and ethical behavior by internet users. Incorporating augmented reality into Civic Education fosters digital ethics and promotes educational values among students. This research aims to develop augmented reality-based mobile learning tools suitable for Civic Education lessons. The research follows a 4D-development framework involving defining, designing, developing, and disseminating stages. The study involved 120 student participants and included validation by two academic experts, two media specialists, and four civic education teachers. Data collection methods encompassed observations, literature reviews, interviews, and questionnaires, with the questionnaire serving as the primary instrument. Results show that the augmented reality-based learning tool achieved excellent ratings: 85% from academic experts, 88% from media specialists, 86% from teachers, and 88% from students, categorizing it as very effective. The tool also improved students' digital ethics and is recommended for use in Civic Education programs.

INTRODUCTION

The rapid advancement of information and communication technology in the 21st century has transformed the world and highlighted numerous cross-border challenges. These global issues include poverty, human rights, population growth, refugee crises, climate change, health concerns, energy resources, the global economy, and security (Hernandez-de-Menendez et al., 2020). John Cogan (Affandi & Nu'man Somantri, 2019) stated that such international problems are deeply connected to civic education, particularly concerning privacy and individual rights. Key challenges in this area involve balancing freedom of expression, demands for transparency, national and international security policies, and advancements in technology and data protection (Indeks, 2020). According to Microsoft TRG (2021), Indonesia ranks 29th out of 32 countries in digital interaction on social media, placing it last in Southeast Asia. The 2022 Indonesian Digital Literacy Index Survey for the Digital Ethics pillar reported a score of 3.76, revealing that most social media users still post content without obtaining permission. Additionally, many struggle to verify the credibility of information, compare details from various sources, identify computer viruses, and differentiate between legitimate emails and those containing spam or malware. Social media interactions often involve decisions affected by ethnicity, religion, social status, and political views (Kementerian Informasi dan Komunikasi, 2021). A preliminary study conducted by researchers on Digital Ethics in Surakarta City, involving 90 respondents across 10 high schools, found that the majority fell into the low category, as shown in Table 1.

Table 1. Digital Ethics on High School Student in Surakarta

Digital Ethics Category	Frequency	%
Low	83	92
Middle	6	7
High	1	1
Total	90	100

Source: Data by Research, 2023

Digital Ethics encompasses the safe, ethical, and responsible behavior of internet users (Cristol et al., 2015). In the context of 21st-century learning, digital citizens are expected to understand human, cultural, and social issues related to technology while practicing legal and ethical behavior. They should promote and adhere to the safe, legal, and responsible use of technology and information, demonstrating a positive attitude that fosters collaboration, learning, productivity, and leadership (Penulis et al., 2022). Civic education must innovate to enhance civic competence and develop civic knowledge tailored to the digital age's learning demands (Halimi et al., 2022). Civic educators, despite various challenges, are tasked with designing creative, innovative, engaging, and effective learning experiences to meet these needs (Hannes Magdalena Hutagalung & Fazli Rachman, 2023).

Integrating mobile learning into civic education offers a valuable opportunity to address these challenges, as it aligns with the preferences and habits of digital natives. This approach can effectively introduce digital ethics and educational character values to its users. A preliminary study conducted by researchers, involving four high school teachers in Surakarta City, highlighted the critical need for digital ethics education. The teachers observed that current learning media are inadequate in providing meaningful learning experiences with digital ethics outcomes, failing to meet students' needs. As a result, they recommended the development of interactive media focused on digital ethics through mobile learning. These findings are supported by Halimi et al. (2022), who emphasize that mobile learning integration enhances educational experiences, improves digital ethics comprehension, and sustains student engagement without compromising learning objectives. Mobile learning can be enhanced with augmented reality (AR) technology, which visualizes objects in two or three dimensions within a real-world setting, making it an engaging and effective tool for education (Hannes Magdalena Hutagalung & Fazli Rachman, 2023). AR is recognized for improving motivation and learning outcomes and is suitable for various subjects (Dinayusadewi et al., 2020). Studies such as those by Hutagalung and Rachman (2023) highlight AR's potential in civic education topics like "National Integration," while others, like Nurholisa et al. (2022), applied AR to teach social phenomena, and Halimah and Sungkono (2021) used puzzle-based AR to instill Pancasila values. This research uniquely focuses on "Obeying the Law" for 10th-grade civic education, aligning AR's ability to simplify complex concepts through interactive tools like 3D illustrations, quizzes, and images, bridging the virtual and real worlds (Wannapiroon et al., 2021). It integrates knowledge of law-abiding behavior, fosters values such as honesty, cooperation, and openness to opinions, and improves creativity by encouraging problem-solving and innovative thinking (Hutagalung & Rachman, 2023). Augmented reality media, when integrated with mobile learning, offers compatibility across various devices, providing an authentic learning experience that helps students acquire knowledge, skills, and attitudes relevant to current developments (Branson, 2007; Savitri, 2019; Rusli et al., 2022; Silva et al., 2023).

