Jurnal Pembelajaran Dan Biologi Nukleus p-ISSN: 2442-9481
Vol 10 (3): 932-943, November 2024 e-ISSN: 2685-7332

Development of Ecobrick Application – Based Android as an Innovative Media in Environmental Pollution Learning

Bibin Rubini(*)[1], Hepi Hapipah[1,2], Anna Permanasari[1]

[1] Science Education Study Program, Postgraduate School, Pakuan University
Jl. Pakuan Tegalega, Bogor Tengah, Bogor City, West Java 16129, Indonesia;
[2]Junior High School of SMP Negeri 3 Cibadak
Jl. Raya Karangtengah No.691 Cibadak, Sukabumi Regency, West Jawa 43351, Indonesia

***Corresponding Author:** bibinrubini@unpak.ac.id

Submitted August 08 Th 2024 and Accepted October 30 Th 2024

Abstract

Environmental pollution learning really needs technology-based media to increase the meaningful learning. Research has been conducted to develop an Android-based application as a media in the context of ecobrick to increase students' awareness to the environment conservation and student's creativity. On using R and D with ADDIE design, the research was conducted through the steps: need analysis, designing, development, implementation, and evaluation. Research was then followed up with feasibility measurement To ensure that the media can be used in the learning practice. The validation was carried out through the expert and user (tearcher) validation test. In addition, survey techniques are used to explore direct responses by interviewing teachers. The validated media was then applied in the learning to measure the student awareness to the environment conservation. The research revealed that the media was very feasible to use with a high visibility index (expert validation index was 96.6%, meanwhile the CVR and CVI indexes were 0.98 and 0.99). The results of media implementation in environmental pollution learning show that the level of environmental awareness of students is in the high category (average student score = 82.49 %), meanwhile the student's creativity shows in the very good category (average student's score was 92.97 %)

Keywords: *Android Based Ecobrick Application; Learning Media; Environmental Pollution*

https://doi.org/10.36987/jpbn.v10i3.6162

INTRODUCTION

In the past five years, global technologies such as artificial intelligence (AI), the Internet of Things (IoT), and 5G have rapidly developed, which has had a significant impact on various aspects of life, including education (Utomo, 2019; Ramadhani & Sutabri, 2024). Nowaday, AI has been integrated in various industries, while IoT is creating a smarter and more efficient ecosystem. 5G technology has driven the acceleration of digital services and supported more advanced applications. Meanwhile, in this digital era, technology-based learning media innovations still need development in order to be able to create interactive and independent learning. Currently, many science learning only relies on conventional methods (Asmendri & Sari, 2019; Lovandri & Suci, 2023). Generation Z, who rely heavily on technology such as Android devices, shows a strong preference for app-based learning that is more in line with their dynamic lifestyles. This opens up great opportunities for the development of more mobile and interesting Android-based learning media (Rahmawati, 2022; Urba et al., 2024). Nevertheless, their reliance on technology needs to be managed wisely to avoid negative impacts on social skills and mental health. Therefore, the development of digital-based media that accommodates didactic-pedagogic principles needs to be developed (Afriza et al., 2024; Ismail & Nugroho, 2022).

One of the learning contexts that can be developed with digital-based media is environmental pollution material. The problem of the scientific environment must be an issue that needs to be realized by Gen-Z as an increasingly worrying problem both at the national and global levels. Therefore, the learning of this material must be developed in an interactive, interesting manner and make students aware of the importance of environmental conservation (Khoirunnida, 2021). While many of the students are active in the environmental movement and support green initiatives, the reality is that many are unaware that they are contributing to the pollution problem, especially through the consumption of single-use products, the intensive use of technology, and lifestyles that rely on digital convenience (Sudaryono & Kartika, 2022). Electronic and plastic waste, as well as carbon emissions from high online activities, such as streaming and cloud computing, are some of the sources of pollution that are often overlooked. This poses a challenge for Gen Z to not only become environmentally conscious consumers but also to realize the need for a balance between the use of technology and environmental sustainability (Setyaningsih et al., 2024). The efforts to reduce the impact of this pollution require significant behavior change and innovation in creating environmentally friendly solutions, which must be trained on Gen Z.

Tackling environmental pollution requires the incredible creativity, as these challenges are increasingly complex and affect almost every aspect of life. Conventional approaches are no longer sufficient to address the ever-increasing scale and impact of pollution. New and innovative ideas are needed, such as the use of green technology, recycling materials with more efficient methods, and the development of environmentally friendly products that can replace polluting products (Sienatra & Evani, 2021). In addition, creativity is also needed in educating the public and changing consumer behavior towards more sustainable habits (Saputri et al., 2024). By thinking beyond traditional boundaries and combining creativity with technology, we can create solutions that are not only effective in reducing pollution, but also contribute to the creation of a healthier and more sustainable environment for future generations (Jamaludin et al., 2023).

