

Designing SDGs-Oriented Digital Materials to Foster 21st Century Learning in the Productive Written Language Skill Course

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ABSTRACT

This study aims to design and evaluate SDG-oriented digital learning materials for the Productive Written Language Skill (PWLS) course in alignment with 21st-century learning principles. Responding to the growing need to integrate global citizenship and sustainability into English language education, the materials embed Sustainable Development Goals (SDGs) within argumentative writing tasks. A research and development (R&D) approach (Branch, 2010) was employed, involving expert validation, student testing, and classroom observation. Two subject-matter experts assessed the materials and rated them as very good ($M = 4.0$) in terms of relevance, clarity, and integration of SDG content. Thirty students from the English Education Study Program at Universitas Negeri Medan participated in the implementation stage. Their feedback indicated strong engagement and perceived usefulness ($M = 4.16$), while pre- and post-test results showed significant improvement in writing performance—from 65.30 to 76.40. Observational data confirmed high student participation and timely task completion, with only minor navigation issues. Overall, the SDG-oriented digital modules effectively supported language development, critical thinking, and 21st-century competencies. The findings imply that SDG-oriented digital materials can effectively foster students' critical thinking and writing competence in the Productive Written Language Skill course, supporting the goals of 21st-century learning.

Keywords: Writing, teaching material, digital, flipbook, SDGs

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INTRODUCTION

The demands of 21st-century education necessitate a paradigm shift in learning design, emphasizing competencies that prepare students to meet global challenges in an increasingly interconnected and digitalized world. Central to this transformation are the “4Cs” of 21st-century learning-critical

thinking, communication, collaboration, and creativity, which are essential for cultivating adaptive and innovative individuals capable of solving complex problems (Trilling & Fadel, 2009). In response, higher education institutions are increasingly adopting the Outcome-Based Education (OBE) framework to ensure measurable, competency-driven learning outcomes (Manickam, 2025; Novrizal & Muhammad, 2025).

In Indonesia, the OBE model is gaining prominence as universities aim to improve graduate readiness and 21st-century skills. Mansyur et al., (2025) highlight the importance of optimizing lecturers' understanding of OBE and integrating the four core literacies - human, language, data, and digital - into instructional practices. These competencies align with the national *Merdeka Belajar Kampus Merdeka* (MBKM) initiative, which advocates for flexible, technology-driven, and contextually relevant education (Hidayat & Mutiara, 2023).

At Universitas Negeri Medan (UNIMED), the English Education Study Program operationalizes these goals through courses such as Productive Written Language Skill (PWLS), designed to develop analytical and globally responsive writing proficiency. Beyond linguistic accuracy and structural coherence, the PWLS course emphasizes higher-order thinking, evidence-based argumentation, and critical engagement with social issues (Hyland, 2003; Graham & Perin, 2007; Kellogg & Raulerson, 2007). Its Course Learning Outcomes (CLOs) focus on constructing clear sentences, developing coherent paragraphs, and producing argumentative essays supported by credible evidence - outcomes consistent with OBE principles (Manickam, 2025; Novrizal & Muhammad, 2025).

In the digital era, writing has evolved into a multidimensional skill that facilitates reasoning, reflection, and problem-solving (Yancey, 2009). Academic writing also serves as a means for students to engage with global issues and contribute to sustainable development discourse. The integration of the United Nations' Sustainable Development Goals (SDGs) (UN, 2015) into language education encourages students to connect communication skills with social responsibility (Wahyuni, 2017; (Emidar et al., 2023; Tareze et al., 2022) Embedding SDG concepts in writing instruction has been found to promote critical thinking, ethical awareness, and solution-oriented reasoning, core aspects of 21st-century competencies.

However, preliminary observations in the PWLS course at UNIMED reveal persistent challenges: about 65% of students struggle to construct evidence-based arguments, and 35% report the need for more structured and relevant learning materials. This highlights a gap between current instructional resources and the integration of global awareness and digital literacy. Prior studies emphasize the value of contextualized and learner-centered writing instruction. Ilham (2023), Sabarun et al., (2018) and Borisova (2015) stress that aligning materials with students' academic and contextual needs enhances engagement and performance. Similarly, Emidar et al. (2023) and Sundari et al. (2018) show that digital and task-based learning approaches can significantly improve motivation, participation, and cognitive development.

