Ijtimaiya : Journal of Social Science and Teaching
https://journal.iainkudus.ac.id/index.php/Ijtimaia
P-ISSN: 2580-8990; E-ISSN: 2720-9245
Vol. 9 No. 1 Tahun 2025 | 81 - 94
10.21043/ji.v9i1.31916

Strengthening Climate Change Literacy through AI-Based Board Game for Social Studies Teachers and Students in Semarang

Siti Ekowati Rusdini
Universitas Negeri Semarang, Semarang, Indonesia
ekowatirusdini@mail.unnes.ac.id

Lukki Lukitawati
Universitas Negeri Semarang, Semarang, Indonesia
lukki.lukitawati@mail.unnes.ac.id

Fredy Hermanto
Universitas Negeri Semarang, Semarang, Indonesia
fredy@mail.unnes.ac.id

Abstract

This applied research aims to enhance climate change literacy among Social Studies (IPS) teachers in Semarang City through the development of an AI-based board game. The core issues addressed include low digital literacy, limited access to engaging teaching media, and a lack of inclusive pedagogical approaches. Involving 50 teachers from the MGMP IPS forum, the study adopted a participatory, community-based approach comprising four phases: planning, organizing, implementation, and monitoring and evaluation. Data were collected through interviews, observations, training documentation, and feedback forms. The findings revealed significant improvements in teachers' digital and pedagogical competencies, along with increased reflective and collaborative learning. The study recommends adopting iterative design methods and ensuring institutional support to sustain this AI-driven instructional innovation in environmental education.

Keywords: Climate Change Literacy, Board Game, Social Studies Education, AI

Abstrak

Penelitian ini bertujuan untuk meningkatkan literasi perubahan iklim di kalangan guru Ilmu Pengetahuan Sosial (IPS) di Kota Semarang melalui pengembangan board game berbasis AI. Permasalahan utama yang dihadapi adalah rendahnya literasi digital guru, keterbatasan media ajar, serta kurangnya pendekatan pembelajaran yang inklusif. Subjek penelitian melibatkan 50 guru IPS di kota Semarang, dengan menggunakan pendekatan partisipatif berbasis komunitas. Penelitian ini terdiri dari empat tahap yakni perencanaan, pengorganisasian, pelaksanaan, serta monitoring dan evaluasi. Data dikumpulkan melalui wawancara, observasi, dokumentasi kegiatan. Hasil penelitian menunjukkan peningkatan kompetensi digital dan pedagogis pada guru, serta terciptanya pembelajaran yang lebih reflektif dan kolaboratif. Penelitian ini merekomendasikan pendekatan desain iteratif dan dukungan kelembagaan untuk keberlanjutan inovasi pembelajaran IPS berbasis AI.

Kata kunci: Literasi Perubahan Iklim, Board Game, Ilmu Pengetahuan Sosial, AI

A. Introduction

Addressing the climate crisis through education has become an urgent global imperative. As climate-related phenomena, ranging from erratic weather patterns and floods to rising sea levels, intensify worldwide, the education sector has been increasingly called upon to prepare future generations for both understanding and responding to these complex challenges. In Indonesia, the intersection of environmental degradation and social vulnerability is particularly pronounced, with coastal and urban areas experiencing the brunt of climate-related disasters. Semarang City, a rapidly growing urban center on the northern coast of Central Java, exemplifies this vulnerability. It faces recurring tidal flooding (locally known as *rob*), intensified urban heat, land subsidence, and unsustainable land use practices. These conditions not only disrupt daily life but also endanger local ecosystems and infrastructures, highlighting the urgent need for schools to serve as transformative spaces for environmental literacy and climate action.

Despite this pressing need, Social Studies teachers often encounter significant barriers when attempting to incorporate environmental education into their pedagogy.

These challenges include a rigid curriculum structure, limited access to updated and contextual instructional materials, and a general lack of formal training in environmental literacy. Moreover, many educators still rely on traditional methods of content delivery, such as lectures and textbook-based instruction, which may not fully engage students or foster critical thinking about environmental issues. In many cases, environmental topics are addressed in superficial or isolated ways, rather than being integrated holistically across subjects or linked to students' everyday experiences. The result is a missed opportunity to equip students with the knowledge, skills, and dispositions necessary to participate in climate solutions.