Fostering creativity in students is becoming increasingly important in this modern era, where the challenges faced by future generations are increasingly complex and dynamic. Creativity is not only about artistic ability, but also involves the ability to think critically, innovate, and solve problems effectively (Ramadhan & Hindun, 2023). In addition, in an ever-changing world, students need to be trained to think outside the box, find new solutions, and adapt quickly to change. By developing creativity, students will not only be better prepared to face future challenges, but will also be able to contribute significantly in a variety of fields, from technology to the environment (Fricticarani et al., 2023). Learning process that encourages creativity also helps to increase students' confidence and independence, as well as making them more proactive and innovative in pursuing their goals (Jayadih et al., 2024).

Learning with Ecobrick themes/projects is an innovative solution that not only helps to tackle environmental pollution, but also encourages increased creativity (Amriani et al., 2024). Ecobricks are made by filling used plastic bottles with non-organic waste that is difficult to decompose, such as plastic and styrofoam. In this way, waste that would normally pollute the environment is converted into building materials that can be used for a variety of purposes, such as the manufacture of furniture, gardens or even simple building structures. The process of making ecobricks involves creativity in utilizing waste, designing shapes, and assembling finished products. In addition, to reducing the amount of plastic waste that ends up in landfills, ecobricks also offer a way for individuals and communities to contribute directly to protecting the environment (Manurung & Djelantik, 2023). Inisiatif ini tidak hanya meningkatkan kesadaran lingkungan tetapi juga memupuk keterampilan kreatif yang bermanfaat di berbagai aspek kehidupan.

The use of technology for science learning media at the secondary school level that carries creativity can be realized through the Android-based ecobrick application. This application is designed to educate and inspire students in understanding the concept of ecobricks, while encouraging them to actively participate in eco-friendly projects. Through interactive features, such as ecobrick making tutorials, Ecobrick-based building design

simulations, and an online community to share ideas and works, the app not only teaches about recycling but also hones students' creativity in utilizing waste. The use of the Android platform makes the application easily accessible and used at any time, allowing students to learn in a fun and practical way. This is inline with Andhini (2024) stated, that technology not only use as a tool for learning but also for the enhancing skills of creativity and the awareness toward environment in our young generation. By this research, the app-based android of ecobrick of the environmental pollution topics was developed for secondary school level.

METHOD

The research was conducted in Sukabumi Regency, West Java. After the product development process, the feasibility test of the product was continued with a product feasibility test with research subjects of secondary school science teachers in several sub-districts of Sukabumi Regency. The technique of taking subjects used was purposive sampling, handling science teachers who are still actively teaching in 2024 in the sub-districts of Cibadak, Cicurug, Cisaat, Cikembar, Palabuhanratu, Surade, Sagaranten, and Geger Bitung. The number of teacher involved were 20 teachers. In additio, this research involved experts to obtain data for the content validity and the feasibility of the developed application.

The research methods used was *Reserch and Development* (RnD) with ADDIE (*Analiysis, Design, Development, Implementation and Evaluation*) design (Rafles et al., 2023). In this article, the fulcrum of the discussion is on the development process, while the implementation results are only explained to support the success of the development product (Lestari & Dwi, 2023). The steps of the apps-based android of ecobrick as ADDIE designed is pictured in the diagram of Figure 1.

