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Bilingual E-Magazine: The Development of Digital Teaching Resource on Students' Literacy of Environmental Pollution

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ABSTRAK

Berdasarkan penelitian di ASIA, Indonesia masih berada di posisi terendah dalam hal literasi. Selain itu, minat siswa untuk menggunakan dan mengeksplorasi bahan ajar konvensional juga masih rendah. Salah satu materi yang diberikan dalam setiap jenjang pendidikan sekarang adalah PLH atau Pendidikan Lingkungan Hidup. Kepedulian pemerintah terhadap pendidikan lingkungan hidup harus didukung dengan tersedianya media pengajaran yang tepat dan interaktif; oleh karena itu, penelitian ini bertujuan untuk mengembangkan dan menghasilkan media pengajaran digital untuk mata kuliah dengan topik pencemaran lingkungan dalam rangka meningkatkan literasi siswa dan meningkatkan pemahaman siswa dalam literasi materi polusi lingkungan. Penelitian yang menggunakan desain penelitian dan pengembangan dimulai dengan proses analisis, proses perancangan, proses pengembangan, proses implementasi dan evaluasi. Hasil penelitian berupa E-Magazine yang merupakan salah satu sumber belajar yang berisi materi pembelajaran yang ditampilkan secara menarik dengan fitur yang lebih menarik seperti gambar, video, dan tampilan yang menarik yang telah divalidasi oleh ahli dan dinyatakan layak untuk digunakan. Hasil implementasi dari produk penelitian ini menunjukkan bahwa literasi digital siswa terhadap pencemaran lingkungan meningkat sebanyak 82,11%. Berdasarkan hasil analisis uji pemahaman materi dengan tema pencemaran lingkungan, diperoleh N-gain 0,83 dan termasuk dalam kategori tinggi (g>0,70).

ABSTRACT

Based on research in ASIA, Indonesia is still in the lowest position in the term of literacy. Moreover, the students' interest of using and exploring conventional teaching materials is also still low. One of the materials given in every level of education now is PLH or Environment Education. The government concerns about environment education should be supported by the availability of appropriate and interactive teaching media. Therefore, this study aims to develop and produce digital teaching media for the subject under the topic of environment pollution as well as improving students' literacy and understanding of the subject material in PLH subject. The research employed research and development design started with analysis process, designing process, development process, implementation and evaluation process. The result of the research is E-Magazine as one of the Learning resources that contain learning materials that are displayed attractively with more interesting features such as images, videos, and interesting display. The result of the product's implementation shows that the students' digital literacy of environmental pollution is increased by the score of 82,11%. Based on results analysis of the students' understanding of the environmental pollution for the subject, the N-gain score was 0,83 and it was higher than 0,70 as the standard for high level effectiveness.

1. INTRODUCTION

The rapid advancement of technology in recent decades has reshaped the way we access and disseminate information. In the context of education, digital resources have become invaluable tools, enhancing the learning experience and expanding access to knowledge (Grassini, 2023; Hanik, 2020). This paradigm shift towards digitalization not only empowers students with dynamic learning experiences but also equips educators with versatile tools to facilitate meaningful and impactful teaching in the digital age. One critical aspect of education in the digital age is digital literacy, which includes the ability to navigate, evaluate, and create content online. With the development of the technological age, it is natural that all forms of activities must be oriented towards digitality, where all human activities are carried out with the help of existing technology (Kasinathan et al., 2022; Oke & Fernandes, 2020; Sudarsana et al., 2019). We have entered the era of the Industrial Revolution

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4.0, which is a major change in all areas of life that use digital technology and the internet. The use of the learning environment in teaching and learning can arouse new interests and desires, create motivation and stimulate learning, and have a psychological effect on students.