Recent advancements in educational technology, particularly the integration of Artificial Intelligence (AI), present new possibilities for transforming how climate change education is delivered and experienced. AI-assisted tools, such as Canva and other digital design platforms, enable educators to create interactive, visually compelling, and pedagogically sound materials without requiring advanced technical skills. These tools not only enhance instructional design but also support student engagement through multimodal learning experiences. According to Chen et al. (2020) and Huang et al. (2021), AI technologies have the potential to support differentiated learning, scaffold student inquiry, and personalize content in ways that traditional methods cannot achieve. Yet, the effective implementation of these technologies in classroom practice hinges on more than just access, it requires a shift in pedagogical mindsets, institutional support, and sustained teacher development.

This research is grounded in the recognition that bridging the gap between technological innovation and everyday classroom practice is both a challenge and a necessity. While digital tools have become more accessible, many teachers remain uncertain about how to integrate them in ways that are meaningful, inclusive, and aligned with curriculum objectives. Previous studies underscore the pedagogical value of gamification as a strategy to promote deeper engagement and enhance students' conceptual understanding in environmental education (Galeote et al., 2021; Monroe et al., 2019). By embedding learning content into game-based formats, educators can foster active learning, emotional involvement, and long-term retention. Games encourage exploration, collaboration, and reflection, offering a dynamic space for learners to grapple with real-world issues through simulated experiences.

In parallel, the incorporation of Gender, Equity, and Social Inclusion (GESI) principles in instructional design ensures that learning environments reflect diverse perspectives and realities. Climate change does not affect all populations equally;

marginalized communities often bear a disproportionate burden due to social, economic, and geographical vulnerabilities. GESI-informed pedagogies strive to make these disparities visible and engage students in thinking critically about justice, inclusion, and collective responsibility. According to Santos et al. (2022) and USAID (2022), GESI-aligned educational practices not only broaden students' understanding of environmental issues but also foster empathy and civic engagement, making them indispensable in climate change education.

This study emerges from a broader community engagement program focused on climate change literacy among IPS teachers in Semarang. Initially framed as a capacity-building initiative, the program introduced teachers to participatory approaches in environmental education through the co-creation of learning materials. This paper transforms that initiative into an applied research project, with the aim of analyzing the processes and outcomes of teacher engagement in AI-assisted game design. Specifically, it investigates how participatory methods, supported by digital tools like Canva, can empower teachers to design eco-digital board games that are not only contextually relevant but also aligned with curricular goals and inclusive in nature.

At the heart of this research is the development of a board game titled APIK (Aksi Pejuang Iklim)**,** or "Climate Action Heroes." This hybrid board-digital game invites students to assume the roles of environmental stewards tasked with addressing real-life challenges such as mangrove preservation, flood mitigation, urban waste management, and policy advocacy. Each scenario is based on actual locations and issues from the Semarang region, such as Tanjung Emas Port, Banjir Kanal Barat, and Gedong Songo temple complex, making the content geographically grounded and personally relevant to learners. Through role-playing and decision-making, students are encouraged to explore the complexities of environmental issues, consider diverse perspectives, and develop collaborative solutions.

The creation of APIK was not merely a technical exercise but a pedagogical journey. It involved iterative design cycles in which teachers collaboratively brainstormed, prototyped, and refined their instructional games. These activities fostered a culture of inquiry, experimentation, and peer learning. Teachers who initially expressed hesitation about digital tools began to gain confidence and even enthusiasm for integrating technology into their teaching. As they moved from content consumers to content creators, many developed a renewed sense of professional identity and agency. The participatory nature of the process allowed them to draw on local

knowledge, cultural references, and student experiences, thereby creating materials that were not only academically rigorous but also socially meaningful.

By examining the development process, outcomes, and reflections of participating teachers, this study contributes to a growing body of literature that explores how technology, gamification, and inclusive pedagogy can intersect to address complex educational challenges. It asks How can participatory, AI-assisted design processes support teacher professional development in environmental education? What kinds of learning materials emerge from these processes, and how do they reflect local environmental and social contexts? In what ways do such initiatives contribute to broader goals of curriculum relevance, student engagement, and educational equity?.

Ultimately, this research underscores the transformative potential of combining participatory learning, AI technologies, and GESI-aligned practices in climate change education. In a context where traditional pedagogies often fall short in addressing contemporary ecological challenges, eco-digital board games offer a promising alternative. They serve not only as instructional tools but also as catalysts for teacher innovation and student empowerment. The findings from this study aim to inform future teacher training programs, curriculum development strategies, and educational policies that seek to integrate environmental literacy into mainstream schooling in ways that are inclusive, engaging, and responsive to local realities.