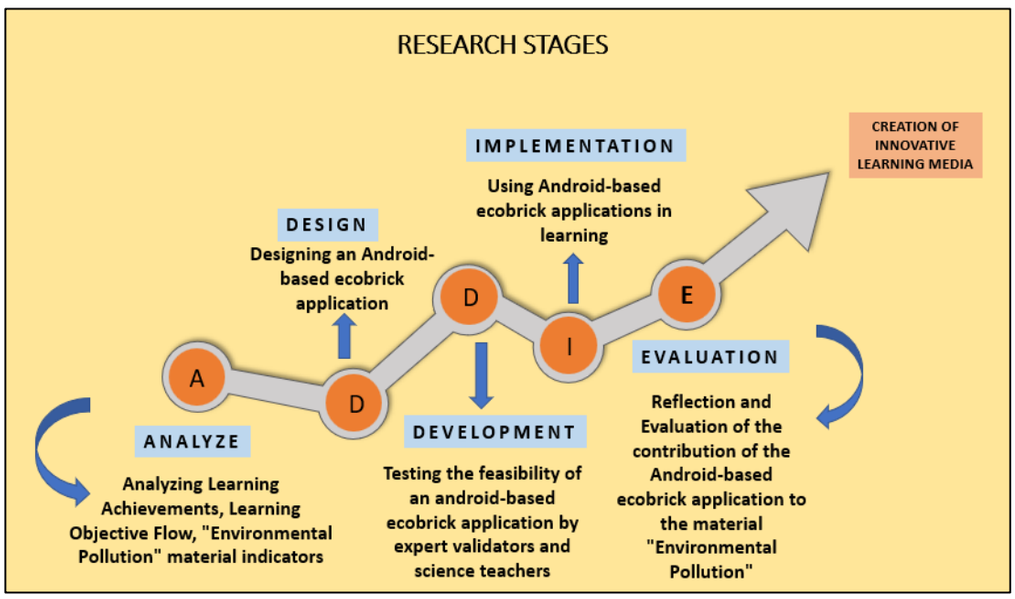


Figure 1. The ADDIE Steps of apps-based androids of ecobricks designing

Analyzing Stage

In the initially stages of the ADDIE development model, a preliminary analysis was carried out to determine the right solution to the problem that must be solved. The analysis carried out includes analysis of Learning Outcomes (CP), Learning Objectives Flow (ATP), indicators of environmental pollution materials that refer to the Independent Curriculum and innovative media that can be used in learning. Observation through questionnaires to junior high school science teachers was also carried out in several areas of Sukabumi Regency to explore the information needed in the context of developing applications that suit the needs and readiness of students.

Designing Stage

The designing stage is the second stage in the ADDIE research and development model. At this stage, flowcharts and storyboards are created as the basis and description of the form, content and appearance of android-based ecobrick application development. In accordance with Bates (2019), the design stage seeks to harmonize between learning objectives, learning materials, activity stages, STEM content, MIT App Inventor products and applications used in the creation of android-based ecobrick applications.

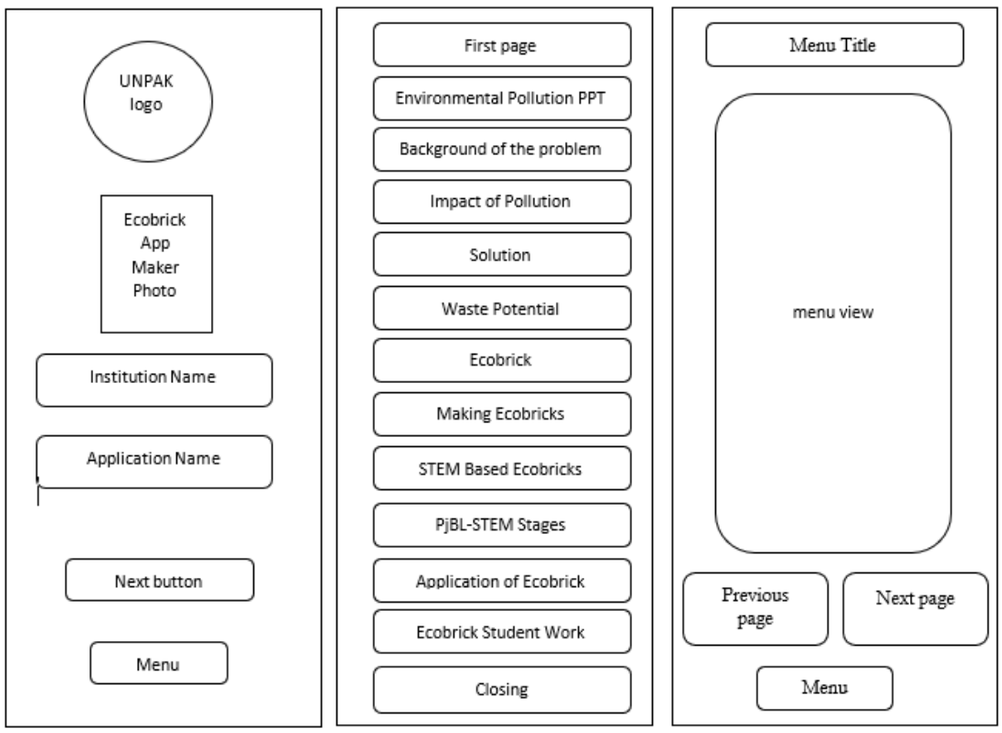


Figure 2. The Story Board of Apps-Android based of Ecobrick

Developing Stage

At this stage, an Android-based Ecobrick application was developed. The app is built with MIT App Inventor media downloaded from appinventor.mit.edu. The app's compatibility is adjusted to android version +5.0. The sources of assets displayed on the application come from personal documentation photos, pengdownload.id (free), and photos from google (free). The application is designed to be easily accessible on android-based mobile phones by users. Validate the android-based ecobrick application to experts (2 expert lecturers in the field of education), then make revisions based on the results of the validation.