This research aims to develop AR-based mobile learning media for the topic "Obeying the Law" to enhance students' digital ethics. The outcome seeks to diversify learning tools, enabling teachers to create engaging and interactive learning environments in civic education, making the subject more appealing and effective for students.

METHOD

This study adopts the Research and Development (R&D) method, designed to create products that undergo testing, evaluation, and refinement until they meet desired standards (Gal, 2005). The R&D approach is employed to develop AR-based mobile learning media using the Four-D (4D) model introduced by Thiagarajan (1974), which consists of four stages: Define, Design, Develop, and Disseminate. The Define stage identifies existing gaps that need addressing. The Design stage initiates the product's creation. The Develop stage evaluates the product's feasibility, while the Disseminate stage ensures the finalized product is distributed for practical use in the learning process. This research was conducted in four high schools in Surakarta City, targeting 10th-grade students, with a sample of 90 participants selected through random sampling techniques. The feasibility of the learning media was assessed through a validation test involving two academic experts and two media experts. Once the media was deemed suitable by the validators, it was further tested and refined based on feedback from teachers and students. Data collection methods included observation, interviews, and questionnaires. Observations were conducted during the Civic Education learning process, interviews were conducted with teachers, and questionnaires were distributed to academic experts, media experts, teachers, and students.

RESULT AND DISCUSSION

RESULT

The research and development of AR-based mobile learning media focused on the content "Obey the Law" within the Pancasila Education subject for phase E, class X high school students. The process began with the Define stage, aimed at identifying gaps that could justify product development. This stage included several analyses: front-end analysis to understand general learning challenges, learner analysis to pinpoint students' constraints and needs, task analysis to assess their initial and required skills, concept analysis to determine the core material to be taught and specifying instructional objectives to set clear learning goals (Thiagarajan, 1974). A mixed-method approach was employed at this stage, combining qualitative and quantitative research methods to ensure comprehensive insights and robust findings throughout the study.

Quantitative research in this study draws on Choi's (2016) findings that digital ethics is influenced by demographic factors, internet self-efficacy, and internet anxiety. Data analysis was conducted using the partial least square (PLS) method via SmartPLS software. An online questionnaire was distributed to 90 respondents from 10 high schools in Surakarta to collect data. The demographic breakdown included 26 male and 64 female participants aged 15 (48 respondents), 16 (32 respondents), and 17 (10 respondents). Daily internet use ranged from 1-3 hours (7 respondents), 4-6 hours (23 respondents), 7-9 hours (36 respondents), and more than 9 hours (24 respondents). Devices used to access the internet included computers (4 respondents), laptops (6 respondents), smartphones (74 respondents), and tablets (6 respondents). The findings revealed that 33 students used the internet for entertainment, 2 for reading news, 26 for completing assignments, and 29 for accessing social media. Hypothesis testing to examine the influence of Internet self-efficacy and Internet anxiety on digital ethics was conducted by analyzing the t-statistic and p-value. A relationship between variables was considered significant if the t-statistic was ≥ 1.96 or the p-value was less than 5% (0.05), indicating rejection of the null hypothesis (H_0). Table 2 provides a summary of the hypothesis testing results, outlining the significance of the proposed relationships between the variables.

Table 2. Hypothesis Testing

	Hypothesis	Coefficient	T Statistics	P Values	Decision
H1:	Internet Self Efficacy -> Digital Ethics	0,325	2,769	0,006	Significant
H2:	Internet Anxiety -> Digital Ethics	0,532	4,179	0,000	Significant

Source: Data by Research, 2023

The analysis reveals that Internet self-efficacy positively and significantly impacts students' digital ethics, with a coefficient value of 0.325, a t-statistic of 2.679 (≥ 1.96), and a p-value of 0.006 (< 0.05). Similarly, Internet anxiety also has a positive and significant effect, indicated by a coefficient value of 0.532, a t-statistic of 4.179 (≥ 1.96), and a p-value of 0.000 (< 0.05). To complement and strengthen these findings, qualitative research was conducted with four civic education teachers from different schools in Surakarta (Connolly, 2021). The qualitative results highlight a lack of students' understanding of digital ethics in schools. Students often show limited awareness of issues like fake news in social, political, and academic contexts, overshare personal information, exhibit a dependence on social media, engage in plagiarism, and experience inferiority due to online social comparisons. Furthermore, civic education lessons are described as monotonous and uninspiring, failing to address these issues effectively.