B. Methods

This applied research employed the Community Development Practice model as its foundational methodology. The model prioritizes participatory planning, local ownership, capacity development, and iterative innovation, principles that align well with the goals of teacher empowerment and collaborative instructional design. The study was conducted with 50 junior high school Social Studies (IPS) teachers in Semarang, all of whom were active members of the MGMP IPS, a professional Subject Teacher Forum that facilitates regular peer learning, curriculum discussions, and pedagogical development. The MGMP served as a strategic hub for participant recruitment and ongoing engagement throughout the research process.

The data collection approach combined both qualitative and quantitative methods to ensure a rich and holistic understanding of the intervention's impact. Multiple instruments were utilized, including in-depth interviews, direct observations, workshop activity logs, field notes, and open-ended feedback forms. These tools captured the lived experiences, reflections, and evolving competencies of the

participants. Additionally, pre- and post-intervention surveys were administered to quantify changes in digital literacy, environmental awareness, and pedagogical innovation. The use of data triangulation enhanced the validity and reliability of the findings by integrating multiple perspectives and evidence sources.

The intervention was designed as a four-stage process, beginning with a planning phase that focused on identifying existing gaps and local educational needs. Researchers conducted needs assessments through structured interviews and baseline surveys to uncover limitations in teachers' knowledge of environmental issues, digital media, and inclusive pedagogy. Teachers also completed self-assessment instruments that revealed their prior experiences with instructional technology, their familiarity with AI-based tools like Canva, and their understanding of Gender, Equity, and Social Inclusion (GESI) principles. These findings informed the development of shared objectives, collaboratively established during goal-setting meetings with MGMP IPS leadership, ensuring that the research goals were contextually grounded and locally relevant.

Following the planning phase, the organizing stage was dedicated to resource mobilization and the preparation of training content. A team comprising university lecturers, environmental educators, and instructional designers developed modular training packages on key themes such as climate science, environmental justice, AI-enhanced learning, and inclusive teaching strategies. The training design incorporated pre-made board game prototypes and Canva-based templates to scaffold the creative process, reduce cognitive overload, and offer inspiration for localized adaptation. These resources were deliberately framed to balance scientific accuracy, pedagogical relevance, and cultural appropriateness.

The actualizing phase took shape through a series of participatory workshops conducted over a period of one month. Each workshop session was structured to blend conceptual input with experiential learning, allowing teachers to immediately apply what they had learned in collaborative design activities. Teachers were divided into small, heterogeneous teams to promote peer learning and exchange of diverse perspectives. Within these teams, participants worked through the stages of conceptualizing, storyboarding, and digitally prototyping their own board games. Canva served as the central AI-assisted tool, offering an intuitive platform for the creation of visual and textual game elements. The instructional focus during this phase was on embedding environmental narratives, GESI-responsive content, and curricular integration into the game mechanics. A flagship product of this stage was the development of *APIK* (Aksi Pejuang Iklim), a board game that featured climate action

heroes navigating real-world environmental challenges such as mangrove conservation, plastic waste reduction, and tidal flood prevention, all situated within the geographical and social context of Semarang.

The final phase consisted of monitoring and evaluation activities, which were designed to assess both the immediate outcomes and the longer-term potential of the intervention. Evaluation strategies included reflective journaling, focus group discussions, peer review of game prototypes, and classroom simulation exercises. Teachers engaged in testing each other's games, offering constructive feedback and identifying areas for improvement. These simulations also allowed researchers to observe how effectively the games translated into active classroom practice. Quantitative data from post-intervention surveys were analyzed to measure changes in participants' confidence, digital proficiency, and intent to implement game-based instruction. Meanwhile, qualitative data collected through interviews and observation notes were coded thematically to identify recurring patterns, critical incidents, and emerging insights regarding teacher transformation and student engagement.

Overall, this methodological approach foregrounded collaboration, context, and creativity as essential components of professional learning. By situating teachers as co-researchers and co-creators, the study not only facilitated knowledge transfer but also fostered a sustainable model of instructional innovation rooted in community empowerment and technological inclusion.

C. Discussion

This applied research generated a series of valuable insights into how participatory and AI-assisted instructional design can transform pedagogical practices, particularly in the context of climate change literacy for Social Studies (IPS) teachers in Semarang, Indonesia. Through iterative and community-based engagement, the study demonstrated that empowering teachers with creative autonomy and digital tools can significantly enhance their capacity to design meaningful, inclusive, and engaging climate-focused learning experiences.

