JPPIPA 10(11) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Development of Augmented Reality Based Flipbook Media on Natural Science Subject Matter of Ecosystems

Kurnia Lita Cahya[1*], Kurniana Bektiningsih[1]

[1] Elementary School Teacher Education, Faculty of Education and Psychology, Universitas Negeri Semarang, Semarang, Indonesia.

Received: May 11, 2024
Revised: August 03, 2024
Accepted: November 25, 2024
Published: November 30, 2024

Corresponding Author:
Kurnia Lita Cahya
kurnialitaa@gmail.com

DOI: 10.29303/jppipa.v10i11.7630

Abstract: This research aims to develop flipbook media based on augmented reality using ecosystem material. Research and Development (R&D) is the research method used, while ADDIE is a development model consisting of analysis, design, development, implementation, and evaluation. Tests and non-tests are used for data collecting, while qualitative and quantitative methods are employed for data processing. The study's participants comprised 22 fifth-grade pupils and an educator from SDN Sidomulyo 3. The outcomes demonstrated how extremely possible it is to use Flipbook media with augmented reality for education. Media, material, and language expert validation scored 90, 94, and 92%. The normality test results indicate that the data is normally distributed, with the Sig. The pretest value was 0.74 > 0.05, and the Sig. Postest value of 0.14 > 0.05. A paired sample t-test showing the impact of employing Augmented Reality-based Flipbook media in learning, with a Sig. (2-tailed) 0.00 < 0.05. The n-gain test shows 0.78 with a high category. In light of these findings, it may be said that augmented reality-based Flipbook media is feasible and effective for learning IPAS Ecosystem content in grade V elementary school.

Keywords: Augmented reality; Ecosystem; Flipbook; Learning media

Introduction

Education plays a vital role in educating human life. Education is a means to develop potential and endeavors to enhance the caliber of human capital (Amania et al., 2021). This is because education has a function and purpose to create a learning process and an organized learning atmosphere so students can optimally develop their potential. Education is also used as a measure of the progress of a country. The more advanced a country is, the better the quality of education. Quality education will produce the next generation of intelligent people who can compete in the future. Therefore, the government continues to address various problems in education, ranging from limited access to education, teaching quality that still needs to be improved and inadequate education infrastructure.

Natural Science, combined with Social Science, or IPAS, are two scientific disciplines that study inanimate and living objects in the universe and their interactions. They also study human life as an individual and a social being interacting with his neighborhood. Natural Science represents a collection of knowledge assembled logically and systematically by considering cause and effect. Natural Science includes the study of nature and natural phenomena, such as astronomy, biology, geology, physics, chemistry, and many more (Johan et al., 2023; Permana et al., 2021). Meanwhile, Social Science studies how humans interact, form societies and influence their environment. Social Science includes the study of social interaction, culture, history, geography, economics, politics, and others (F et al., 2022; Waisakanitri et al., 2023). Social Studies will help students to analyze problems from various points of view (Meldina et al., 2020).

How to Cite:
Cahya, K. L., & Bektiningsih, K. (2024). Development of Augmented Reality Based Flipbook Media on Natural Science Subject Matter of Ecosystems. *Jurnal Penelitian Pendidikan IPA*, *10*(11), 8436–8445. https://doi.org/10.29303/jppipa.v10i11.7630

Learning is one of the most critical processes in realizing quality education (Oktavia & Agustin, 2020; Utami, 2023). Teachers must deliver quality learning to optimize learning objectives (Gama et al., 2016). One way to attain educational goals is by optimizing learning media (Sidabutar et al., 2017). Utilizing educational materials in elementary schools is crucial because students at this level are primarily in the concrete operational stage of development (Nevyanti et al., 2017; Nikmah & Suryanti, 2018). Learning media serves as a tool or mechanism to facilitate students' comprehension of the material presented by the teacher, thereby fostering a conducive, effective, and efficient learning atmosphere (Elan et al., 2017; Maulidah & Aslam, 2021).

However, in reality, using technology-based learning media is still not optimal. This is due to the limited ability of teachers to develop technology-based learning media (Pramana & Suarjana, 2019; Wisada et al., 2019). Based on the results of observations and interviews with the fifth-grade teacher of SDN Sidomulyo 3, it can be seen that student learning outcomes are still low. This is due to the growing necessity for increased utilization of learning media, the teacher's assumptions about the IPAS subject content, the absence of diversity in instructional models and methodologies, and findings indicating low academic achievement.