With rapid technological development, the rate of change is also high. This rapid change often leaves people confused and overwhelmed with information. Many people are unaware of the impact technology has on their daily lives. Technology used for education, communication and entertainment impacts everyone's life in different ways (Ibrahem & Alamro, 2020; Oktasari et al., 2020). For example, students use digital devices at school and at home, but lack of digital literacy can cause problems. Literacy is an important thing for students in the 21st century, not only in all fields, but also in real life. Furthermore, the educators also play important role on utilizing technology as digital resources for teaching activities. Qualified English teachers prepared for digital literacy. They must be technically and pedagogically equipped to use technology and be ready to integrate it into the educational learning process (Maharani et al., 2023; Nardo et al., 2022). Originally, digital literacy included a variety of skills, such as the physical ability to tap and move a mouse, or knowing how to use certain software. Therefore, the definition of digital competence is different. Many scholars have come to view digital literacy within the framework of multiliteracy. Literacy is recognized in many different forms other than written language, and that each of these literacies has its own (and sometimes converging) ways of communicating and deciphering meaning (McCord, 2015; Tsaniyah & Juliana, 2019).

Digital literacy is a crucial skill in today's technology-driven world, encompassing the ability to access, evaluate, and utilize information effectively online (Bystrova, 2020; Shidqiyah et al., 2023). In the context of the Merdeka Curriculum, which focuses on fostering well-rounded and empowered individuals in Indonesia, digital literacy plays a pivotal role. As the curriculum aims to equip students with 21st-century skills, integrating digital literacy ensures that learners can navigate the digital landscape responsibly. This includes understanding online safety, critically evaluating information, and leveraging digital tools for communication and problem-solving. By intertwining digital literacy with the Merdeka Curriculum, students are better prepared to engage with the modern world and contribute meaningfully to society (Rina et al., 2020; Simarmata & Mayuni, 2023). Merdeka curriculum which is applied in Indonesia's education today emphasizes that learning in the 21st century must include 16 skills that are divided into three parts, namely literacy, competence, and character. This curriculum was developed with the hope that the millennial generation can understand the material or information quickly, not only memorize knowledge, but also know how to use technology in learning.

In Pakuan University, one of the general courses that must be studied is the PLH or Environmental Education course. Environmental Education is a cornerstone of academic curricula that transcends the boundaries of traditional disciplines, offering students a transformative perspective on the intricate relationship between humans and the natural world. In an era marked by escalating environmental challenges, ranging from climate change to biodiversity loss, the significance of Environmental Education courses in college cannot be overstated. These courses equip students with the knowledge, skills, and values necessary to become informed, responsible stewards of the planet, fostering a deep-seated understanding of environmental issues and inspiring a commitment to sustainable practices. As the world grapples with pressing environmental crises, the pursuit of a comprehensive Environmental Education has never been more vital, empowering future generations to address and mitigate these challenges for a more sustainable and harmonious coexistence with the Earth (Karataş & Karataş, 2016; Ramadhan et al., 2019). Environmental pollution is a topic of paramount importance in the field of environmental education. College-level environmental education courses play a vital role in educating students about the various aspects of environmental pollution, its causes, consequences, and potential solutions.

Environment pollution is the contamination of the earth`s environment by human activity. In recent years, several environmental disasters have drawn public attention and raised concerns about how to protect the environment (Siddiqua et al., 2022; Suryawati et al., 2020). Pollution adversely affects people, animals, and the earth itself. The problems caused by pollution are increasing as technology advances and people become more educated. Environmental pollution has been for centuries but just began to remain important following the industrial revolution in the nineteenth century. Contamination occurs when the physical environment will not kill the element without creating harm or damage to itself. The components involved are not created naturally, and the destroying process may change from a couple of times to thousands of years (that is, for example, the argument for radioactive pollutants). Put differently, pollution takes place when world does not learn how to decompose the element that has been taken to it in the artificial manner. Environment pollution is the contamination of the earth`s environment by human activity (Harahap et al., 2021; Wu et al., 2020). Environmental pollution is a pressing global concern that demands immediate attention and action. College-level environment education courses play a crucial role in equipping students with the knowledge and skills needed to address pollution and its consequences. By teaching students about the causes, effects, and solutions of environmental pollution, colleges contribute to the development of environmentally responsible citizens who can actively work towards a cleaner and more sustainable future for our planet. It is imperative that we continue to

prioritize the integration of environmental pollution topics into college-level curricula to foster a generation of environmental stewards.