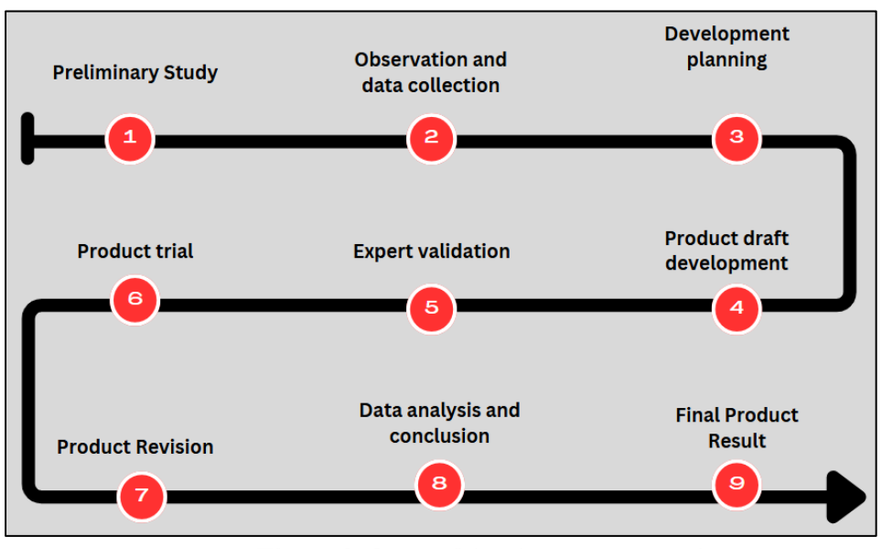


Figure 3. Steps of development research

In data collection, primary data was used that was mined directly to science teachers and expert validators using questionnaires. The questionnaire was developed based on the Likert scale with 4 options, namely Very Good (SB), Good (B), Less (K) and Very Less (SK). The questionnaire contains 5 indicators, namely display feasibility, component completeness feasibility, language feasibility, feasibility of PjBL-STEM learning strategies, and content feasibility. The display feasibility indicator consists of 2 sub-indicators, namely the attractive appearance of the application and the ease of reading text or writing. The indicator of the feasibility of component completeness consists of 4 sub-indicators, namely the cover contains clear information, contains a clear background, objectives and flow of the material, contains a description of the learning stages, and contains complete information.

The linguistic feasibility indicator consists of 5 sub-indicators, namely the language used communicatively, the instructions in the Ecobrick application are clear, the use of language is effective and efficient, the accuracy of using terms, and the conformity with Indonesian rules. The feasibility indicators of the PjBL-STEM learning strategy consist of 4 sub-indicators, namely opening opportunities to build STEM projects, STEM projects are able to solve existing problems, allowing students to actively discover the concept of environmental pollution, and projects to produce innovative products that are easy to do according to the level of student development. The content feasibility indicator consists of 4 sub-indicators, namely the suitability of learning objectives, suitability with student needs and the Independent Learning curriculum, suitability of the difficulty level with students' cognitive development, suitability of the project theme with the material taught.

The questioner results were analyzed descriptively. The questioner data were then analyzed and calculated through the true answer Percentage on using formula as follows (Anastasi & Urbina, 1997), The calculation results were then interpreted as it is shown by table 1.

$$(\%)\ \text{Validity} = \left(\frac{\text{the score obtained}}{\text{maximum score}}\right) \text{x } 100\% \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Table 1. Validity criterion (Lestari & Rispatiningsih, 2023)

No	Interval (%)	Validity Criterion	Response category
1	$0 \leq x \leq 20$	Totally invalid	Totally not feasible
2	$21 \leq x \leq 40$	invalid	Not feasible
3	$41 \leq x \leq 60$	Fairly valid	Fairly feasible
4	$61 \leq x \leq 80$	Valid	feasible
5	$81 \leq x \leq 100$	Very valid	Very feasible

The validation data were then calculated using *Content Validity Ratio* (CVR) and *Content Validity Indeks* (CVI). CVR insdex is for measuring the truth among the validators for certain items (Lawshe, 1975), on using the formula:

$$\text{CVR} = \frac{n_e - (N/2)}{N/_2} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Notes:
n_e : number of respondents who stated it was feasible
N : Total respondents

The CVR value has a range between -1 and 1, if half of all respondents stated "Not Eligible" then the CVR value = 0 ,while the CVR value = 1 when all respondents stated "Eligible". The CVR value obtained from the calculation is accepted if its value is greater than the minimum CVR value (Lawshe, 1975). The standard reference for item validity is shown in Table 2.

Tabel 2. CVR minimum value (Lawshe, 1975)

Total Respondent	CVR Minimum Score
5	0.99
6	0.99
7	0.99
8	0.85
9	0.78
10	0.62
15	0.49
20	0.42

Note: one tailed test, p = 0.05

Content Validity Indeks (CVI) value reflected the totally test can be received ot not, on using the formula (Polit & Beck, 2006),

$$\text{CVI} = \frac{\Sigma\ \text{CVR}}{Sum\ of\ acceptable\ questions} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

RESULT AND DISCUSSION

Based on the research objectives, an android-based ecobrick application has been developed that has been tested for validity and feasibility using the ADDIE model. The results of each stage of activity according to the ADDIE model are as follows,

Analyzing stage

The results of the analysis show that 79 % of teachers have not used innovative technology-based learning media that can be good practices in overcoming environmental pollution. As many as 46 % of respondents use learning media from the internet, 23 % from the Merdeka Mengajar Portal, 15 % design their own, 8 % from MGMP IPA and 8 % from other sources. As many as 79 % of respondents answered that it is very necessary to develop innovative learning media in environmental pollution material and the remaining 21 % answered that it is necessary to develop innovative learning media that makes it easier for teachers to practice good practices in overcoming environmental pollution.