Besides, the current learning media fails to align with students' characteristics and learning styles, and the material does not adequately meet the learning objectives. This gap underlines the importance of developing AR-based mobile learning media for the civic education subtopic "Obeying the Law." The Design stage focuses on the initial product creation, beginning with the construction of criterion-referenced tests based on the analysis of learning objectives and student needs. These tests include essays, multiple-choice questions, and case studies. The second step involves media selection, which is informed by the Define stage, to guide the development of AR-based mobile learning. The third step is format selection, which enhances the learning media through two-dimensional and three-dimensional formats. Finally, the initial design phase involves creating a product prototype using T3 Turbo tech stack software. In the Development stage, the product undergoes feasibility testing and is revised based on feedback from two academic experts and two media experts, with results detailed in Table 3.

Table 3. Material Expert Validation I

No	Validator	Mean	Category
1	Content Suitability	78%	Layak
2	Content Language	80%	Layak
3	Learning Support	70%	Layak

The results of the material suitability test by the first validator showed that the content suitability category received an average score of 78%, placing it in the feasible category. The content language category achieved an average score of 80%, also categorized as feasible. In the learning support category, the average score was 70%, falling into the feasible category as well. Overall, the average content feasibility score from the first validator was 76%, deemed feasible and suitable for use in research, provided revisions are made.

Table 4. Material Expert Validation II

No	Validator	Mean	Category
1	Content Suitability	82%	Sangat Layak
2	Content Language	100%	Sangat Layak
3	Learning Support	100%	Sangat Layak

The content suitability test results from the second validator showed an average score of 82% in the content suitability category, classified as very feasible. The content language category achieved a perfect score of 100%, also classified as very feasible. Similarly, the learning support category received a 100% score, falling into the very feasible category. The overall average content feasibility score from the second validator was 90%, deemed very feasible and suitable for use in research without requiring any changes.

Table 5. Media Expert Validation I

No	Validator	Mean	Category
1	Media Visualization	86%	Very Feasible
2	Media Programming	90%	Very Feasible

The media feasibility test results from the first validator indicated that the media display category received an average score of 86%, classified as very feasible. The media programming category achieved an average score of 90%, also categorized as very feasible. The media was deemed suitable for use in research, requiring only minor changes.

Table 6. Media Expert Validation II

No	Validator	Mean	Category
1	Media Visualization	86%	Very Feasible
2	Media Programming	90%	Very Feasible

The media feasibility test results from the second validator showed that the media display category achieved an average score of 86%, classified as very feasible. The media programming category also received an average score of 90%, categorized as very feasible, making it suitable for use in research with minor adjustments. Learning media deemed appropriate by academic and media experts was subsequently tested in schools to gather feedback from civic education teachers and students. Civic education teachers rated the augmented reality-based mobile learning media with a score of 86, categorized as very feasible. Testing was conducted with 120 students from SMAN 1 Surakarta, SMAN 3 Surakarta, SMAN 4 Surakarta, and SMA Al Islam 1 Surakarta, resulting in an average score of 88, also classified as very feasible (see Table 7 and Table 8 for details).

Table 7. Trial to Students

No	Trials	Mean	Category
1	Application Attractiveness	88%	Very Feasible
2	Content	86%	Very Feasible
3	Language	90%	Very Feasible

Table 8. Trial to Teacher

No	Trials	Mean	Category
1	Application Attractiveness	86%	Very Feasible
2	Content	86%	Very Feasible
3	Language	86%	Very Feasible

The feasibility tests for content, media, teacher, and student validation confirm that augmented reality-based mobile learning media is suitable for use in civic education learning. The Disseminate stage focuses on introducing the product to the public. The augmented reality-based mobile learning media, developed for the subtopic "Obeying the Law," was distributed to schools for integration into the civic education curriculum. To ensure broader accessibility, the media is also available for download on the Play Store.