Digital technologies offer transformative potential in writing instruction by enabling autonomous, interactive, and multimodal learning experiences enriched with immediate feedback and authentic tasks (Ramdhani et al., 2024; Wijaya et al., 2023). Recent research demonstrates that digital materials can improve writing performance and engagement: Waluyo et al. (2024) found flipbook-based materials effective for EFL learners, and Dari et al. (2025) showed that module-based materials enhance writing skills and learner autonomy.

Nevertheless, the adoption of SDG-oriented digital materials in English writing courses remains limited (Wulandari et al., 2019). Risnawaty et al., (2021) and Fitrianto (2024) observed

that many existing materials lack contextual relevance and fail to address contemporary global challenges. While prior research has explored digital pedagogy and OBE curricula separately (Manickam, 2025; Mansyur et al., 2025; (Novrizal & Muhammad, 2025), few studies combine these frameworks in academic writing instruction with an explicit focus on SDGs, critical thinking, and 21st-century competencies. To address this gap, the present study focuses on designing and evaluating SDG-oriented digital learning materials for the Productive Written Language Skill course at UNIMED. The study aims to enhance students' academic writing proficiency, critical thinking, and global engagement, contributing to the advancement of writing instruction that is linguistically rigorous, socially relevant, and aligned with 21st-century educational priorities.

METHOD

This research utilized a Research and Development (R&D) framework as outlined by Branch (2010), employing the ADDIE model, which includes five sequential phases: Analysis, Design, Development, Implementation, and Evaluation. The model was selected to facilitate the structured creation and validation of SDGs-oriented digital learning materials designed to strengthen academic writing proficiency and 21st-century competencies, particularly critical thinking skills. The study was carried out in the English Education Study Program at Universitas Negeri Medan during the even semester of the 2024–2025 academic year.

The participants in this research were students enrolled in the Productive Written Language Skills course. A purposive sampling technique was employed to select 30 students who were actively taking the course. Additionally, two academic writing lecturers and two experts in English education and curriculum design participated in the process by offering content validation and pedagogical input throughout the development and evaluation phases.

The research instruments comprised interviews, questionnaires, and writing assessments. Semi-structured interviews were held with five students, two lecturers, and two experts to explore learning needs, assess usability, and collect qualitative feedback after implementation. Each session lasted approximately 20–30 minutes and was conducted in Bahasa Indonesia to ensure clarity and comfort for participants. All interview data were audio-recorded, transcribed, and analyzed thematically. Following the implementation, questionnaires were distributed to all 30 students to gauge their perceptions of effectiveness, engagement, and usability of the developed materials. Responses were collected using a five-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

To measure students' writing performance, pre-tests and post-tests were administered, requiring participants to produce a 250–300-word argumentative essay on SDG-related issues such as climate action or gender equality. Each writing test was conducted under supervised classroom conditions within a 60-minute time limit to maintain consistency. The essays were evaluated using an analytic scoring rubric focusing on organization, coherence, evidence use, grammar accuracy, and critical reasoning.

In addition, classroom observations were conducted during the implementation phase to monitor student engagement, interaction with the digital modules, and technical usability. Observations took place over three class meetings, each lasting 100 minutes, with field notes focusing on student participation, task completion, and any navigation issues encountered. These observations provided qualitative insights into how students interacted with the SDG-oriented digital materials and helped identify areas for improving module design and instructional support.

The research procedure followed the five stages of the ADDIE model. In the Analysis stage, needs analysis was conducted through interviews, questionnaires, and observations involving students, lecturers, and experts. Existing instructional materials were reviewed to identify gaps and determine the need for new digital materials aligned with SDGs and academic writing skills. In the Design stage, the structure and content of the digital modules were developed based on the findings from the analysis. These modules included global issues such as climate change, poverty, and inequality, presented in interactive formats with multimedia elements like videos and infographics to stimulate students' engagement and critical thinking. Each module concluded with writing assignments that required students to formulate arguments based on provided information.

During the development phase, the digital learning content was designed and produced through the use of interactive authoring platforms. Collaboration with discipline experts ensured that each component aligned with the curriculum goals, maintained instructional coherence, and reflected accurate subject matter. Prior to full implementation, a preliminary usability trial was undertaken to confirm the clarity, technical functionality, and learnability of the materials.

In the implementation phase, the completed modules were piloted among a targeted group of learners. Before engaging with the materials, participants were given a brief orientation session explaining how to access, navigate, and interact with the digital content. During this period, information was collected using survey instruments, guided interviews, and in-class observations to evaluate how effectively the materials facilitated learning processes and stimulated student engagement.