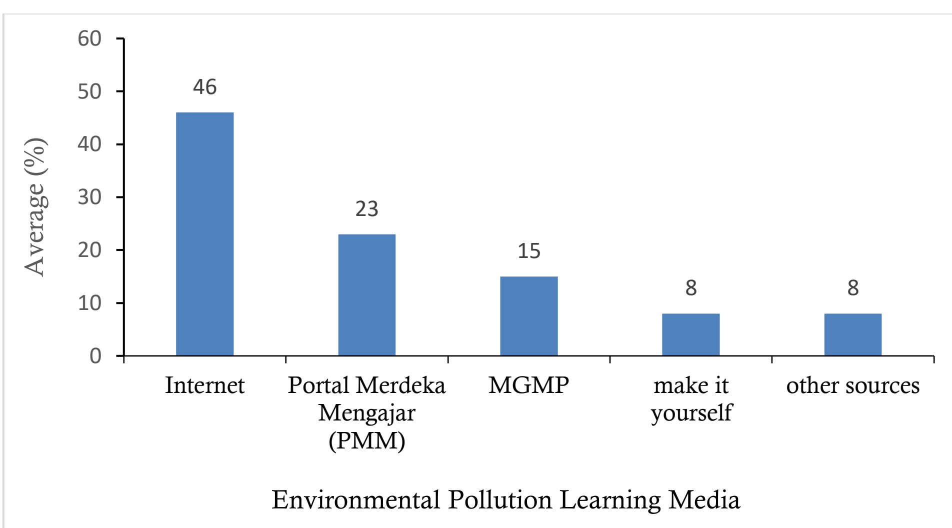


Figure 4. Learning Media Resources In Environmental Pollution Topics

Based on the the needs analysis, the solution that can be proposed to make it easier for teachers is the development of the intended android-based ecobrick application. The results of this analysis are supported by research which states that the use of digital media will attract more attention from students and learning will not seem monotonous and will be much more effective (Meliyani et al., 2022). Prensky (2009) stated that students today are classified as digital natives, it is a generation that has been surrounded by and is also a

user of technology since birth. This indicates that a teacher needs to make adjustments in the selection of learning media, one of which is by using technology in this digital era.

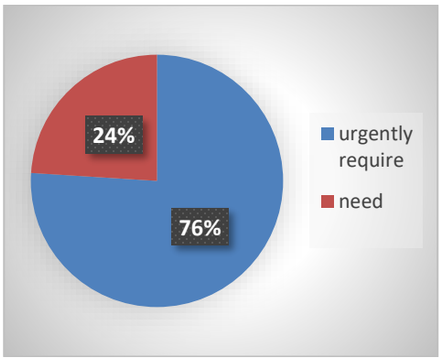


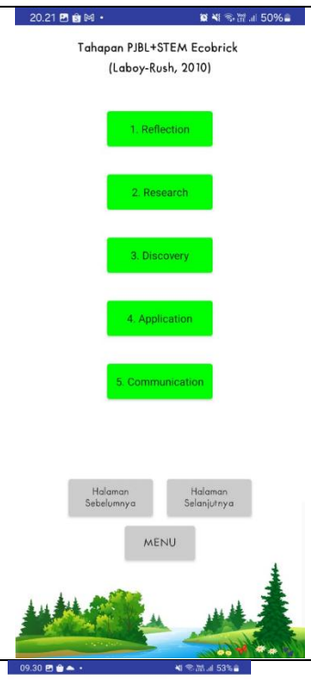
Figure 5. Need Analysis On Innovative Learning Media In The Pollution Topics

Design Stage

At this stage, the ecobrick application was designed by creating a storyboard to place the components of the completeness in the application being developed. The application components are partially displayed in Table 3.

Table 3. Android Based Ecobrick Application Design

Apps Components	Performance	Description
Cover		Showing logo UNPAK, the pictures of the ecobricks-apps desginers, identity of the designers, the program, the apps title, motto, knob" next" , knob "menu"
completteness		Perform menu available in the ecobricks apps.

Apps Components	Performance	Description
The language used		The language used is simple, clear and aquipped with relevant picture
Learning strategy		Describe the steps of learning (fit to sintax) relevant to the models of learning (PjBL-STEM)
Content		Describe problems, alternative solutuion, the coosen solution, the strategy for dolving the problem and the best practice those have been done

Development Stage

The validation steps by practicians were done by the 20 of science teachers selected. The validation ersult were the calculated using CVR dan CVI indexes to figure the validity. Table 4 shows the result of validity calculation wuith CVI and CVR methods.

