Validity and Practicality: Study of E-Poster Development to Improve Environmental Literacy

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ABSTRACT

The advancement of Era 4.0 technology has shifted the way humans think and work which were faster, more efficient, and effective in various sectors, including in education field. The Universitas Terbuka (UT) is one of university which has been existed for a long time and actively develop learning methods, for both online platforms and independent learning. In this context, it is important to support, develop and evaluate the distance learning system in utilizing all facilities including teaching materials, especially in terms of UT student practicum. This research aimed to increase environmental knowledge which intended to prepare people who understand and willing to overcome environmental problems by developing a QR-Code based E-Poster. This research implemented development research (Research and Development) with the ADDIE development model (Analysis, Design, Develop, Implementation, Evaluation). The results showed that the QR Code-based E-Poster developed had a high level of validity, practicality and effectiveness in increasing environmental literacy. Most of respondents gave positive responses to the use of E-Posters, such as easy to use, good layout, accessible, effective to deliver, clear text presentation, use of QR Codes, attractive color composition, good systematics, and efficiency in conveying information. In assessing the quality of media, the aspects of readability and understanding of concepts were very important, especially in the context of E-Posters. Conceptual reasoning as the respondent's ability to follow and understand the thoughts or concepts conveyed in the E-Poster was a significant factor. Good text comprehension includes ease of reading and understanding the information presented in the texts on E-Poster, Additionally, good language comprehension in this media included the respondent's ability to understand and interpret the information conveyed through the language used in the E-Poster. These findings highlighted the importance aspects in the development of E-Posters as effective learning and communication instruments.

Keywords: e-poster, cyber-university pioneer , validity, practicality

INTRODUCTION

Low environmental literacy habit in society is a challenge, especially when it dealing with problems such as fires due to a lack information about types of plants which were effective with optimal capacity and absorption rate in absorbing carbon or rare herbaceous plants with various types of endemic flora which were important for humans. The problem was getting worst by their ignorance about the environment which caused by low environmental literacy which was defined as the ability or capacity to understand the importance of protecting the environment for present life and future generations. (Nugraha et al., 2021). Their low environmental literacy due to limited environmental information available in mass media such as television. Socialization about environmental awareness was generally conducted through lectures and field experiments, with a little use of digital media such as e-posters.

Some previous research showed that the lack of environmental literacy was mostly caused by a lack of interest in the environment issue which leaded by limited information about environment in mass media such as television. Beside that, the low scientific literacy was believed due to a low education on the importance of environmental literacy to the public. The education of environmental outreach tent to deliver through lectures and field experiments rather than using digital media. To overcome this problem, this research developed a QR-Code based E-Poster. The aim of the research was to increase environmental knowledge which intended to prepare people who understand and willing to overcome environmental problems by developing a QR-Code based E-Poster, so that there would be environmental reform actors which can be caring and act positively towards the environment. (Afrianda et al., 2019).

e-Poster can be used as an effective and interactive educational instrument to increase environmental literacy. As stated by Erivan (2019), E-Poster is multimedia for digital publications which intended to provide various information. The e-Poster exhibited at various festivals, village workshops, and in schools, especially from primary to secondary level. The development method used the ADDIE model. Research data were collected through observation sheets, questionnaires and test instruments, then analyzed by using various statistical methods, both parametric and non-parametric.

Conceptual e-posters include elements such as text, images, barcodes, etc. (Harahap et al., 2023). This research produced a QR-Code-based E-Poster which used to convey information about plants more quickly and accurate. The e-poster also contained information about the causes of forest and land fires, endemic plant types, fire prevention, measuring hotspots , weather conditions, educational games, videos on forest use, and assessments required by schools. Thus, this research made an important contribution to increase environmental literacy. Overall, this research combined elements of educational technology and environmental awareness, with the main goal of creating an effective and relevant learning instrument to improve environmental literacy among the public, especially among the young generation.

METHODOLOGY

This research was development research (*Research and Development), the E Poster* was developed using the ADDIE (*Analysis, Design, Develop, Implementation, Evaluation*) development model by Dick Walter and Lou Carey (2005). The ADDIE development approach was implemented due to the benefits of the structured working stages of the development model. Each stage was assessed and changed based on the develoment of previous stage which made the finished product was a valid product (Harefa et al., 2023). The research was carried out in Pekanbaru in 2021 with the objects of research was UPBJJ UT Pekanbaru tutors and students.