The evaluation phase focused on a comprehensive review and interpretation of collected evidence to determine the extent to which the developed resources enhanced academic writing proficiency and promoted critical thinking growth. Findings from this analysis highlighted the advantages and limitations of the instructional design and informed a series of recommendations for further refinement.

Quantitative evidence obtained from student questionnaires and writing assessments was processed using basic statistical measures such as mean scores and percentage distributions. The comparison between initial and final test performances was employed to assess measurable progress in writing ability. Meanwhile, qualitative insights drawn from interviews and observational records were subjected to thematic analysis to uncover patterns of perception and response regarding the effectiveness and user-friendliness of the digital modules. To reinforce the credibility of results, data triangulation was applied alongside expert review of the instruments and participant validation during feedback sessions. Consistency was maintained through a pilot procedure conducted prior to the main study and the uniform application of analytic rubrics when evaluating writing performance.

Despite these contributions, certain constraints were identified. The use of purposive sampling confines the representativeness of the results to similar populations. Moreover, conducting the project within a single academic institution limits its contextual transferability. The relatively brief intervention period may also have prevented observation of long-term learning effects. Even so, this research provides a practical and adaptable approach to embedding SDG principles in digital academic writing pedagogy, offering a model framework that can be replicated and adapted for curricular enhancement in future studies.

FINDINGS

Content validation by experts

To ensure the quality and relevance of the SDGs-based digital learning materials developed in this study, two subject-matter experts (lecturers in English education and curriculum development) conducted a validation process. The evaluation used a structured rubric covering seven key aspects, each rated on a 5-point Likert scale (1 = Very Poor, 5 = Excellent).

TABLE 1. Content Validation

No.	Validation Aspect	Validator 1	Validator 2	Mean	Interpretation
1	Relevance to PWLS learning objectives	4	4	4.0	Very Good
2	Integration of SDG content	5	4	4.5	Very Good
3	Clarity of instructions	4	4	4.0	Very Good
4	Stimulation of critical thinking	4	4	4.0	Very Good
5	Use of multimedia elements (videos, visuals)	4	4	4.0	Very Good
6	Visual and interface design	3	4	3.5	Good
7	Alignment with 21st-century competencies	4	4	4.0	Very Good
	Average			4.0	Very Good

The validation results indicate that the overall quality of the digital learning materials is classified as Very Good, with an average score of 4.0. The following key findings were derived:

- 1) The relevance of the materials to PWLS learning objectives (Aspect 1) scored 4 from both validators, confirming that the content appropriately supports the course’s core focus, namely, students' ability to produce critical and structured academic writing.
- 2) The integration of SDG content (Aspect 2) received the highest average (4.5), showing that global issues, such as climate change, poverty, and social equity, have been effectively embedded into the writing activities in a meaningful and contextualized way.
- 3) Clarity of instructions (Aspect 3) and the ability to stimulate critical thinking (Aspect 4) were also rated Very Good, suggesting that the digital modules provide clear guidance while promoting higher-order thinking among students.
- 4) The use of multimedia elements (Aspect 5), including visuals and videos, received strong ratings, supporting the idea that these tools help enhance student engagement and comprehension.
- 5) The visual and interface design (Aspect 6) received a slightly lower average score (3.5 – Good), indicating that although the modules are generally well-structured, there is room for improvement in terms of visual appeal, layout consistency, or user-friendliness.
- 6) Finally, the materials’ alignment with 21st-century competencies (Aspect 7), including critical thinking, communication, collaboration, and creativity, was also rated Very Good.

Based on the expert validation, the SDGs-based digital materials are considered very suitable for use in the PWLS course. While the content effectively supports academic writing and integrates relevant global issues, minor enhancements are recommended, particularly in improving interface aesthetics and interactivity. These results confirm that the materials can meaningfully contribute to both language skill development and students’ global awareness.

Student feedback on the digital modules

To evaluate students’ perceptions of the SDG-integrated digital learning modules, a survey instrument was distributed to 30 participants from the Productive Written Language Skills (PWLS) course within the English Education Study Program at Universitas Negeri Medan. The questionnaire consisted of ten items, each measured on a five-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree).