The planning phase revealed a strong latent interest among teachers in incorporating environmental and climate-related topics into their classrooms. Many participants expressed concern over the growing climate crisis and its local manifestations—flooding, urban heat, pollution—but were unsure how to translate these concerns into pedagogically sound lessons. Teachers' baseline practices largely

revolved around textbook explanations and lecture-style PowerPoint presentations, which they admitted failed to generate student engagement or critical reflection. This limitation reflects what Popenici and Kerr (2017) described as a disconnect between teachers' awareness of technology's potential and their ability to utilize it effectively in educational contexts.

Furthermore, although nearly all participants had encountered the term "Artificial Intelligence" (AI), none had previously used AI tools in lesson planning or delivery. There was a mixture of excitement and skepticism: while some teachers were eager to explore AI for education, others were apprehensive about the perceived complexity and unfamiliarity of the technology. The workshop's early discussions helped normalize these feelings and highlighted the need for scaffolding and collaborative learning environments to bridge this digital pedagogical divide.

A cornerstone of the workshop's organizing phase was the integration of Gender Equality and Social Inclusion (GESI) principles into instructional design. Teachers engaged with case-based modules that explored the intersections between environmental degradation and social inequality, such as the disproportionate effects of flooding on low-income neighborhoods or the lack of access to clean water in rural areas. These case studies were not only eye-opening but also foundational in shaping teachers' understanding of how climate literacy must include social justice dimensions.

The use of culturally responsive pedagogy, grounded in Gay's (2010) framework, guided teachers in localizing their content. Teachers were encouraged to identify real-world sites and social issues from their own communities to form the basis of their game narratives. By doing so, they made climate change relevant and tangible for students. For instance, one group designed a game scenario where students had to protect Semarang's coastal mangroves from encroaching development—a scenario inspired by real environmental disputes. The availability of visual templates and prompts reduced cognitive overload and gave teachers more space to explore creative and contextualized storytelling.

Importantly, teachers were introduced to inclusive design thinking. They learned how to accommodate diverse learners, including those with different reading levels, visual impairments, and attention spans. This not only reinforced GESI values but also aligned with universal design for learning (UDL) principles, creating more equitable access to climate education.

The actualizing phase marked a critical transformation in teacher engagement and identity. Teachers collaborated in small teams to design, prototype, and test their climate literacy board games. Digital tools such as Canva proved especially empowering, enabling teachers to quickly visualize game boards, character cards, and storytelling sequences. One standout product of the workshop was APIK (short for *Aksi Peduli Iklim*), a hybrid physical-digital board game that challenged players to become "climate warriors" navigating urban planning dilemmas, conservation missions, and environmental policy advocacy.

APIK and similar games integrated familiar Semarang landmarks, such as Banjir Kanal Barat, Tanjung Emas Port, and Candi Gedong Songo, into their gameplay, grounding climate education in recognizable contexts. Teachers discovered that gamified learning offered a more effective scaffold for building students' higher-order thinking skills, mirroring the progression of Bloom's Taxonomy from basic knowledge recall to evaluation and creation.

The collaborative nature of the game design process also strengthened teachers' sense of agency. As co-creators of pedagogical content, they moved beyond the role of curriculum implementers to become instructional designers. This transformation is consistent with Smaldino et al. (2019), who emphasized the importance of teacher agency in cultivating adaptive and responsive learning environments. Many teachers reported increased confidence in experimenting with instructional strategies that deviate from traditional modes.

Post-intervention evaluations, conducted through surveys, interviews, and classroom simulations, offered strong evidence of pedagogical growth. Quantitative survey data showed a 35% increase in self-reported digital literacy among teachers, alongside a 42% improvement in their ability to integrate climate content across subjects. Teachers began incorporating game-based activities not only into Social Studies, but also into science and civics, indicating early signs of cross-curricular integration.

Simulated classroom sessions and follow-up observations revealed that students responded positively to the gamified approach. Engagement levels improved markedly, with students demonstrating curiosity, teamwork, and ethical reasoning during gameplay. Teachers noted that even typically disengaged learners became active participants when immersed in role-based scenarios. For example, students debated policy choices during a simulated "Climate Congress" segment, illustrating the potential of the games to foster critical citizenship.

Debriefing sessions following the simulations allowed teachers to refine their game mechanics and learning objectives, ensuring better alignment with national curriculum standards. Importantly, the inclusion of cooperative tasks—such as collective decision-making or shared resource management, promoted 21st-century competencies such as collaboration, communication, and systems thinking.