Environmental pollution is a global crisis that requires informed and proactive citizens to address it effectively. In the era of digitalization, students must be equipped with the skills to find, analyze, and share information on environmental issues. Digital literacy in the context of environmental education encompasses several key aspects; information Retrieval (Students should be proficient in using online search engines, databases, and digital libraries to access credible information about environmental pollution), critical evaluation (they should have the ability to critically assess the reliability and credibility of online sources, distinguishing between accurate and misleading information), data interpretation (digital literacy involves the capability to interpret and visualize environmental data through digital tools and platforms), media literacy (understanding how media portrays environmental issues and recognizing potential biases is essential in forming well-informed opinions), communication skills (the ability to create and share digital content related to environmental pollution promotes awareness and activism) (Menggo, 2022; Mudra, 2020).

In an era defined by the relentless march of technology, the interconnectedness of digital literacy, digital competency, and teaching resources has become more apparent than ever before. As our world becomes increasingly digitized, the ability to navigate this digital landscape has transformed from a mere convenience to an essential life skill (Anthonysamy et al., 2020; Basilotta-Gómez-Pablos et al., 2022). Teaching resources play a pivotal role in nurturing digital literacy. Educators rely on carefully curated materials to introduce students to digital tools, techniques, and best practices. Whether through textbooks, online tutorials, or interactive software. These resources provide learners with the essential building blocks required to navigate the digital landscape. The relationship between digital literacy, digital competency, and teaching resources is symbiotic (Bravo et al., 2021; Nurhidayat et al., 2023). Digital literacy is a prerequisite for effective use of teaching resources, as learners need to possess basic skills to navigate and benefit from digital educational materials. Conversely, teaching resources, in the form of instructional materials and technologies, are essential tools for educators to impart digital literacy and competency to their students. Moreover, the availability of teaching resources directly impacts the accessibility of digital education. Access to high-quality resources can level the playing field, ensuring that learners from diverse backgrounds have equitable opportunities to develop their digital skills in any subjects of teaching (Har et al., 2019; Jalongo, 2021).

In the past, education in Indonesia relied heavily on textual books as learning media. Learning media is part of the teaching and learning process which plays a very important role that can improve the quality of education. Developing the use of learning media can also motivate students to implement the learning process (Diana et al., 2023; Sutrimo et al., 2019). The learning environment can help in learning activities and can be used in learning activities. Learning media is part of the teaching and learning process which plays a very important role in supporting success that can improve the quality of education. Developing the use of learning media can also motivate students for the implementation of the learning process, including in the teaching of environmental education, many use props (Astuti et al., 2022; Muyaroah & Fajartia, 2017). The learning environment can help in learning activities and can be used in learning activities. Today's learning media is designed for mobile devices that are easy to carry around, such as smartphones and tablets. In addition, with digital learning media, students can also easily interpret data, improve understanding and summarize to inform, present data, stimulate motivation and interest in learning, so that students not only listen to the teacher's explanation, but also do more with the help of the learning environment (Ibrahim & Ishartiwi, 2017; Suwartono & Aniuranti, 2019).

In today's digital age, education is undergoing a profound transformation, with educators and students alike embracing technology as an integral part of the learning process. E-magazines, in particular, have emerged as a valuable tool in this context, serving as dynamic and versatile digital teaching materials. E-magazines offer a plethora of benefits, including accessibility, interactivity, and up-to-date content, making them an essential component of modern education (Mcgeown et al., 2016; Zulfarina et al., 2021). In the ever-evolving landscape of knowledge and information, keeping course materials current is a challenge for educators. E-magazines, however, excel in this regard. Many e-magazines are updated regularly, providing access to the most recent developments in various fields. This ensures that students receive the latest information, enhancing the relevance and practicality of their learning. For subjects like science, technology, and current affairs, e-magazines are invaluable as they keep students well-informed about the latest trends and discoveries (Anggraini et al., 2022; Cahyani, 2023).