Teachers have not used learning media optimally because the use of media is too time-consuming. Teachers only use learning media such as concrete objects, pictures, posters, PowerPoint, and videos. These media are only used occasionally in learning because of the limited number of LCDs and projectors, causing teachers to take turns with other teachers when using them. The absence of diversity and intensity of utilizing learning media can sometimes diminish students' enthusiasm and make them less interested in the subject matter presented. Teachers also assume that IPAS is a rote subject, so teachers only convey material without instilling the concept of IPAS material. This impacts students who tend to memorize material instead of finding their material concepts.

The approach employed by the teacher in instruction is an expository learning model that emphasizes the teacher to convey material verbally until students understand. The lack of learner participation causes one-way communication. Meanwhile, the method applied by the teacher in learning is a lecture. This approach has yet to succeed in fully engaging students. Many students remain passive and do not dare to express their opinions. This indicates that students' motivation to learn still needs to be improved because the teacher needs to use a variety of learning models and methods.

This issue is compounded by data regarding the academic performance of fifth-grade students at SDN Sidomulyo 3 in the Odd Semester Final Summative (SAS), where the Criteria for Achieving Learning Objectives (KKTP) set for the IPAS subject is 70. The data shows that 6 out of 22 students (27%) get scores above KKTP, while 16 other students (73%) get below KKTP. It can be concluded that student learning outcomes are still low, so the quality of IPAS learning implementation still needs to be improved.

Given these challenges, there is a need for innovation in learning media to enhance fifth-grade elementary school students' activeness and learning outcomes. Therefore, researchers developed augmented reality-based flipbook media. Flipbooks are technology-based interactive teaching materials that contain text, sound, video, and animation and can encourage student activeness in the educational process (Abadiyah et al., 2018; Damayanti et al., 2022). Previous studies indicate that flipbooks can improve students' critical thinking skills (Roemintoyo & Budiarto, 2021). Modification of flipbook media and augmented reality are anticipated to assist students in comprehending information and grasping initial about ecosystem material in real-time. Augmented reality (AR) is an emerging technology that seamlessly integrates two-dimensional or three-dimensional objects and then projects them into the natural environment (Hakim, 2018; Utami et al., 2021).

Research on Flipbook and Augmented Reality has been widely done. The results of the attractiveness trial by students produced a figure of 98.80% with the category very interesting (Kholiq, 2020). The t-test results the obtained significance value (Sig.) of 0.00 < 0.05, this indicates a significant difference between pretest and post-test scores. Additionally, the n-gain test results yielded an average of 0.45, falling within the moderate category (Damayanti et al., 2022). The validity of augmented reality-based flipbook media is established and practical for learning (Atut et al., 2023; Azhar et al., 2021). The disparity between this study and prior research lies in the selected material namely ecosystems, and the addition of video content and quizzes in augmented reality-based flipbook media to clarify the content learned. Another difference lies in the research model, place, and subject. Previous research used the Borg and Gall development model, while this study used the ADDIE research model. The previous research was conducted at SMPN 30 Pekanbaru, while this research was conducted at SDN Sidomulyo 3. The subjects of the previous study were 30 seventh-grade students and physics teachers of

SMPN 30 Pekanbaru, while this study used research subjects of 22 fifth-grade students and fifth-grade teachers of SDN Sidomulyo 3.

One advantage of AR-based Flipbook media is its accessibility from anywhere and anytime with attractive 3D features. This media is packaged attractively so students are interested in the material described. Moreover, students are anticipated to become more active in their interactions with the media to create active, interactive, and fun learning. This study aims to create AR-based flipbook media for Natural and Social Sciences (IPAS) lessons targeted at fifth-grade elementary school students.

Method

The research approach utilized is research and development (R&D), which emphasizes the development and innovation of new products while assessing the effectiveness of existing ones (Sugiyono, 2019). The research model employed in the development of augmented reality-based flipbook media is the ADDIE model, comprising five stages: analysis, design, development, implementation, and evaluation (Wicaksana et al., 2020). The research flow is illustrated in Figure 1.