The following was the flow of the ADDIE development model at each stage, briefly explained in Figure 1.
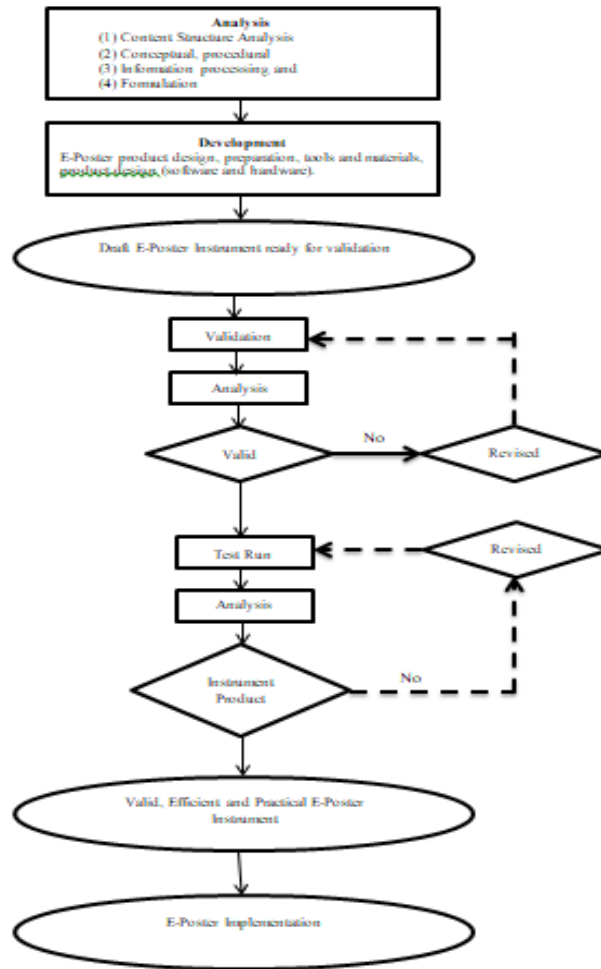
Figure 1. *E Poster* Development Flow

RESULT AND DISCUSSION

The results of this research on digital literacy skills were: (1) the description of development results using the stages of the ADDIE model ; and (2) the description of the results of developing a QR Code-based E-Poster which was valid, practical and effective.

Analysis

At this needs analysis stage, the subjects of the research involved 162 people, which consisted of 128 students and 34 UT Tutors as shown in Figure 2 below.
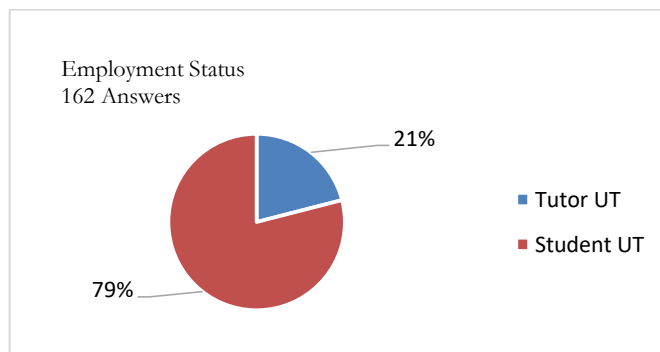

Figure 2. Respondent Diagram Needs Analysis

Development Experience Analysis

Researcher investigated the development experiences of students and lecturers based on aspects of assessment and E-Poster development. The results of the questionnaire were presented in Figure 3. below.
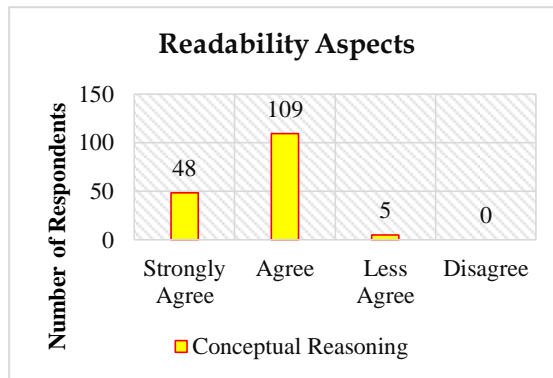
Readability Aspects

Figure 3. Readability Respondent Chart in Conceptual Reasoning

Based on the figure 3, it can be seen that there were 109 respondents answered "Agree" and 48 respondents answered "Strongly Agree" for the readability aspect in the concept reasoning indicator. Beside that, there were 5 respondents who answered "Disagree." Conceptual reasoning was the respondents' ability to follow and understand the thoughts or concepts conveyed in the E-Poster well.
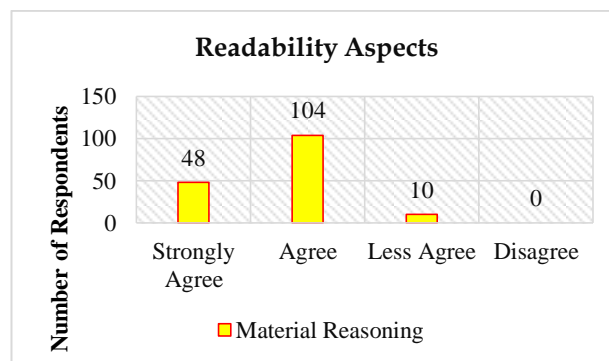
Readability Aspects

Figure 4. Readability Respondent Diagram in Material Alignment

Based on Figure 4, it can be seen that there were 104 respondents answered "Agree" and 48 respondents answered "Strongly Agree" regarding the readability aspect in the Material Alignment indicator. Beside that, there were 10 respondents who answered "Disagree." Alignment of learning materials and media were important factor in ensuring the content and material presented in the media, including in E-Posters, which can be comprehended by users or learning participants.
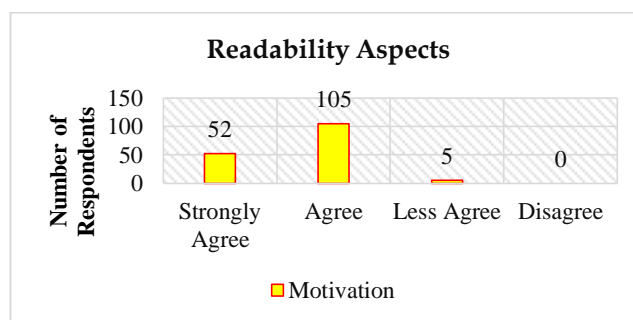
Readability Aspects