E-magazine learning resources are one of the breakthroughs in the use of technology to improve the quality of learning in the classroom. E-Magazine as a learning resource can contain learning materials that are presented interestingly with various supporting functions such as images, video and audio. One of the primary advantages of using e-magazines as digital teaching materials is their accessibility and convenience; therefore, the urgency of the development of this e-magazine lies in its potential to enhance learning outcomes, engagement, and accessibility in the digital age (Anggraini et al., 2022; Saraswati et al., 2019). By exploring its

impact on comprehension, the result of the research can contribute valuable insights to educational strategies and technology integration in academic setting. Unlike traditional textbooks or printed materials, e-magazines can be accessed anytime, anywhere, with an internet connection. This accessibility eliminates geographical barriers, allowing students from different locations to access the same educational content. Moreover, e-magazines are typically available on various devices such as computers, tablets, and smartphones, making learning more flexible and adaptable to students' preferences and lifestyles.

The development of this bilingual e-magazine dedicated to enhancing students' digital literacy on the critical issue of environmental pollution represents a significant step forward in our collective efforts to combat this pressing global challenge. The creation of an e-magazine dedicated to enhancing students' digital literacy on environmental pollution is a beacon of hope in the fight against this global crisis. It bridges the gap between knowledge and action, equipping students with the tools they need to become informed, engaged, and proactive advocates for a cleaner, more sustainable future.

2. METHOD

In this study, the researchers employed R&D design. R&D is a research method used to develop or validate products used in education and learning. In addition, R&D is a research method used to produce certain products, and test the effectiveness of those products (Sugiyono, 2013). The research developed was descriptive and in the form of research and development. This research focuses on developing a bilingual electronic magazine using the ADDIE model. The development of electronic magazine has been introduced by various computer software or applications such as, flip maker, canva and and other supporting software and application. Development is carried out at the basic skill level associated with the material of environmental pollution. The developed media was validated by four validators and included media experts, materials experts and two practitioners.

The ADDIE design produces products in the form of developing digital learning media. The first activity carried out in research is to conduct a preliminary study to find out the initial conditions of learning that have been applied by the teacher in analysis step. The instrument used in this step was observation and interview that resulted in the need analysis showing that the media used in the teaching process was a conventional one. The next step is to create a product design in design stage. The instrument in this step was the use of application like canva and assemblr as well as designing the evaluation instruments for the product. Then the researchers carried out product development that has been designed at the product design stage and validated the product by using the evaluations instruments. In addition, in this research also carried out product revision and validation by a team of experts before being tested. After the product is declared valid by the validators, then the product is implemented in the learning process. In this step, the data gained was the students' responses toward the implementation of the e-magazine in the teaching and learning process. The last step at the ADDIE model stage is evaluation, namely by providing instruments about product assessment to teachers and students. In this step, the product was implemented in experimental class and the quantitative data was gained from pre test and post test. The formula employed to get the information of the effectiveness was N-gain formula. Normalized gain is the ratio of the class's pretest-posttest gain score to the maximum possible gain obtained. The normalized high and low gain (N-gain) can be classified as follows: (1) if $g>0.7$, then the resulting N-gain belongs to the high category; (2) if $0.3 \leq g \leq 0.7$, then the resulting N-gain is in the medium category, and (3) if $g<0.3$ then the resulting N-gain is in the low category. Here is the framework of implementing ADDIE procedure in the study as show in Figure 1.

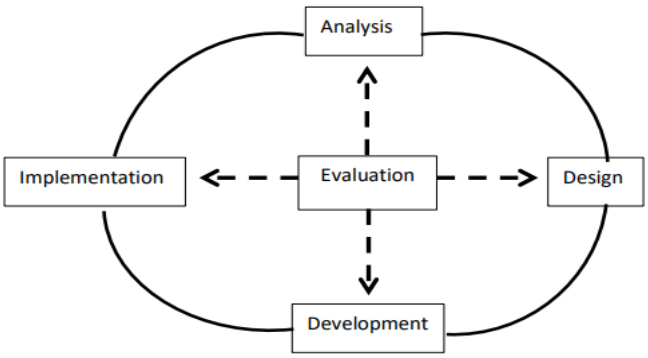

Figure 1. ADDIE Research Procedure

Data analysis in this study is using qualitative and quantitative. Qualitative data is obtained from input from experts in the validation process, both media experts, material experts and question instruments, then the results of interviews with teachers. While quantitative data is obtained from the results of product assessment sheets, questionnaires, and instrument trials. The analysis phase of the study is carried out using the quantitative descriptive method. This study was classified as quasi-experimental with a single-group pretest-posttest design. The designed study was used by a testing team during product implementation and then post-test data measurement. The study was conducted within the framework of the FKIP English Teaching research program at the University of Pakuan. Samples were collected using purposive sampling technique. Determining the sample was done by considering the subjects selected by the students taking the PLH (Environmental Education) subject and then determined by random sampling method. The research sample includes class: as the experimental class. The treatments were processed using bilingual electronic magazine. Data were collected directly through observation, questionnaire distribution, and cognitive testing. Descriptions of data and research tools for each phase are presented in Table 1.