Table 4. The Validation Result Of Android Based Ecobrick Application By Science Teachers

No	Aspects of validation	CVR index	CVI index	Category
1	Performance	1.00	1.00	valid
2	Component complitteness	1.00	1.00	valid
3	Linguistics	0.97	0.98	valid
4	Learning strategy	0.97	0.98	valid
5	Content	0.98	0.99	valid
	Average	0.98	0.99	valid

The conclusion of the results of the validation of practitioners with the CVI and CVR methods according to Ayre & Scall (2014) shows that the CVR and CVI values are in the valid category. At this stage, the interactive multimedia design that has been made is then realized. The initial design of the ecobrick application is validated and tested for its feasibility by learning experts, namely expert lecturers in education. The results of the validation process and feasibility test are used as a reference for revising the ecobrick application design. The validation process is carried out by submitting the initial draft of the android-based ecobrick application to the validator accompanied by a validation questionnaire. The results of the recapitulation of the validator's answers to the validation questionnaire can be seen in Table 5.

Tabel 5. Expert Validation Report

No	Aspects of validation	Validation index	Category
1	Performance	97	Very feasible
2	Component complitteness	95	Very feasible
3	Linguistics	98	Very feasible
4	Learning strategy	95	Very feasible
5	Content	98	Very feasible
	Average	96.6	Very feasible

Based on Table 5, the highest validation percentage is in the aspects of language feasibility and content feasibility. Meanwhile, the lowest percentage is in the aspect of component completeness feasibility. Component completeness is limited by the size of the MIT App Inventor application file with a maximum storage limit of 30 megabytes (Brown, 2020). In addition to quantitative data, researchers also explored criticism and suggestions for improvement of the Android-based ecobrick application that was developed. The following are suggestions submitted by the validator.

Table 6. Validator Recommendation To The Android Based Ecobrick Application

No	Validator reccomendation
1	The product should be strengthened by the concepts related to the pollutions.
2	The steps of learning should be strengthened
3	The STEM approach shloud be clearly explained

Based on the development results on table 6, basically the android based ecobrick application has met the eligibility as an application to be used in learning. Based on the recommendations of the validator, the development product is then improved to ensure that important concepts are accommodated in the application. Likewise, the learning stages have been clarified so that teachers and students can follow the learning stages more certainly. Likewise, the STEM steps have been improved to provide differences with other approach steps.

The results of the improvements has tried to be applied in learning. The results of the study show that overall, learning using android-based ecobrick application media greatly contributes to students' enjoyment of learning. This has shown giving the great impact for students' awareness of the environment which is very promising. The results of the study show that on average students show awareness of the environment in the very good category. this is in line with the results of the study Talakua & Maitimu (2020) that interactive media-based learning that is in accordance with didactic-pedagogical principles will increase students' awareness of the importance of the subject matter presented.

Meanwhile, the increasing interest of students causes their creativity in learning to also increase. This is shown by the appearance of their products which are on average very good. The teacher thinks that some of the student group's products are very out of the box, beyond what the teacher had previously imagined. This development is in line with what was stated by Haya et al., (2023) that the use of learning media that attracts interest and is based on digital technology can increase student creativity.

CONCLUSION

The product produced in this study was an android-based ecobrick application. The results of the study concluded that the developed ecobrick application was feasible to be used in learning, based on the fulfillment of the CVR index of 0.98 and CVI of 0.99, including the valid category. The feasibility of the expert validator with a percentage of 96.6 % is included in the very feasible category. The results of the study also showed that the use of media in learning can have a good impacts on environmental awareness and student creativity.

ACKNOWLEDGMENT

Thanks to the Directorate of Research, Technology and Community Service (DRTPM), Directorate General of Higher Education, Research and Technology, Ministry of Education, Culture, Research and Technology of the Republic of Indonesia as the funder through the 2024 Master's Thesis Research grant fund that has funded this research. Thanks also to Pakuan University, validators and science teachers in Sukabumi Regency who have contributed to this research.

REFERENCE

Afriza, A. F., Chambar, F. H., Aryanti, N. D., & Bella, S. (2024). Analisis pengaruh gaya hidup berbasis digital dan perilaku konsumtif terhadap kesehatan mahasiswa Fakultas Ilmu Keolahragaan Universitas Negeri Semarang. *Jurnal Analis*, *3*(2), 195–205.

Amriani, S. D., Uzzakah, I., Prakoso, R. A., Sabella, P. A., Surur, M., & Agusti, A. (2024). Analisis penerapan model pembelajaran Project Based Learning (PjBL) untuk meningkatkan kreativitas siswa. *Jurnal Kajian Penelitian Pendidikan dan Kebudayaan*, 2(2), 13-25.