Figure 5. Readability Respondent Diagram in Increasing Motivation

Based on Figure 5, it can be seen that there were 105 respondents answered "Agree" and 52 respondents answered "Strongly Agree" regarding the readability aspect of the motivation indicator. However, there were 5 respondents who answered "Disagree." Good media has potential chance to increase learning motivation or stimulate higher interest and curiosity among users.
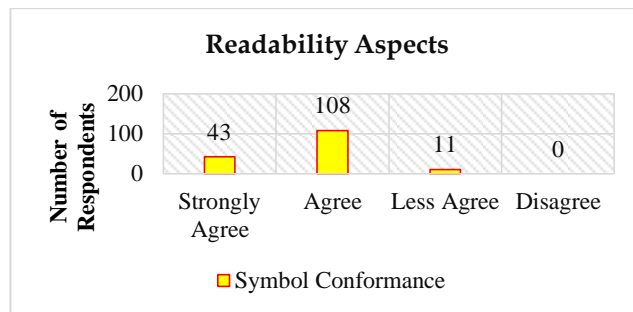

Figure 6. Respondent Diagram Readability in Symbol Conformity

Based on Figure 6, it was found out that there were 108 respondents responded with Agree, while 43 respondents responded with Strongly Agree regarding the suitability of the symbols on the E Poster. However, there were 11 respondents who responded with Disagree. These results indicated a good understanding of the suitability of symbols in this visual media by respondents, and it confirmed the succeed of using symbols in the E Poster context. The suitability of symbols in visual media was very important as it provided a faster, more efficient and universal understanding message to the audience. It was also enabling effective and efficient message conveyed in various communication contexts.
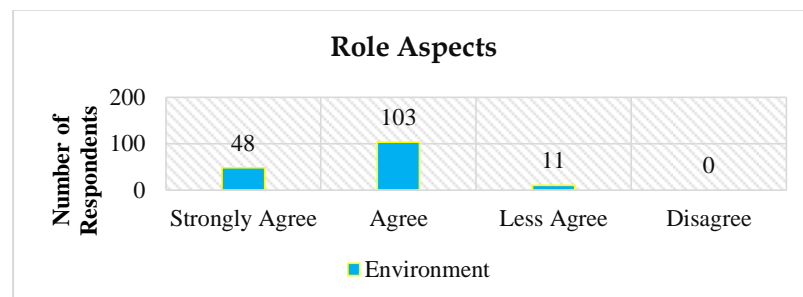

Figure 7. Role Respondent Diagram in the Environment

Based on the data in Figure 7, it can be seen that there were 103 respondents said "Agree", 48 respondents said "strongly agree" to the role of E Posters in the environmental context. However, there were 11 respondents who said "disagree". The results showed that the E Poster had a significant role in environmental conservation efforts, especially in the context of germplasm plants.
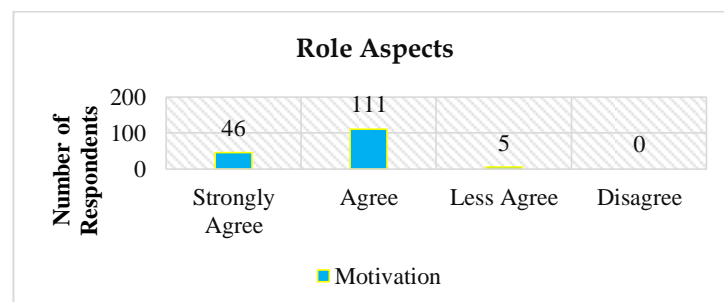

Figure 8. Respondent Diagram of Roles in Motivational Interest

Based on the Figure 8, it was found that there were 111 respondents said "Agree", 46 respondents said "Strongly Agree" to the role of E Posters in increasing interest and motivation to the readers. However, there were 5 respondents who said "disagree". E Posters as visual media had potential to increase users' interest and motivation in gaining information in a more interesting and interactive way.
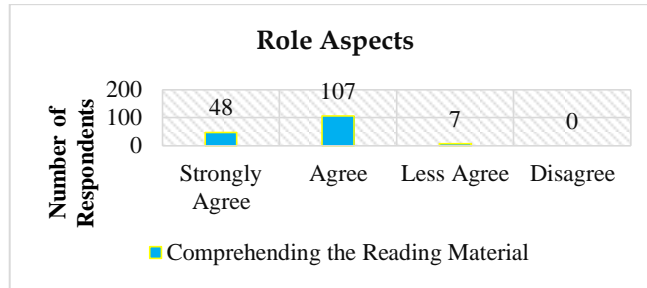

Figure 9. Respondent Role Diagram in Comprehending the Reading Material.