Table 1. Research Instruments

Development Stages	Data	Instruments
Analysis	Observation and interviews	Observation questionnaire and interviews about students' understanding of the material (pollution), the teaching media used and the students' needs regarding the learning process.
Design	• Bilingual electronic magazine design concept and learning media design. • Instruments for product effectiveness test • Instruments for product evaluation	Software usage: canva, flip maker and assemblr
Development	• Initial product development • Evaluation product instrument development • Expert validation • Product practicality test	Learning media (e-magazine) Validation sheet (material expert, media expert, language expert) Practicality questionnaire Students' response questionnaire
Implementation	Teaching and learning process using the media	Electronic magazine as a teaching media Practicality and students' response questionnaire
Evaluation	Classroom experimental treatment	Pre test and post test with N-gain formula

The e-magazine was validated by four validators consisting of material experts, education experts, media experts and lecturer. Validity data is carried out by two validators, namely media validators and material validators, in the same aspect validity tests are obtained by using Likert scale using scores 1 to 5. There are 5 questionnaires of responses to media use according to the content of the question. That includes the display, images, content, language and benefits of e-magazine media. Students' understanding of environmental pollution is conducted through a test and given to students in the experimental class. The experimental class has 15 students. The test includes 25 reporting items with 4 indicators. The test is taken directly at the end of the course. The analysis of test results is done by scoring each item in the test sheet. The results of the questionnaire will be filled in by students and teachers, containing questions and answers, which will then be calculated using the Likert scale formula used for answer choices. Likert scale answer form used that is, strongly agree, agree, disagree less, disagree, and strongly disagree. Based on the results of material validation, from the aspects of content eligibility, content eligibility, and language eligibility, in order for an e-magazine product to be declared eligible, the product must have a P> 80% eligibility criteria. In the aspect of content eligibility with a total score of 40, e-magazine products get a score of 35 so that a percentage value of 86% can be obtained. In the aspect of content eligibility, the product gets a score of 30 out of a maximum score of 35, so that a percentage value of 86% can be obtained. In the aspect of language eligibility, the product gets a score of 36 out of a maximum score of 40, so that a percentage of 90% can be obtained. The results of material expert validation in these 3 feasibility aspects are very feasible, with the total score as a whole obtained 96 total scores and 110 maximum scores, then the overall percentage of this material expert validation is 87.27%, with very feasible criteria

3. RESULT AND DISCUSSION

Result

The development of this e-magazine is intended to improve student literacy skills, especially regarding Environmental Pollution material within FKIP Universitas Pakuan. In the initial step, previous research has been carried out by validating the product by media experts, material experts and linguists and has been tested on students. In analysis stage the process is adjusted to the needs of teaching materials to be developed. The analysis stage is carried out by surveying and filling out questionnaire questionnaires. This activity began with a preliminary analysis by conducting field studies, in the form of interviews with teachers and the distribution of student questionnaires that took PLH or Environmental Education courses. This analysis stage aims to determine the literacy ability of students in Environmental Pollution material. The results of the preliminary study obtained the following data; the curriculum used is Kurikulum Merdeka that emphasizes more flexible learning and focuses on essential material and character development and competence of learners. One of them is project-based learning for the development of soft skills and character in accordance with students. Then the essential material is focused on learning on basic competencies such as literacy and numeracy. E-Magazine learning media has never been given in the PLH learning process before and lecturers only use learning media in the form of power points. In addition, in the learning process, lecturers only use the lecture method so that it does not support the literacy skills of students. Based on the literacy test given to the students about environmental pollution, it was found out that their understanding about the material was still low in the average of score 60-70.