Discussion

Development of augmented reality-based mobile learning media to strengthen students' digital ethics in Surakarta City

AR-based mobile learning media was selected following an analysis of students and teachers, which revealed a low level of digital ethics among students, influenced by internet self-efficacy and internet anxiety factors (Choi, 2015). Internet self-efficacy, defined as an individual's belief in their ability to manage and execute internet-related behaviors effectively, is a crucial psychological factor for productive internet use (Choi, 2016). It has a significant correlation with digital ethics, as

demonstrated by research in Surakarta City, which found that internet self-efficacy accounts for 47.786% of the variance in students' digital ethics. Previous studies show that individuals with higher internet self-efficacy exhibit stronger digital ethics (Baylor et al., 2002; Choi, 2016). Therefore, it can be concluded that increased internet self-efficacy leads to a higher likelihood of developing robust digital ethics. A study by Halimi et al. (2022) emphasizes the significance of integrating technology into the learning process, especially through mobile learning. Mobile-based learning enables students to access information and educational resources anytime and anywhere, fostering an increase in internet self-efficacy. This approach supports independent learning, encourages students to explore topics of personal interest, and aids in developing digital skills within a flexible and adaptable environment.

The use of mobile technology enhances student engagement in the learning process by leveraging devices they are already familiar and comfortable with. Halimi et al. (2022) notes that integrating mobile learning into education creates a more interactive and engaging experience, which positively affects students' digital ethics. As students become more confident in their technological abilities, they are more inclined to exhibit ethical behavior in the digital realm. The second factor is internet anxiety, a condition in which individuals feel fear or discomfort when using the internet, affecting how they engage in the digital world. According to Choi et al. (2018), internet anxiety is closely linked to a person's level of digital ethics. The greater the anxiety experienced, the lower their adherence to digital ethics. Research on students in Surakarta City indicates that internet anxiety affects 52.214% of students. This anxiety stems from various causes, such as limited understanding of digital technology, privacy concerns, or negative online experiences like cyberbullying (Choi et al., 2017). People with high internet anxiety often avoid complex online activities and are more prone to errors in practicing digital ethics principles.

Another study by Halimi et al. (2022) found that students experiencing internet anxiety often lack the confidence to engage in technology-based learning. Consequently, they struggle to fully utilize information and communication technology in the teaching-learning process. To enhance digital ethics, it is essential to reduce internet anxiety through educational and training programs aimed at building students' skills and confidence in internet use. Research by Crompton (2013) supports mobile learning as a solution to address internet anxiety. Crompton highlights that mobile learning encourages students to be more active and independent in the learning process, increasing their confidence in using technology. By overcoming their fear of the internet, students can develop the skills needed to participate ethically in the digital world. The analysis of student needs revealed that the low level of digital ethics among students in Surakarta City stems from low internet self-efficacy and high internet anxiety. Addressing this issue requires an educational strategy focused on building students' confidence in using the internet while reducing their anxiety.

One effective way to improve internet self-efficacy is through training programs designed to improve students' digital skills. Halimi et al. (2022) emphasizes the importance of integrating information and communication technologies, such as mobile learning, into education to boost student engagement and foster digital ethics. Providing students with safe and supportive opportunities to interact with technology helps them gain confidence and apply ethical behavior in digital contexts.

In addition, an inclusive and supportive learning approach is crucial for reducing internet anxiety. By fostering a learning environment that encourages exploration of technology and offers emotional support, students can overcome their fears and become more active participants in digital learning. Consequently, enhancing digital ethics in Surakarta City requires a dual approach that strengthens internet self-efficacy while minimizing internet anxiety.

The development of AR-based mobile learning media was driven by in-depth interviews with four Pancasila Education teachers in Surakarta City, who emphasized the need for engaging, varied, and enjoyable learning tools that suit the diverse characteristics and learning styles of students while

aligning with the material, design, and learning objectives. Variations in how students comprehend material underscore the importance of creative and innovative learning media to foster an interactive and effective learning environment (Sayu Putri Ningrat et al., 2018). A significant obstacle to achieving this is the reliance on traditional methods, such as textbooks and PowerPoint presentations, which often create teacher-centered instruction and fail to engage students actively (Hannes Magdalena Hutagalung & Fazli Rachman, 2023). Moreover, the need for resources that incorporate visual, audio, and kinesthetic elements, in line with modern technological advancements, remains unmet due to outdated and unsuitable learning media (Carolina, 2022).