TABLE 2. Student Feedback on SDGs-Based Digital Learning Modules in the PWLS Course

No.	Statement	Mean	Interpretation
1	The content supports the PWLS course goals	4.10	Very Good
2	SDG topics helped me think more critically	4.30	Very Good
3	The instructions in the modules were clear	4.03	Very Good
4	The writing tasks encouraged reflection and argumentation	4.27	Very Good
5	The modules increased my awareness of global issues	4.35	Very Good
6	The digital design was easy to navigate	3.97	Good
7	Multimedia helped me understand the context of the writing tasks	4.13	Very Good
8	I feel more confident in writing arguments after using the materials	4.23	Very Good
9	I can now organize ideas more clearly in my writing	4.20	Very Good
10	I prefer digital modules for writing practice over printed textbooks	4.00	Very Good
Average		4.16	Very Good

The overall average score of 4.16 falls within the *Very Good* category, indicating a strong positive response from students toward the developed digital learning materials. Several key insights are outlined below:

- 1) The highest mean score (4.35) was achieved by the statement “*The modules increased my awareness of global issues*” (Item 5). This suggests that the integration of SDG content into writing activities was highly effective in promoting students’ global perspectives - one of the intended goals of the module design.
- 2) Students also responded favorably to how the materials stimulated critical thinking (Item 2, Mean = 4.30) and encouraged argumentation and reflection (Item 4, Mean = 4.27). These aspects are central to the development of 21st-century competencies and confirm that the learning materials successfully fostered higher-order thinking.
- 3) In terms of writing performance, students reported increased confidence in writing arguments (Item 8, Mean = 4.23) and improved ability to organize ideas clearly (Item 9, Mean = 4.20), showing that the modules had a positive impact on essential academic writing skills.
- 4) Usability and design were rated positively, though slightly lower than content-focused items. For instance, “*The digital design was easy to navigate*” received a score of 3.97, which, while still in the *Good* category, indicates that further improvements could be made to enhance user experience and interactivity.
- 5) The preference for digital learning formats over traditional printed materials (Item 10, Mean = 4.00) suggests that students appreciate the flexibility and engagement offered by the interactive modules.

The results confirm that students perceive the SDGs-based digital modules as relevant, engaging, and effective for developing writing skills in the PWLS course. The materials not only support academic skill development but also contribute to building global awareness and critical

thinking, aligned with the goals of 21st-century education. While most aspects were rated very positively, minor enhancements in digital design and navigation could further improve the learning experience.

Pre-test and post-test writing scores

To evaluate the effectiveness of the SDGs-based digital learning materials, a writing test was administered to 30 students enrolled in the *Productive Written Language Skills (PWLS)* course before and after the intervention. The test aimed to measure students' ability to produce argumentative texts aligned with the course's learning outcomes, such as clarity of structure, coherence, use of evidence, and critical reasoning. The same rubric was used consistently to ensure objectivity in the scoring process.

TABLE 3. Comparison of Pre-Test and Post-Test Writing Scores of PWLS Students

Test Type	Mean Score	Standard Deviation
Pre-Test	65.30	5.61
Post-Test	76.40	5.08

The results show that the mean score increased by 11.10 points, indicating a notable improvement in students' academic writing performance. The decrease in standard deviation from 5.61 to 5.08 also suggests more consistency in students' writing scores after using the materials. These findings support the effectiveness of the SDGs-based modules in enhancing students' ability to write coherent and evidence-based argumentative texts, in alignment with the course learning outcomes and 21st-century skills.

Classroom observation during implementation of SDGs-based digital modules

Classroom observations conducted during the implementation of the SDGs-based digital learning modules in the *Productive Written Language Skills (PWLS)* course provided valuable qualitative insights into student engagement and learning behaviors. The observations revealed that approximately 85% of the students were actively engaged with the learning content. For example, one student remarked during group work, *"I didn't realize climate change affects our daily life until we analyzed this topic in writing,"* while another noted, *"I like how I can organize my argument clearly with the examples from the module."* Most students were able to complete their writing tasks on time and work independently, suggesting that the digital materials were accessible, appropriately scaffolded, and aligned with their academic abilities.

Although some students encountered minor navigation challenges - such as difficulty finding specific instructions or accessing multimedia elements - these issues did not significantly interfere with their learning process. One student noted, *"I had to scroll back to find the instructions, but then it was easy to continue"*. In fact, student interest remained high, particularly in SDG topics such as climate action and gender equality, with comments such as, *"I didn't realize gender inequality is still a problem in our city; it gives me ideas for my essay."* These observations indicate that integrating real-world issues into writing tasks not only maintains motivation but also fosters deeper critical thinking and engagement.

Overall, the observations support the effectiveness of the SDGs-based digital modules in promoting active learning and independence. The modules successfully created a learning environment that was both interactive and meaningful, encouraging students to reflect critically on global issues while strengthening their academic writing skills. The minor usability issues observed suggest areas for technical improvement, but do not undermine the overall positive impact of the materials on student learning outcomes.