At the design stage, the activity consisted of the design of in which the researchers made a design of the e-magazine started from the topic, the cover and the layout. The second step was designing the content of the e-magazine. The decision was taken according to the material for the subject based on the syllabus. The material covered the topic of kinds of pollution, the cause of the pollution and the ways to decrease the level of the pollution. After considering the material, the researcher then determining the presentation of the content. The material of the e-magazine was taken from latest articles of researches, students' handbook and also free images from the internet. The last step of the designing stage was designing the instruments. This planning instrument is used to validate the product to be used, and tested where the product is feasible or not to be tested. Starting from validation instruments given to media experts and material experts to assess the feasibility of the product before the piloted session. Instruments were given to students to measure the level of student literacy, besides that students are also given a response questionnaire to assess the products that have been given.

At the development stage, the research team developed a product in the form of an e-magazine using the Canva application which was made into a flip book, making it easier to flip through pages and can be accessed online. Here are some of the display of the e-magazine as show in Figure 2.

Figure 2. E-Magazine

After the e-magazine media is validated, then make improvements to the media in the form of product design and question instruments, from the results of the validation then make product improvements in accordance with the notes and suggestions provided by expert validators so that the product is quality, effective, and efficient. The following are notes and suggestions from expert validators on learning media and instruments on literacy skills. The results of validation of media experts, and virus learning material experts using e-magazine media and instrument validation of literacy skills are presented in Figure 3.

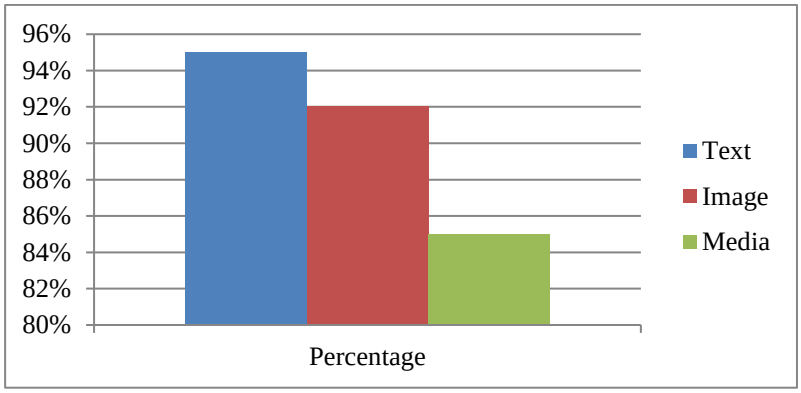

Figure 3. Tabulation of Media Validation Results

In this study, data collection was carried out with pre test and post test on students who attended PLH lectures consisting of 19 students using e-magazine media with environmental pollution material in the learning process. They conduct discussions, do tests to find out literacy skills in the form of multiple-choice questions. The results of the trial are presented in the table as show in Table 2.

Table 2. N-Gain of the Test Result

	Pre test	Post test
Max Score	5	5
Min Score	1	1
Average	2.182	2.697
N-Gain Score	**0.83**	
Category	**High**	

Base on Table 2, the implementation of learning using e-magazine learning media showed high results seen from the average pre-test value of 2.182 and post-test 2.697 with an N-Gain value of 0.83. Because the value (g) > 0.70 with a high category, the level of effectiveness is interpreted as effective to support the increase of students' literacy for the material of Environmental Pollution.

Discussion

In students' literacy abilities, reading and writing play a central role. Educators need to innovate the form of developing learning materials with certain characteristics for each age group so that they can be used as a means to help students activate reading skills and love of reading (Alrwele, 2017; Made et al., 2022). Students' literacy skills play an important role in their ability to navigate and understand the ever-changing media landscape. A significant step forward in addressing contemporary educational challenges is the development of a bilingual e-magazine as a digital teaching resource for enhancing students' literacy of environmental pollution. By using digital platforms and bilingual content, this study aimed to bridge linguistic and educational gaps while promoting environmental literacy among students. Previous study concluded the response of educators and students to the e-magazine media trial yielded positive findings, with scores falling into the extremely feasible interpretation group, indicating that e-magazine media may be used as a tool in social studies learning (Septyani et al., 2023). The statement was in line with the result of the research that shows positive impact on students' understanding as well as gains positive responses from the students. As other study stated the result of his study of the students response toward the use of e-magazine in his class, the students gave more positive responses than negative responses (Park et al., 2015). In this study, according to the result of the questionnaire, it shows 83% of the students responded positively toward the use of the e-magazine as the teaching media in PLH class. The e-magazine provides an immersive learning experience that engages students and helps them better understand complex environmental concepts by using interactive multimedia elements like videos, infographics, and interactive quizzes. Furthermore, the resource's bilingual nature accommodates students from a variety of linguistic backgrounds, fostering inclusivity and accessibility in education.