Based on the data depicted in Figure 9, it was revealed that there were 107 respondents showed "agree", 48 respondents showed "Strongly Agree" to the role of E Posters in creating reading meaning. However there were 7 respondents said "disagree" to comprehend the meaning. Comprehending the reading material in visual media was important to ensure the information can be well understood by the users. Comprehending the reading material meant the readers understand how messages or content were arranged visually to communicate information effectively.
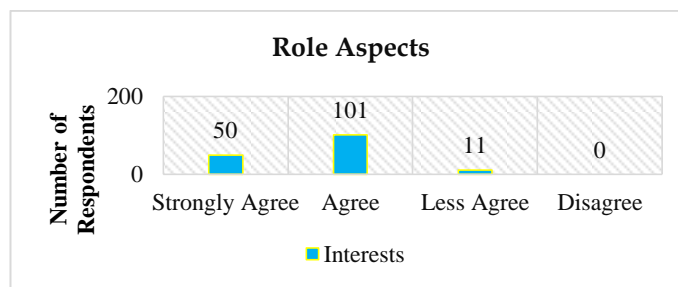

Figure 10. Diagram of Respondents' Roles in Interest in Learning

From Figure 10, it can be inferred that there were 101 respondents said Agree, 50 respondents said Strongly Agree to the role of E Posters in increasing readers' interest in learning. However, there were 11 respondents who said disagree.

Based on these findings, several researchers have agreed that E Poster media were expected be able to increase readers' interest in learning because of the use of various visual elements which eye catching that were able to attract interest and desire to learn. Learning interest was one of important factors in the learning process, as it influenced the level of engagement and learning achievement of students or users.
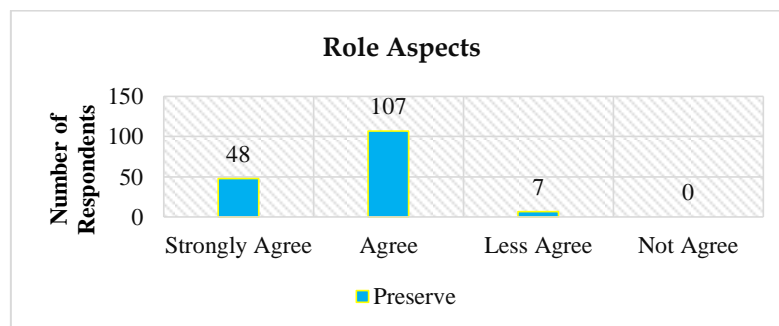

Figure 11. Diagram of Respondents Role in Preserving

In Figure 11, it can be seen that the majority of respondents 107 showed a level of agreement (Agree) and 48 respondents showed strong agreement (Strongly Agree) regarding the role of E Poster in preserving germplasm plants. However, there were 7 respondents who expressed disagreement (Less Agree).

Therefore, these results indicated the needs of improvements in the implementation of the E Poster that has been created. E posters created potentially increase a person's awareness and desire to play a role in preserving the environment.
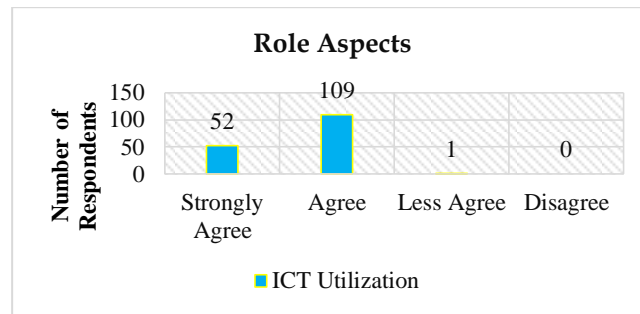

Figure 12. Diagram of Respondent Roles in ICT Utilization

Based on the data depicted in Figure 12, it can be concluded that there were 109 respondents Agree, 52 respondents Strongly Agree to the role of e-posters that utilize Information Technology and Communication. But, there was 1 respondent who disagree

The result showed that the use of Information and Communication Technology in E Posters was effective in conveying messages to the users. By utilizing the technology, the messages were easy to access, comprehended, and widely disseminated, so that they can reach the target audience more efficiently.
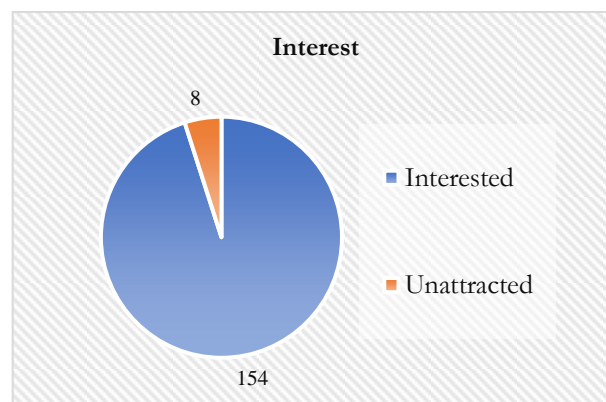
Figure 13. Interest Respondent Chart

By considering data which were depicted in Figure 13, it can be said that 154 respondents showed a high interest in using e-posters as a medium for understanding and finding out more about the environment news. However, there were 8 respondents who showed no interest.