Anastasi, A., & Urbina, S. (1997). *Psychological testing*. 7th edition.). UK: Prentice Hall.

Andhini, D. (2024). Analisis pelaksanaan program destinasi agro edu wisata kebun Bang Jani terhadap kesadaran lingkungan pengunjung (generasi muda) di Kabupaten Bangkalan. *Jurnal Ilmiah Agribisnis*, 8(3), 221-229.

Asmendri, A., & Sari, M. (2019). The Teacher's Perception About Principal Competence In Organizing Madrasah Activities. Proceeding Seminar IAIN Batusangkar, 4(1), 1-4.

Ayre, C., & Scally, A. J. (2014). Critical values for Lawshe's content validity ratio: Revisiting the original methods of calculation. *Measurement and Evaluation in Counseling and Development,* 47(1), 79–86. https://doi.org/10.1177/0748175613513808.

Bates, A. (2019). *Teaching in a digital*. Tony Bates associates Ltd, University of British Coulombia.

Brown, D. (2020). App size limit help. https://community.appinventor.mit.edu/t/app-size-limit-help/19222. Accessed on 10th June 2024

Fitriani, W., Suwarjo, S., & Wangid, M. N. (2021). Berpikir Kritis dan Komputasi: Analisis Kebutuhan Media Pembelajaran di Sekolah Dasar. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, 9(2), 234-242.

Fricticarani, A., Hayati, A., R, R., Hoirunisa, I., & Rosdalina, G. M. (2023). Strategi pendidikan untuk sukses di era teknologi 5.0. *Jurnal Inovasi Pendidikan Dan Teknologi Informasi (JIPTI)*, *4*(1), 56–68. https://doi.org/10.52060/pti.v4i1.1173

Haya, A. F., Kurniawati, K., Hardiyanti, N., & Saputri, I. A. (2023). Pentingnya penerapan literasi digital dalam meningkatkan kreativitas peserta didik di Sekolah Dasar. *Tsaqofah*, 3(5), 850-862.

Ismail, D. H., & Nugroho, J. (2022). Kompetensi kerja gen z di era revolusi industri 4.0 dan society 5.0. *JIIP-Jurnal Ilmiah Ilmu Pendidikan*, *5*(4), 1300–1307. https://doi.org/10.54371/jiip.v5i4.566.

Jamaludin, A., Firmansyah, Y., Afra, A. F., Halimatussa, D., Alfajri, F. A., Fahrezaldi, H. M., Hernalis, H., Firmansyah, I., & Nurasyiah, M. S. (2023). Informasi bagi karang taruna*, UMKM* masyarakat lokal dalam strategi pemasaran *"Cariumulya Creative"*. *Jurnal Buana Pengabdian*, *1*(1), 37–47.

Jayadih, M., Suhardi, H. E., & Rubini, B. (2024). Strategi dan peningkatan kualitas layanan guru: transformasi melalui kepemimpinan, teknologi, kreativitas dan enterpreneurship. Surabaya: Jagad Media Publishing. p. 24.

Khoirunnida, F. (2021). *Penguatan literasi pembelajaran IPS dalam menghadapi perubahan sosial budaya generasi Z era 4.0 (studi kasus kelas IX A MTsN 6 Sampung Ponorogo*. Skripsi Jurusan Tadris Ilmu Pengetahuan Sosial Fakultas Tarbiyah Dan Ilmu Keguruan Institut Agama Islam Negeri Ponorogo.

Lawshe, C. H. (1975). A quantitative approach to content validity. *Personel Psychology,* 28(4), 563–575. doi:10.1111/j.1744-6570.1975.tb01393.x.

Lestari, H. L. H., & Dwi, D. F. (2023). Pengembangan LKPD berbasis inquiry training tema panas dan perpindahannya kelas V SD. *Jurnal Penelitian Pendidikan MIPA,* 7(2), 155-165.

Lestari, W. T., & Rispatiningsih, D. M. (2023). Validitas isi instrumen TPACK pada calon guru kimia menggunakan Aplikasi Model Rasch. *JIMAD: Jurnal Ilmiah Mutiara Pendidikan, 1*(2), 16-25.

Manurung, E.M., & Djelantik, S. (2023). Meningkatkan kesadaran menjaga kebersihan lingkungan melalui sosialisasi Film Citarum. *Jurnal Abdimas Bina Bangsa*, *4*(2), 1570-1581.

Meliyani, A. R., Mentari, D., Syabani, G. P., & Zuhri, N. Z. (2022). Analisis Kebutuhan Media Pembelajaran Digital Bagi Guru Agar Tercipta Kegiatan Pembelajaran yang Efektif dan Siswa Aktif. *Jurnal Jendela Pendidikan, 2*(2), 264-274.

Rahmawati, L. (2022). The Estimation of Ground Carbon Stock in The Tourist Forest Area Ngalau Indah Payakumbuh. *Jurnal Biologi UNAND, 10*(2), 78-84.