DISCUSSION

This study set out to investigate the effectiveness of SDGs-based digital learning materials in enhancing students' academic writing, critical thinking, and global awareness within the Productive Written Language Skills (PWLS) course. The findings suggest that the integration of SDG themes into digital modules aligns well with both the pedagogical objectives of the course and the broader goals of 21st-century education, which emphasize critical thinking, creativity, collaboration, and global literacy (Trilling & Fadel, 2009).

The content validation process, conducted by two subject-matter experts, confirmed that the materials developed were of high quality, with an average rating of 4.0 or "Very Good." The strongest aspect, according to the validators, was the integration of Sustainable Development Goals, particularly how global issues like climate change and social justice were embedded meaningfully into writing activities. This is consistent with Wahyuni (2017), who argued that writing tasks centered around global issues help foster both critical thinking and global awareness. Although the visual and interface design received slightly lower scores, the materials were still considered pedagogically sound and suitable for implementation. This finding points to the importance of continuous refinement in digital design to enhance usability and engagement (Branch, 2010).

Feedback from 30 students further confirmed the perceived effectiveness of the digital modules. With an overall average score of 4.16, students rated the materials as "Very Good," particularly in promoting critical thinking and increasing awareness of global issues. These findings align with prior studies highlighting the value of writing instruction that encourages students to think critically and reflect on complex real-world topics (Hyland, 2003). Moreover, students indicated that the modules boosted their confidence and ability to organize ideas more clearly in argumentative writing, reinforcing the idea that authentic and contextualized tasks can improve academic writing outcomes (Graham & Perin, 2007; Kellogg & Raulerson, 2007). The slight decrease in the score related to digital navigation echoes the expert feedback and highlights the need for improved user interface design.

The quantitative improvement in students' writing ability was also evident in the pre-test and post-test results. A mean increase of 11.10 points, coupled with a slight decrease in standard deviation, indicates not only overall improvement but also greater consistency in student performance. This supports the idea that well-structured digital learning materials can serve as effective scaffolding tools in writing instruction (Graham & Perin, 2007). In particular, materials that incorporate global issues and foster critical engagement offer dual benefits: they develop writing competence while also nurturing global citizenship (Emidar et al., 2023).

Classroom observation during module implementation further validated the effectiveness of the materials in promoting active and independent learning. Around 85% of students participated

actively and completed tasks on time, showing strong engagement. This level of involvement can be attributed to the relevancy of SDG topics, such as climate action and gender equality, which appeared to resonate with students' interests and values. According to Tareze et al., (2022), integrating SDGs in classroom instruction enhances social awareness and student motivation. Although some students encountered minor technical challenges, these issues did not significantly hinder learning and serve as useful feedback for future design improvements.

In conclusion, the results suggest that SDGs-based digital learning materials effectively support the development of academic writing skills while fostering essential 21st-century competencies. The combination of expert validation, positive student feedback, significant test score improvement, and observed classroom engagement provides a strong argument for the integration of real-world, socially relevant content in writing instruction. These findings support the broader pedagogical shift toward student-centered and globally conscious learning environments (Trilling & Fadel, 2009; Yancey, 2009). These findings imply that teachers can enhance student motivation, critical thinking, and global awareness by incorporating SDG-oriented digital tasks into their classrooms, using structured guidance and interactive tasks to support independent learning, consistent with prior studies on challenges in teaching writing, paraphrasing skills, and project-based learning approaches in Indonesian contexts (Adam et al., 2021; Akbar, 2020; Paris et al., 2024). Such integration supports a student-centered and socially conscious learning environment, aligns with 21st-century learning goals, and can be adapted across different writing courses. Further research could explore long-term impacts, integration with other language skills, and cross-institutional implementation to broaden the scope and application of these promising instructional strategies.

CONCLUSION

This study concludes that integrating SDGs-based digital learning materials into the Productive Written Language Skills (PWLS) course effectively enhanced students' writing abilities, critical thinking, and global awareness, as reflected in positive student feedback, expert validation, and a significant 11.10-point increase in post-test writing scores. Classroom observations confirmed high engagement, particularly in SDG topics such as climate action and gender equality, although minor navigation and design issues were noted. Limitations include the small sample size, single-institution context, and short implementation period, which may affect generalizability and long-term impact. These findings imply that teachers can use SDG-oriented digital tasks to promote student-centered, socially conscious learning environments, fostering both academic skills and 21st-century competencies while integrating real-world, socially relevant topics into writing instruction.

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