In today's digital age, where information is continuously disseminated through various mediums such as text, images, videos and social networks, literacy goes beyond traditional reading and speaking skills. A strong foundation in literacy equips students with the critical thinking skills, media analysis skills, and discernment needed to distinguish between trustworthy and unreliable sources (White, 2021; Zubaidah et al., 2018). Effective media teaching therefore depends on promoting and strengthening students' literacy skills. By

developing the ability to interpret and critically evaluate media messages, educators help students become informed and responsible consumers of information, helping them make informed decisions and participate more actively in modern communication networks. Ultimately, the relationship between student literacy and the medium of instruction is symbiotic, as each reinforces the other by developing informed, media-savvy individuals.

The material used to train students' literacy skills is about environmental pollution. This material was chosen because it is very close to the daily lives of students as it happens at this time where many diseases are widespread in society caused by environmental pollution, therefore lecturers must be able to provide interesting media so that literacy skills about the material increase and improve their understanding of the issue. A bilingual e-magazine can be a powerful digital teaching resource to foster students' digital literacy concerning environmental pollution. The contribution of the teaching media is as follows; 1) a bilingual e-magazine can cater to a diverse audience, breaking language barriers and ensuring that a wider range of students can access information on environmental pollution, 2) e-magazines incorporate various multimedia elements such as text, images, videos, and interactive features, engaging students through different sensory channels, enhancing comprehension and retention, 3) the e-magazine can curate and present reliable and up-to-date information on environmental pollution, teaching students how to discern trustworthy sources from misinformation, 4) interactive elements like quizzes, polls, and discussion forums can be embedded in the e-magazine, encouraging active participation and collaborative learning among students, 5) through infographics, charts, and interactive maps, the e-magazine can help students better understand complex environmental data, promoting data literacy, 6) articles and features in the e-magazine can critically analyze how environmental issues are portrayed in the media, fostering media literacy skills, 7) encouraging students to contribute articles, videos, or graphics to the e-magazine can help them develop digital content creation skills, promoting active participation in environmental advocacy.

As for to fulfil the students' suitability to the digital teaching media, the study develops e-magazine as one of digital teaching resources. This E-Magazine is a teaching material in the form of digital teaching materials without using sheets of paper for the material but using a computer, Tablets, iPads, and smartphones (Jaya, 2018; Nuraida et al., 2022). The effectiveness of the e-magazine as a digital teaching resource in improving students' comprehension of environmental pollution is a critical component of the study. The study evaluated the impact of the e-magazine on various aspects of students' understanding, including knowledge acquisition, comprehension of key concepts, critical thinking skills, and overall engagement with the subject matter, using comprehensive assessment methodologies such as pre-tests, post-tests, surveys, and qualitative feedback. A comprehensive understanding of the e-magazine's effectiveness in facilitating meaningful learning experiences and fostering a deeper understanding of environmental pollution among students was gained by analysing quantitative data such as test scores and survey responses, as well as qualitative insights gathered through interviews.

4. CONCLUSION

The development of e-magazine media uses the ADDIE method which consists of 5 stages, namely Analysis of the process of defining, Design what has been formulated in the analysis stage, Development of production stages that have been made in the design stage into reality, Implementation of the learning system is ready to be used, and Evaluation to improve the learning system made before the last version is applied. In this e-magazine media, there are features that can attract the attention of students such as full color ground, interesting images, learning videos, and info on how to reduce pollution. The eligibility of the e-magazine was validated by a team of media experts and material experts. As for the result of the implementation, it was evaluated from the score of pre test and post-test which showed the significant increase of the students' understanding as well as their literacy skill.

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