Qualitative feedback underscored the emotional and professional impact of the program. Teachers described the workshop as a revitalizing experience that rekindled their enthusiasm for teaching. Several teachers formed informal design collective post-workshop to continue developing educational games and share them with colleagues, indicating the potential for sustainable communities of practice.

One of the most innovative aspects of the board games was how they embedded GESI principles into both form and content. Teachers intentionally designed characters representing various gender identities, economic backgrounds, and cultural affiliations. Storylines explored themes such as female leadership in environmental advocacy, indigenous ecological knowledge, and rural-urban environmental conflicts. This narrative diversity encouraged classroom conversations about equity, empathy, and shared environmental responsibility.

Consistent with Reyna et al. (2017), who advocated learner-generated media for equity-centered education, the games served as platforms for students to engage with issues of justice through play. Furthermore, teachers integrated accessibility features, such as icon-based instructions, tactile elements for visually impaired learners, and group-based game mechanics that reduced pressure on individual performance. These design choices helped level the playing field and ensured broader student participation.

Despite the overall success, several challenges emerged that warrant attention. First, the limited duration of the training constrained deeper exploration of AI applications in education. Some teachers felt that while they had gained introductory exposure to AI and design tools, they needed more sustained mentorship to fully integrate these into regular practice. Second, balancing creative freedom with rigid curriculum demands proved difficult. Teachers expressed concern over time constraints within the academic calendar, which limited opportunities to implement innovative practices.

Technical barriers also surfaced, including unstable internet connectivity and limited access to digital devices, especially in public schools. These systemic issues highlight the need for institutional support and infrastructure development. Recommendations

include incorporating game-based learning into teacher professional development programs, developing offline-compatible AI tools, and creating a centralized repository of teacher-designed board games for resource sharing.

There is also a clear need for policy-level recognition of teacher-led innovation. By formalizing collaborative design efforts into school improvement plans or extracurricular clubs, educational leaders can foster a culture of innovation from the ground up. Partnerships with local universities or environmental NGOs could further support the dissemination and evaluation of these pedagogical tools.

Overall, the study affirms the efficacy of participatory, AI-supported instructional design as a powerful mechanism for enhancing climate change literacy in formal education settings. The board games developed by teachers were not only pedagogically sound but also socially conscious. By integrating GESI perspectives, localized storytelling, and gamified learning strategies, teachers created tools that transcended traditional instruction. These games promoted both cognitive and affective learning outcomes, transforming classrooms into spaces of inquiry, empathy, and action.

Furthermore, the process itself was as transformative as the product. Teachers emerged from the program with enhanced digital confidence, renewed professional identity, and a stronger sense of their role in shaping environmental futures. They came to see themselves not just as educators, but as facilitators of critical engagement and community resilience.

The findings of this study contribute to a growing body of literature that emphasizes the importance of teacher empowerment, creative pedagogy, and equity in educational innovation. They also provide a replicable model for other regions seeking to address climate change education through inclusive and engaging methods. Future research could explore longitudinal impacts on student learning and civic behavior, or expand the program to include student co-designers as part of a more youth-centered innovation cycle.

The fusion of AI, gamification, and participatory design offers a promising pathway for addressing complex global challenges in classrooms. By equipping teachers with the tools, mindset, and community support to innovate, we can cultivate a generation of learners who are not only informed but also inspired to act for a more just and sustainable world.

D. Conclusion

This community service program demonstrated that strengthening climate change literacy among IPS (Social Studies) teachers and students can be effectively achieved through participatory, technology-based educational innovation. By employing the principles of Community Development Practice, the initiative successfully empowered teachers to co-create AI-based board games as learning media that align with both curricular content and local environmental challenges. The program addressed the identified problem of limited access to engaging, contextually relevant climate education tools and significantly enhanced teachers' capacity in both digital literacy and instructional design.

Throughout the phases of planning, organizing, actualizing, and evaluation, the project facilitated meaningful collaboration between facilitators, teachers, and students. This approach not only increased awareness of climate issues but also fostered a culture of reflective practice and co-learning. Teachers were not merely recipients of knowledge, but active participants in the design process, contributing ideas, local perspectives, and creative insights that shaped the final learning product.