The development of AR-based mobile learning media for the Pancasila Education subject on "Obeying the Law" aims to provide students with a contextual learning experience by visualizing concepts in a real-world environment (Carolina, 2022). Augmented reality simplifies complex learning materials, making them concrete, engaging, and easier to understand, and its use has been shown to improve student learning outcomes (Andriani, 2020; Sapulette, 2023). Integrating augmented reality into education enhances the learning experience, supports the development of digital ethics, and sustains student interest without compromising the subject's objectives (Halimi et al., 2022). This approach combines knowledge, attitudes, and skills (Maulidiah et al., 2023) by presenting the "Obeying the Law" material in a structured way with images, quizzes, and 3D illustrations that blend the virtual and real worlds. It fosters values such as cooperation, honesty, enthusiasm for learning, and openness to opinions while encouraging idea generation. Students actively engage with the material in a manner suited to their learning styles, gaining direct experience (Andriani, 2020). This aligns with Bruner's theory, which highlights the interplay of abstract, pictorial, and direct experiences to create a comprehensive learning process that develops knowledge, attitudes, and skills over time (Harahap et al., 2018).

According to Bruner's theory, abstract experience involves presenting concepts, facts, data, and quizzes in symbolic forms. In this learning media, abstract experience is achieved by understanding the concept of obeying the law through textual materials enhanced with graphics, real-world examples, and quizzes that measure students' initial and final comprehension through assessment activities. Pictorial experience, as defined by Bruner, focuses on grasping concepts through visual representations. This is realized in the learning media through augmented reality, which uses three-dimensional (3D) illustrations to depict real behaviors associated with obeying the law. Meanwhile, direct experience refers to physical interaction or manipulation of real objects. Within this learning media, direct experience is reflected in a comprehensive exploration of the "Obeying the Law" material, designed to inspire behavioral changes that foster good citizenship and intelligent decision-making (Schunk, 2012).

Effectiveness of augmented reality-based mobile learning media to strengthen students' digital ethics in Surakarta City

The augmented reality-based mobile learning media developed for Pancasila Education was rated as very feasible and very interesting. The very feasible category was supported by validation test results from material experts (85%), media experts (88%), and Pancasila Education teachers (86%). The very interesting category was based on student assessments, which scored the media at 88%. Additionally, testing with 120 students in Surakarta City demonstrated a considerable improvement in knowledge after using the media. The average pre-test score was 82.5, which increased to 89.5 in the post-test, indicating the effectiveness of the augmented reality-based mobile learning media. This learning media is not only effective in improving students' understanding of the material but also serves as an innovative tool to support character building, particularly in applying digital ethical values in daily life. It is expected to assist Pancasila Education teachers in creating more interactive and relevant learning experiences that align with technological developments.

AR-based mobile learning media has been deemed feasible for use in Pancasila Education classrooms, helping to improve students' digital ethics and adapt learning to modern educational needs (Halimi et al., 2022). This research introduces novel contributions compared to previous studies, which primarily focused on augmented reality learning media for subjects like chemistry and social studies across universities, elementary schools, and high schools (Carolina, 2022). Until now, no AR-based mobile learning media has been developed specifically for the Pancasila Education subject on the material of "Obeying the Law." This development aligns with Bruner's theory (1973), emphasizing the active involvement of students in the learning process through the integration of abstract experiences, image experiences, and direct experiences. These interconnected elements provide a comprehensive learning experience, fostering knowledge, attitudes, and skills relevant to contemporary educational needs. Augmented reality-based mobile learning media is highly compatible and feasible for application in Pancasila Education, particularly for teaching the material "Obeying the Law." Future research will focus on evaluating the effectiveness of this media in enhancing students' digital ethics. In the current digital era, teachers need to be adaptive, technologically competent, and able to integrate technology into their teaching practices to meet the demands of 21st-century education (Isatul Hasanah, 2023).

CONCLUSION

Based on the research findings, augmented reality-based mobile learning media for the material "Obeying the Law" has been declared highly feasible for use in Pancasila Education. This conclusion is supported by evaluation results from material experts, media experts, Pancasila Education teachers, students, and classroom experiment outcomes, all of which affirm its suitability and effectiveness in enhancing the learning process. This research recommends that schools, teachers, and students optimally utilize this learning media with a focus on promoting digital ethics. The integration of information and communication technology (ICT), especially through augmented reality-based mobile learning media, is expected to enhance classroom learning effectiveness and contribute to improving students' digital ethics.