E Poster media attracted many people interest as it offered many benefits. One of them was E Poster enable to present information in an interesting and interactive way. Then, E Poster also allowed the integration of various types of media, such as text, images, video and audio, so that it provided a richer and deeper learning experience. Furthermore, it had high accessibility as it can be accessed from various digital devices which made users were easier to get the information.

Figure 14. Evaluation of Respondent Diagram

Based on Figure 14, it was found that 89 respondents were agree if the E Poster which had been created still needed improvement, while 64 respondents thought that the E Poster did not need any improvement.
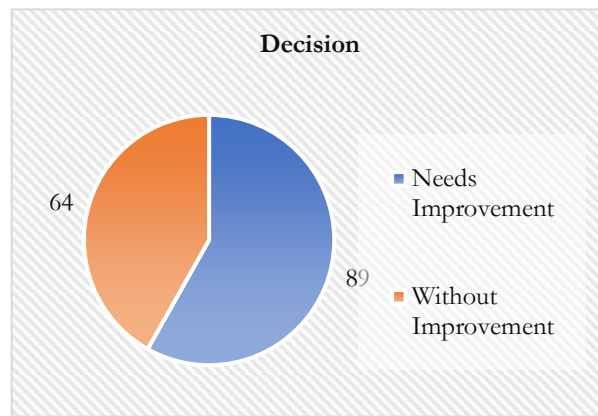
By regarding the results, it was considering to improve the quality of the created E Poster. The improvements could be in certain aspects, such as layout, visual design, or information content. By making appropriate improvements, E Poster might be more effective and efficient instrument in conveying messages and meeting user needs. Thus,, this improvement would increase the value and benefits of the E Poster.

From the 162 respondents' responds, it can be concluded that the E Poster that had been created had: (a) The material explained in the QR-code-based e-poster was very interesting and easy to comprehend. It was it suitable for increasing environmental literacy; (b) The use of QR-Code in E-Posters was considered effective in conveying information. It also facilitated access to more detailed information about plants and the environment; (c) Many respondents were agree with the development of the E-Poster product and hopefully this product can be developed and targeting school children; (d) There was support for practical testing of this product, which considered very helpful in comprehending the product and ensuring its usability; (e) The use of QR-code-based e-posters was considered to have great potential for increasing environmental awareness, environmental literacy, and preserving germplasm plants. This technology were able to overcome some challenges such as technology access and public awareness.

Understanding E-Posters

Researcher also conducted mini research on E-Posters which had been carried out or encountered by students and lecturers. Based on the results, it showed that the E-Poster experienced by students and lecturers was viewed from several aspects, including the following. Media or applications used in the learning process include Google Classroom, PPT, Smartphone, Zoom, Youtube, E-Poster, Canva, Google Meet, Mendeley, Zotero, laptops, and teaching aids. The difficulties were faced in learning, including designing e-posters, lack of understanding on the use of learning media, virtual-based media, clarity on the material due to network constraints, the device used was inadequate and so on. Media and sources which were frequently used in the learning process include books, the internet, e -journals and others. Most respondents were aware of the E-Poster design and said that it could be developed for students so that it could be used as an alternative learning media

Design and Development

The following was description on the characteristics of the E-Poster designed by researchers.

The home page contained an E-Poster. The initial page designed for developing E-poster-based textbooks can be seen in Figure 15.

Figure 15. E-Poster Design

It contained instructions on how to use textbooks for respondents. The design of the study guide in the textbook can be seen in Figure 16.

Figure 16. Guidelines for Using E Posters

Discussion of the research results was carried out based on the factors analyzed in this research. These factors include E-Posters to increase environmental care attitudes.

Needs Analysis

Development Experience

Based on the findings, it was found that most of respondents had previous experience related to training in making E-Posters. It showed that they had a good basic knowledge in developing E-Posters and it might experience fewer difficulties in the development process. However, this also indicated that there was emerging needs to provide further training to the respondents so that they abilities were develop.

Training was an important approach in individual development as a way to provide additional experience and knowledge so that they can improve their skills and attitudes in achieving certain goals. Respondents considered training were very important in improving their abilities in developing E-Posters.

In line with this point, Efendi (2017) had stated that training provides valuable experience in developing knowledge, skills and attitudes. Besides that, training also helped teachers and students to have self-evaluate their abilities. In teaching context, it was crucial to adapted professional training based on the student needs, starting from the selection of materials, and training methods, selected qualified instructors. In this way, the results of the training can be implemented effectively in the campus or school to give a positive impact on educators and students. It meant that training was an important means of developing individual competence and encouraging growth in the educational environment. Training helped the teachers achieve their professional competencies, both in the mastery of teaching materials, innovative teaching techniques and the use of technology in learning. By training, teachers were able to understand how to deliver material more effectively, interestingly, and in accordance with the students' today's needs. In the digital era, the use of technology in learning process had become inevitable. Training provided opportunities for teachers to learn how to use the latest technology instruments, such as E-posters, presentation software, or learning evaluation applications. This helps them to improve teaching efficiency and effectiveness.