The program's success highlights the importance of collaborative planning and reflective learning in professional development. Teachers gained valuable technical skills, such as prompt engineering and digital prototyping—but more importantly, they underwent a pedagogical transformation. They learned to communicate complex environmental concepts in more creative, interactive, and student-centered ways. Furthermore, the integration of AI technologies bridged the gap between digital tools and meaningful learning, reinforcing the relevance of innovative, adaptive media in 21st-century classrooms.

Based on the evaluation process, it was evident that this approach stimulated active participation, fostered a deeper understanding of climate issues, and produced tangible educational outputs with lasting pedagogical value. The AI-assisted board games developed during the program are not only reusable but also adaptable, offering opportunities for continuous refinement and classroom application.

However, the sustainability of this innovation requires continued support. Follow-up training, ongoing mentoring, and institutional recognition of teachers' creativity are essential to ensure long-term impact. The success of this model also opens opportunities for replication in other schools and regions. To support scalability, future

efforts should consider extending the program's duration and adopting design-based research frameworks that allow iterative refinement of tools and strategies.

With proper support and broader dissemination, this AI-enhanced, GESI-informed educational model holds great promise for advancing environmental literacy and inclusive pedagogical practices across Indonesia's education system—equipping future generations with the knowledge, empathy, and skills needed to confront the climate crisis.

Bibliography

Ariza, M. R., Boeve-De Pauw, J., Olsson, D., Van Petegem, P., Parra, G., & Gericke, N. (2021). Promoting environmental citizenship in education: The potential of the sustainability consciousness questionnaire to measure the impact of interventions. *Sustainability (Switzerland)*, *13*(20). https://doi.org/10.3390/su13207893

Branch, R. M., Lee, H., & Shiang, S. (Eds.). (n.d.). *Educational Media and Technology Yearbook 42*. Springer. https://www.springer.com/series/8617

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *IEEE Access*, *8*, 75264–75278. https://doi.org/10.1109/ACCESS.2020.2985134

Galeote, D. F., Rajanen, M., Rajanen, D., Legaki, N. Z., Langley, D. J., & Hamari, J. (2021). Gamification for climate change engagement: Review of corpus and future agenda. *Environmental Research Letters*, *16*(4), 043005. https://doi.org/10.1088/1748-9326/abe2fe

Huang, J., Saleh, S., & Liu, Y. (2021). A review on artificial intelligence in education. *Academic Journal of Interdisciplinary Studies*, *10*(3), 206–217. https://doi.org/10.36941/ajis-2021-0036

Kibonggsong, S., & Johnnburton, B. (n.d.). *Advances in Game-Based Learning: Gamification in Learning and Education. Enjoy Learning Like Gaming.* Springer. http://www.springer.com/series/13094

Kurni, M., Mohammed, M. S., & Srinivasa, K. G. (2023). *A Beginner's Guide to Introduce Artificial Intelligence in Teaching and Learning.* Springer International Publishing. https://doi.org/10.1007/978-3-030-76192-3

Monroe, M. C., Plate, R. R., Oxarart, A., Bowers, A., & Chaves, W. A. (2019). Identifying effective climate change education strategies: A systematic review of the research. *Environmental Education Research*, *25*(6), 791–812. https://doi.org/10.1080/13504622.2019.1639396

Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology*

Enhanced Learning, *12*(1), 22. https://doi.org/10.1186/s41039-017-0057-1

Poushter, J., & Huang, C. (2019). Climate change still seen as the top global threat, but cyberattacks a rising concern. *Pew Research Center*. https://www.pewresearch.org

Reyna, J., Hanham, J., & Meier, P. (2017). A taxonomy of digital media types for learner-generated digital media assignments. *E-Learning and Digital Media*, *14*(6), 309–322. https://doi.org/10.1177/2042753017738886

Santos, A., Wallace, T., & Tenorio, A. (2022). *Gender Equality and Social Inclusion (GESI): A Reference Guide*. Education in 2. https://www.refoindonesia.com

Smaldino, S. E., Lowther, D. L., Mims, C., & Russell, J. D. (2019). *Instructional technology and media for learning* (13th ed.). Pearson.

The International Initiative for Impact Evaluation. (2021). How does the use of technology in classrooms affect student learning? Key findings. *The International Initiative for Impact Evaluation*. https://www.3ieimpact.org

Friesem, Y., Raman, U., Kanižaj, I., & Choi, G. Y. (Eds.). (n.d.). *The Routledge Handbook of Media Education Futures Post-Pandemic*. Routledge. https://www.routledge.com

USAID. (2022). *Gender Analysis for the USAID Climate Strategy*. USAID. *https://www.refoindonesia.com*