Sari, M. U., & Asmendri, A. U. (2020). Natural Science: Jurnal Penelitian Bidang IPA dan Pendidikan IPA Website. *Natural Science*, *6*(1), 41-53.

Pare, A., & Sihotang, H. (2023). Pendidikan holistik untuk mengembangkan keterampilan abad 21 dalam menghadapi tantangan era digital. *Jurnal Pendidikan Tambusai*, *7*(3), 27778–27787.

Polit, D. F., & Beck, C. T. (2006). The content validity index: are you sure you know

what's being reported? critique and recommendations. *Research in Nursing & Health*, *29*(5), 489-497. doi:10.1002/nur.20147.

Prensky, M. (2009). H. sapiens digital: From digital immigrants and digital natives to digital wisdom. *Innovate: journal of online education*, *5*(3), 110-119.

Putra, L. D., & Pratama, S.Z.A., (2023). Pemanfatan media dan teknologi digital dalam mengatasi masalah pembelajaran. *Journal Tranformation of Mandalika*, *4*(8), 323-329.

Rafles, R., Riswandi, R., Nurwahidin, M., Herpratiwi, H., & Yulianti, D. (2023). Efektivitas desain pelatihan model ADDIE untuk meningkatkan kompetensi guru sekolah minggu. *Media Bina Ilmiah*, 17(7), 1327-1336.

Ramadhan, E. H., & Hindun. (2023). Penerapan model pembelajaran berbasis proyek untuk membantu siswa berpikir kreatif. *Jurnal Bahasa, Sastra, Budaya, Dan Pengajarannya (Protasis)*, *2*(2), 43–54. https://doi.org/10.55606/protasis.v2i2.98.

Ramadhani, N., Sutabri, T. (2024). Analisis Jaringan 5G Terhadap E-Commerce di Indonesia. *Scientica: Jurnal Ilmiah Sains dan Teknologi,* 2(6), 79-83

Said, S. (2023). Peran tekonologi sebagai media pembelajaran di era abad 21. *Jurnal PenKoMi: Kajian Pendidikan & Ekonomi*, *6*(2), 194–202.

Saputri, D., Syahbanu, N. A., Wahab, M. A., Wakhyudi, M. D., Laksono, A. N., Manik, I. V., ... & Rafsanzani, M. R. (2024). Pengamatan terhadap Kebiasaan Membuang Sampah Plastik Kemasan Makanan Mahasiswa UNNES. *Jurnal Analis, 3*(1), 1-13.

Setyaningsih, A., Permatasari, R., Hita, I. P. A. D., Sabur, F., & Al Haddar, G. (2024). Pemanfaatan sistem pengukuran otomatis untuk menilai kemajuan belajar siswa pada materi sains. *Jurnal Review Pendidikan Dan Pengajaran (JRPP), 7*(2), 4048-4057.

Sienatra, K.B., & Evani, E.S. (2021). Efek green marketing mix terhadap minat beli produk ramah lingkungan. *Jurnal Managemen Bisnis dan Kewirausahaan, 5*(2), 220-225.

Sudaryono, H. N. B., & Kartika, L. (2022). Strategi internalisasi green behavior berbasis pendidikan pada generasi Z untuk terwujudnya lingkungan sehat bagi Indonesia Emas 2045. *Among Makarti, 15*(1), 38-51.

Talakua, C., & Maitimu, C. V. (2020). Efektifitas media pembelajaran berbasis smartphone untuk mengembangkan sikap peduli lingkungan peserta didik: (The effectiveness of smartphone based learning media to develop attitudes caring for students' environmental). *Biodik, 6*(3), 392-401.

Urba, M., Ramadhani, A., Afriani, A. P., & Suryanda, A. (2024). Generasi Z: apa gaya belajar yang ideal di era serba digital?. *DIAJAR: Jurnal Pendidikan dan Pembelajaran*, *3*(1), 50-56. https://doi.org/10.54259/diajar.v3i1.2265.

Utomo, T. P. (2019). Potensi implementasi Internet of Things (IoT) untuk perpustakaan. *Buletin Perpustakaan Universitas Islam Indonesia*, *2*(1), 1–18.

How To Cite This Article, with *APA style* :

Rubini, B., Hapipah, H., & Permanasari, A. (2024). Development of Ecobrick Application – Based Android as an Innovative Media in Environmental Pollution Learning. *Jurnal Pembelajaran dan Biologi Nukleus*, *10*(3), 932-943. https://doi.org/10.36987/jpbn.v10i3.6162

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author contributions All authors contributed to the study's conception and design. Material preparation, data collection and analysis were performed by all authors. The first draft of the manuscript was submited by [**Hepi Hapipah**]. All authors contributed on previous version and revisions process of the manuscript. All authors read and approved the final manuscript.