Understanding E-Posters

The findings showed, there were many media or applications used in learning process, such as Google Classroom, PPT, Smartphone, Zoom, Youtube, E-Poster, Canva, Google Meet, Mendeley, Zotero, laptops and teaching aids. This reslut was in line with the opinion of Salamah (2020) who noted that the use of educational technology such as Google for Education, including services such as Google Classroom, Google Calendar, Google Mail, Google Drive, and Google Docs, had become important innovation in modern learning.

E-posters as one of media used in this research have been proven to be an effective instrument in learning. E-posters were visual media which enable the presentation of information in an interesting and informative way which most of respondents showed interest and support as a learning instrument.

However, this research also revealed several difficulties faced in learning, including the difficulties in designing PPT,the limited understanding on the use of learning media, unclear material being taught due to network problems, and limitations of the devices used. One of the difficulties highlighted was the problem of unstable internet connections. This condition was in line with the findings in previous research which indicated the technical problems such as poor internet connections can be a major difficulties in online learning. Despite of these difficulties, E-Poster media was an effective instrument in learning. E-posters provided information in an interesting and easy-to-understand way which help students in the learning process. Therefore, the use of E-Posters in the learning context needs to be continued, improved, and optimized to provide maximum benefits to both educators and students.

The effectiveness of E-Posters supports Environmental Literac

E-Posters can be used as a tool to campaign awareness about the importance of conserving germplasm. In E-Posters, information and messages can be conveyed through the use of effective text and attractive visuals. It helped to motivate communities and stakeholders to get involved in environmental conservation efforts. E-posters also provided visual information with attractive images and colors. The right media in learning played an important role in achieving student learning outcomes (Niruri et al., 2023).

In a learning context, visual media including E-Posters created a more interesting and memorable learning experience. Students were easily understand the plant concepts through visual images, thereby increasing their understanding the importance of preserving biodiversity. By combining the effective use of visual media, it created wider awareness about the importance of maintaining biodiversity and preserving the environment.

CONCLUSION

The conclusions from the research were as follows the QR Code-based e-poster developed for the Germplasm Plant Inventory were valid, practical, and effective, most respondents gave positive feedback on the use of E-Posters, highlighting ease of use, layout, information accessibility, effectiveness, text presentation, QR code integration, color composition, organization, and efficiency. Aspects of readability and understanding concepts were very important in assessing the quality of media, including E-Posters. Conceptual reasoning was the respondent's ability to follow and understand the thoughts or concepts conveyed in the E-Poster well. Good text comprehension includes ease of reading and understanding the information presented in the texts. Good language understanding in this media includes the respondent's ability to comprehend and interpret the information conveyed in the E-Poster. The use of e-Poster learning media was expected to increase students involvement in learning. By using interesting technology, such as images, videos, and animations, students tend to be more interested and involved in learning materials. E-Posters allow the presentation of information in a visual form that is interesting and easily understood by learners.

REFERENCES

Adilbay, D., Adilbayev, G., Kidirbayeva, G., Shipilova, V., Sadyk, Z., Koyanbekova, G., Klozar, J. (2018). HPV Infection and P16 Expression in Oral and Oropharyngeal Cancer in Kazakhstan. *Infectious Agents and Cancer* , *13* (1). https://doi.org/10.1186/s13027-018-0175-8

Afrianda, R., Yolida, B., & Marpaung, PRC (2019). The Influence of The Adiwiyata Program on Environmental Literacy and Environmental Care Attitudes. *Bioeducated Journal: Vehicles for Scientific Expression*, *7* (1), 32-42.

Aljumaili, S. J. (2018). Genetic Diversity of Aromatic Rice Germplasm Revealed by SSR Markers. *BioMed Research International* , *2018* . https://doi.org/10.1155/2018/7658032

Aragão, LEOC, Anderson, LO, Fonseca, MG, Rosan, TM, Vedovato, LB, Wagner, FH, Saatchi, S. (2018). 21st Century Drought-Related Fires Counteract The Decline of Amazon Deforestation Carbon Emissions. *Nature Communications*, *9* (1). https://doi.org/10.1038/s41467-017-02771-y

Bartolucci, F., Peruzzi, L., Galasso, G., Albano, A., Alessandrini, A., Ardenghi, N. M. G., … Conti, F. (2018). An updated checklist of the vascular flora native to Italy. *Plant Biosystems* , *152* (2), 179–303. https://doi.org/10.1080/11263504.2017.1419996

Bissinger, K., & Bogner, F.X. (2018). Environmental literacy In Practice: Education On Tropical Rainforests And Climate Change. *Environment, Development and Sustainability*, *20* (5), 2079–2094. https://doi.org/10.1007/s10668-017-9978-9

Braun, T., Cottrell, R., & Dierkes, P. (2018). Fostering Changes In Attitude, Knowledge And Behavior: Demographic Variation In Environmental Education Effects. *Environmental Education Research* , *24* (6), 899–920. https://doi.org/10.1080/13504622.2017.1343279

Church, H.R., & Fazlanie, L. (2021). Twelve Tips for Organizing A Local Or Regional E-Poster Session. *Medical Teacher* , 1–7. https://doi.org/10.1080/0142159X.2021.1915968