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REFERENCES

- Affandi, I., & Nu'man Somantri, M. (2019). Civic education, global issues, and global citizen. *advances in social science, Education and Humanities Research*, 541–545.
- Andriani, A. (2020). *Implementasi pendidikan karakter melalui model pembelajaran discovery learning di mim pasir lor karanglewas banyumas*, 1(2).
- Baylor, A. L., Ritchie, D., & Baylor, A. L. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classrooms? *Computers & Education*, 39, 395–414. www.elsevier.com/locate/compedu
- Branson, M. S. (2007). *Character development and democratic citizenship*. www.civiced.org/branson@civiced.org
- Carolina, Y. Dela. (2022). Augmented reality sebagai media pembelajaran interaktif 3D untuk meningkatkan motivasi belajar siswa digital native. *Ideguru: Jurnal Karya Ilmiah Guru*, 8(1), 10–16. <https://doi.org/10.51169/ideguru.v8i1.448>
- Choi, M. (2015). *Development of a scale to measure digital citizenship among young adults for democratic citizenship education* [Dissertation]. The Ohio State University.

- Choi, M. (2016). A concept analysis of digital citizenship for democratic citizenship education in the internet age. *Theory and Research in Social Education*, 44(4), 565–607. <https://doi.org/10.1080/00933104.2016.1210549>.
- Choi, M., Cristol, D., & Gimbert, B. (2018). Teachers as digital citizens: The influence of individual backgrounds, internet use and psychological characteristics on teachers' levels of digital citizenship. *Computers and Education*, 121, 143–161. <https://doi.org/10.1016/j.compedu.2018.03.005>
- Choi, M., Glassman, M., & Cristol, D. (2017). What it means to be a citizen in the internet age: Development of a reliable and valid digital citizenship scale. *Computers and Education*, 107, 100–112. <https://doi.org/10.1016/j.compedu.2017.01.002>
- Connolly, P. (2021). *Quantitative data analysis in education: A critical introduction using SPSS* (1st ed.). Taylor & Francis.
- Cristol, D., Choi, M., Mitchell, R., & Burbidge, J. (2015). Mobile technology in K-12 environments. In *Handbook of Mobile Teaching and Learning* (pp. 669–682). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-54146-9_33
- Crompton, H. (2013). A historical overview of mobile learning: Toward learner-centered education. In Berge L Zane and Lin Y. Muilenburg (Ed.), *Handbook of Mobile Learning* (1st ed.). Taylor & Francis. <https://www.researchgate.net/publication/263852116>
- Dinayusadewi, N. P., Ngurah, G., & Agustika, S. (2020). Development of augmented reality application as a mathematics learning media in elementary school geometry materials. In *Journal of Education Technology* (Vol. 1, Issue 2).
- Gal, D. G. (2005). Global perspectives for teacher education. In *International Perspectives on Education and Society*, 6, pp. 259–287). [https://doi.org/10.1016/S1479-3679\(04\)06010-4](https://doi.org/10.1016/S1479-3679(04)06010-4)
- Sayu Putri Ningrat, I M. Tegeh, & M. Sumantri. (2018). Kontribusi gaya belajar dan motivasi belajar terhadap hasil belajar bahasa Indonesia. *Jurnal Ilmiah Sekolah Dasar*, 2(3), 257–265.
- Hak atas Privasi dan Tantangannya di Era Digital*. (2021). Indeks.or.Id. <https://indeks.or.id/hak-atas-privasi-dan-tantangannya-di-era-digital/>
- Halimah, N. N., & Sungkono, S. (2021). Pengembangan puzzle berbasis augmented reality untuk penanaman nilai Pancasila bagi siswa kelas 4 SD IT. *Epistema*, 2(2), 100–112. <https://doi.org/10.21831/ep.v2i2.42721>
- Halimi, M., Rahmat, R., Nugraha, R. A., & Pratiwi, E. D. (2022). Young digital citizen answers: Can online learning improve the quality of civic education learning? *Jurnal Civics: Media Kajian Kewarganegaraan*, 19(1), 99–109. <https://doi.org/10.21831/jc.v19i1.40140>
- Hannes Magdalena Hutagalung, & Fazli Rachman. (2023). Android-based augmented reality media in learning Pancasila and citizenship education. *Jurnal Pedagogi Dan Pembelajaran*, 6(3), 385–396. <https://doi.org/10.23887/jp2.v6i3.66149>
- Harahap, M., Mayasari, L., Stai, S., & Sibuhuan, B. R. (2018). *Mengembangkan Sumber dan Media Pembelajaran*. <https://doi.org/10.13140/RG.2.2.19282.86721>
- Nurholisa, Wika Hardika Legiani, & Qotrun Nida. (2022). Pengembangan media pembelajaran augmented reality berbasis fenomena sosial pada mata pelajaran PPKn di SMAN 1 Mancak. *Jurnal Kewarganegaraan*, 6(1), 298–306.