Curdt-Christiansen, XL (2020). Environmental literacy: raising awareness through Chinese primary education textbooks. *Language, Culture and Curriculum* , 1–16. https://doi.org/10.1080/07908318.2020.1797078

De las Heras Prat, P. (2022). American Society of Tropical Medicine and Hygiene, 70th Annual Meeting. Virtual - November 17-21, 2021. *Drugs of the Future* , Vol. 47, pp. 229–231. https://doi.org/10.1358/dof.2022.47.3.3393246

Dolenc Orbanić, N., & Kovač, N. (2021). Environmental awareness, attitudes, and behavior of preservice preschool and primary school teachers. *Journal of Baltic Science Education* , *20* (3), 373–388. https://doi.org/10.33225/jbse/21.20.373

Dyderski, M. K., Paź, S., Frelich, L. E., & Jagodziński, A. M. (2018). How much does climate change threaten European forest tree species distributions? *Global Change Biology* , *24* (3), 1150–1163. https://doi.org/10.1111/gcb.13925

Edsand, H.E., & Broich, T. (2020). The Impact of Environmental Education on Environmental and Renewable Energy Technology Awareness: Empirical Evidence from Colombia. *International Journal of Science and Mathematics Education* , *18* (4), 611–634. https://doi.org/10.1007/s10763-019-09988-x

Erivan, R., Dartus, J., Reina, N., Ollivier, M., Villatte, G., Saab, M., & Devos, P. (2019). Full-text publication rate of studies reported as 2013 SoFCOT Meeting Abstracts. Revue de Chirurgie Orthopedique et Traumatologique, 105(8), 935–940. https://doi.org/10.1016/j.rcot.2019.10.013

Fang, W.T., Lien, CY, Huang, Y.W., Han, G., Shyu, G.S., Chou, J.Y., & Ng, E. (2018). Environmental literacy on ecotourism: A study on student knowledge, attitude, and behavioral intentions in China and Taiwan. *Sustainability (Switzerland)* , *10* (6). https://doi.org/10.3390/su10061886

Fernández, AG, Marín, FR, Lozano, LL, & Ramírez, ES (2022). Environmental literacy in initial teacher training: Design and validation of a questionnaire. *Ensenanza de Las Ciencias* , *40* (1), 25–46. https://doi.org/10.5565/rev/ensciences.3517

Goldman, D., Ayalon, O., Baum, D., & Weiss, B. (2018). Influence of 'green school certification' on students' environmental literacy and adoption of sustainable practices by schools. *Journal of Cleaner Production* , *183* , 1300–1313. https://doi.org/10.1016/j.jclepro.2018.02.176

Guerrero Fernández, A., Rodríguez Marin, F., Solís Ramírez, E., & Rivero García, A. (2022). Environmental literacy of teachers in initial training in Early childhood and Primary Education. *Revista Interuniversitaria de Formacion Del Professorado* , *97* (36.1), 75–98. https://doi.org/10.47553/rifop.v97i36.1.92434

Harahap, AIH, & Vebrianto, R. (2023). Development of E-Posters as Alternative Media in Improving Creative Thinking Skills: Systematic Literature Review. *Millennials: Journal for Teachers and Learning* , *4* (1), 16-22.

Harefa, E. P., Waruwu, D. P., Hulu, A. H., & Bawamenewi, A. (2023). Pengembangan Media Pembelajaran Bahasa Indonesia Berbasis Website dengan Menggunakan Model ADDIE. *Journal on Education*, *6*(1), 4405–4410.

Ilhami, A., Riandi, R., & Sriyati, S. (2019). Implementation of science learning with local wisdom approach toward environmental literacy. *Journal of Physics: Conference Series* , Vol. 1157. https://doi.org/10.1088/1742-6596/1157/2/022030

Innes, S., Shephard, K., Furnari, M., Harraway, J., Jowett, T., Lovelock, B., … Skeaff, S. (2018). Greening the Curriculum to Foster Environmental Literacy in Tertiary Students Studying Human Nutrition. *Journal of Hunger and Environmental Nutrition* , *13* (2), 192–204.

https://doi.org/10.1080/19320248.2016.1255693

Jedrzejczyk, I., & Rewers, M. (2020). Identification and genetic diversity analysis of edible and medicinal Malva species using flow cytometry and ISSR molecular markers. *Agronomy* , *10* (5). https://doi.org/10.3390/agronomy10050650

Kelliher, T., Starr, D., Su, X., Tang, G., Chen, Z., Carter, J., … Que, Q. (2019). One-step genome editing of elite crop germplasm during haploid induction. *Nature Biotechnology* , *37* (3), 287–292. https://doi.org/10.1038/s41587-019-0038-x

Kusumaningrum, D. (2018). Environmental Literacy in the 2013 Curriculum and Science Learning in Elementary Schools. Indonesian Journal of Natural Science Education (IJNSE), 1(2), 57–64. https://doi.org/10.31002/nse.v1i2.255

Ley, T., Carder, P., Dewey, R., Elferink, R., Kämäräinen, P., Müller, W., … Treasure-Jones, T. (2020). Designing Technology-enhanced Learning Research for Sustainable Impact: The Learning Layers case. *CEUR Workshop Proceedings* , Vol. 2676.

Maurer, M., & Bogner, F.X. (2020). Modeling environmental literacy with environmental knowledge, values and (reported) behavior. *Studies in Educational Evaluation*, *65* . https://doi.org/10.1016/j.stueduc.2020.100863

Maurer, M., Koulouris, P., & Bogner, F.X. (2020). Green awareness in action energy conservation action forces on environmental knowledge, values and behavior in adolescents' school life. *Sustainability (Switzerland)* , *12* (3). https://doi.org/10.3390/su12030955

Mcphie, J., & Clarke, D. A.G. (2020). Nature matters: diffracting a keystone concept of environmental education research–just for kicks. *Environmental Education Research* , *26* (9–10), 1509–1526. https://doi.org/10.1080/13504622.2018.1531387

Merritt, E.G., Stern, M.J., Powell, R.B., & Frensley, B.T. (2022). A systematic literature review to identify evidence-based principles to improve online environmental education. *Environmental Education Research* , *28* (5), 674–694. https://doi.org/10.1080/13504622.2022.2032610

Milner, S.G., Jost, M., Taketa, S., Mazón, E.R., Himmelbach, A., Oppermann, M., … Stein, N. (2019). Genebank genomics highlights the diversity of a global barley collection. *Nature Genetics* , *51* (2), 319–326. https://doi.org/10.1038/s41588-018-0266-x

Niruri, R., Rakhmawati, R., Saputri, R. N., & Farida, Y. (2023). Efektifitas Media untuk Peningkatan Pengetahuan dan Sikap pada Perilaku Hidup Bersih-Sehat Siswa Sekolah Dasar saat Adaptasi Kebiasaan Baru Era COVID-19. *JPSCR: Journal of Pharmaceutical Science and Clinical Research*, *8*(3), 291. https://doi.org/10.20961/jpscr.v8i2.56862

Nugraha, F., Permanasari, A., & Pursitasari, ID (2021). Disparity in Environmental Literacy of Elementary School Students in Bogor City. Journal of Science & Science Learning, 5(1), 15–35. https://doi.org/10.24815/jipi.v5i1.17744

Pasaribu, TA (2020). Challenging EFL students to read: Digital reader response tasks to foster learner autonomy. *Teaching English with Technology*, *20* (2), 21–41.

Pitman, S. D., Daniels, C. B., & Sutton, P. C. (2018). Ecological literacy and socio-demographics: who are the most eco-literate in our community, and why? *International Journal of Sustainable Development and World Ecology* , *25* (1), 9–22. https://doi.org/10.1080/13504509.2016.1263689

Riaz, S., De Lorenzis, G., Velasco, D., Koehmstedt, A., Maghradze, D., Bobokashvili, Z., … Arroyo-Garcia, R. (2018). Genetic diversity analysis of cultivated and wild grapevine (Vitis vinifera L.) accessions around the Mediterranean basin and Central Asia. *BMC Plant Biology* , *18* (1). https://doi.org/10.1186/s12870-018-1351-0

Seibold, S., Gossner, M.M., Simons, N.K., Blüthgen, N., Müller, J., Ambarlı, D., … Weisser, W.W. (2019). Arthropod decline in grasslands and forests is associated with landscape-level drivers. *Nature* , *574* (7780), 671–674. https://doi.org/10.1038/s41586-019-1684-3

Simkin, A.J., López-Calcagno, P.E., & Raines, C.A. (2019). Feeding the world: Improving photosynthetic efficiency for sustainable crop production. *Journal of Experimental Botany* , Vol. 70, pp. 1119–1140. https://doi.org/10.1093/jxb/ery445

Souza, AP De. (2020). Photosynthesis across African cassava germplasm is limited by Rubisco and mesophyll conductance at steady state, but by stomatal conductance in fluctuating light. *New Phytologist*, *225* (6), 2498–2512. https://doi.org/10.1111/nph.16142

Stevens-Rumann, C.S., & Morgan, P. (2019). Tree regeneration following wildfires in the western US: a review. *Fire Ecology* , Vol. 15. https://doi.org/10.1186/s42408-019-0032-1

Suprasanna, P., & Ghag, SB (2019). Plant Tolerance to Environmental Stress: Translating Research from Lab to Land. *Molecular Plant Abiotic Stress: Biology and Biotechnology*, pp. 1–28. https://doi.org/10.1002/9781119463665.ch1

Terêncio, DPS, Sanches Fernandes, LF, Cortes, RMV, Moura, JP, & Pacheco, FAL (2018). Rainwater harvesting in catchments for agro-forestry uses: A study focused on the balance between sustainability values and storage capacity. *Science of the Total Environment*, *613 – 614* , 1079–1092. https://doi.org/10.1016/j.scitotenv.2017.09.198

Zhang, L., Yi, K., & Zhang, D. (2020). The classification of environmental crisis in the perspective of risk communication: A case study of coastal risk in Mainland China. *Journal of Coastal Research*, *104* (sp1), 88–93. https://doi.org/10.2112/JCR-SI104-016.1