- Hernandez-de-Menendez, M., Escobar Díaz, C., & Morales-Menendez, R. (2020). Technologies for the future of learning: state of the art. *International Journal on Interactive Design and Manufacturing*, 14(2), 683–695. <https://doi.org/10.1007/s12008-019-00640-0>
- Isatul Hasanah. (2023). Menumbuhkan jiwa kreativitas siswa melalui pembelajaran berbasis IT pada era pandemi COVID-19. *Journal of Education and Teaching Learning (JETL)*, 3(3), 18–28. <http://pusdikra-publishing.com/index.php/jetl>
- Maulidiah, P., Sya, A., & Kusumawati, L. (2023). Efektivitas media pembelajaran augmented reality (AR) dalam meningkatkan hasil belajar kognitif siswa pada pelajaran geografi di kelas X SMAN 36 Jakarta. In *Jurnal Pendidikan dan Ilmu Geografi* (Vol. 8, Issue 2).
- Microsoft TRG. (2021). *Civility, Safety & Interaction Online*. [https://pskp.kemdikbud.go.id/assets_front/images/produk/1-gtk/materi/2_Kondisi_Kesantunan_Digital_Masyarakat_Khususnya_Kalangan_Pelajar_dan_Mahasiswa%E2%80%9D_\(Benny_Kusuma_Education_Lead_Microsoft_Indonesia\).pdf](https://pskp.kemdikbud.go.id/assets_front/images/produk/1-gtk/materi/2_Kondisi_Kesantunan_Digital_Masyarakat_Khususnya_Kalangan_Pelajar_dan_Mahasiswa%E2%80%9D_(Benny_Kusuma_Education_Lead_Microsoft_Indonesia).pdf)
- Penulis, T., Riyanti, A., Indra Daulay, M., Bagenda, C., Supandi Soegoto, A., Soeikromo, D., Kusradi, E., Penus Sagala, Mj., & Khairina Hanum Hasibuan, A. (2022). "Hakikat, konsep dan urgensi." www.penerbitwidina.com
- Astrid Savitri. (2019). *Revolusi Industri 4.0: Mengubah tantangan menjadi peluang di era disrupsi 4.0* (T. Afkar, Ed.; 3rd ed.). Genesis. <https://books.google.co.id/books?id=dSvTDwAAQBAJ&printsec=frontcover#v=onepage&q&f=false>
- Rusli, R., Nalanda, D. A., Tarmidi, A. D. V., Suryaningrum, K. M., & Yunanda, R. (2022). Augmented reality for studying hands on the human body for elementary school students. *Procedia Computer Science*, 216, 237–244. <https://doi.org/10.1016/j.procs.2022.12.132>
- Sapulette, V. (2023). Penggunaan media pembelajaran augmented reality (AR) dalam meningkatkan hasil belajar siswa. *Journal On Teacher Education*, 5(1), 208–213.
- Schunk, D. H. . (2012). *Learning theories : an educational perspective*. Pearson.
- Silva, M., Bermúdez, K., & Caro, K. (2023). Effect of an augmented reality app on academic achievement, motivation, and technology acceptance of university students of a chemistry course. *Computers & Education: X Reality*, 2, 100022. <https://doi.org/10.1016/J.CEXR.2023.100022>
- Kementerian Informasi dan Komunikasi. (2021). *status literasi digital di Indonesia 2021*.
- Thiagarajan, S., Sammel, D. S., & Semmel, M. I. (1974). *Instructional development for training teacher of exceptional children*. Leadership Training Institute/ Special Education.
- Wannapiroon, P., Nilsook, P., Kaewrattanapat, N., Wannapiroon, N., & Supa, W. (2021). Augmented reality interactive learning model, using the imagineering process for the SMART classroom. *TEM Journal*, 10(3), 1404–1417. <https://doi.org/10.18421/TEM103-51>