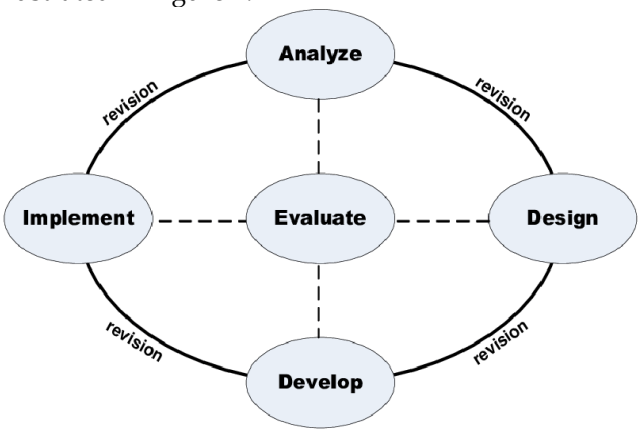

Figure 1. ADDIE model chart

The augmented reality-based flipbook media development research was conducted at SD Negeri Sidomulyo 3, Dempet District, Demak Regency. The participants in this study were 22 students and a 5th-grade teacher in elementary school. The study utilizes both quantitative and qualitative data analysis techniques. Quantitative data were gathered using the media viability test, surveys, and the pretest and posttest results. These data were processed and analyzed using SPSS version 25 for Windows and Microsoft Excel. Meanwhile, qualitative data was obtained through interviews, observations, and documentation.

The learning media created an augmented reality-based flipbook and was assessed for feasibility by elementary school experts in media, material, and language teacher preparation.

Table 1. Grid for the media expert assessment instrument

Aspects	A indicate
Acceptability	The media is suitable for the subject being learned
Look	Quality of media display
Application	Teachers and students can easily use media
Excellence	Media is easy for users to understand

Table 2. Grid for the material expert assessment instrument

Aspects	A indicate
Competency	Acceptability of IPAS composition of the materials with learning outcomes
Suitability	The suitability of IPAS material with AR-based flipbook media and learning evaluation
Language	Language clarity

Table 3. Grid for the language expert assessment instrument

Aspects	A indicate
Direct	The vocabulary used is practical and straightforward
Communicative	The information conveyed can be understood by students
Suitability with student development	The language used is appropriate for students' emotional and intellectual development
Conformity with language rules	The language used is by EYD

Each expert's percentage of feasibility assessment (P) can be computed using the formula that follows (Wulandari et al., 2020).

$$\mathrm{NP} = \frac{\mathrm{R}}{\mathrm{SM}} \times 100\% \quad (1)$$

Details:
NP = The desired or anticipated percentage
R = Initial score
SM = Maximum score overall

Table 4. Criteria for expert validation assessment

Percentages (%)	Criteria	Category
81–100	Very decent	Without revision
61–80	Feasible	Without revision
41–60	Decent enough	Revised
21–40	Less feasible	Not feasible
< 20	Not feasible	Very unfit

Following the computation of the feasibility evaluation (P) results are obtained, the next step is to look at the assessment category in Table 4. A normality test is performed to identify the kind of statistics used when processing data. Researchers conducted a normality test with the Shapiro-Wilk method.

Table 5. Normality test criteria

Results	Information
Significance value ≤ 0.05	H_0 declined
Significance value > 0.05	H_0 acknowledged

(Priyatno, 2018)

The T-test for Paired Samples was performed to compare the average of two matched or related groups.

Table 6. Paired sample t-test criteria

Results	Information
Significance value. ≤ 0.05	H_0 declined
Significance value. > 0.05	H_0 acknowledged

(Priyatno, 2018)

To find the average difference between the pretest and posttest scores, the n-gain test was used (Sesmiyanti et al., 2019).

$$\text{N} - \text{Gain} = \frac{\text{S Pre} - \text{S Post}}{\text{S Max} - \text{S Pre}} \quad (2)$$

Information:
N-Gain = N-Gain Value
S Pre = Pretest Score
S Post = Post-test Score
S Max = Maximum Score

Table 7. N-Gain score criteria

Coefficient Interval	Criteria
N-gain < 0.30	Low
0.30 < n-gain < 0.70	Medium
N-gain > 0.70	High

Result and Discussion

Result

Augmented Reality-based Flipbook media presents an exciting and interactive learning experience by combining 2D and 3D visual elements, video, audio, and quizzes to help students understand material concepts in depth.

Needs Analysis Stage

In developing flipbook media with augmented reality, conducting a needs analysis is essential as it serves as a roadmap. This analysis involves examining the content, identifying student needs, and understanding student characteristics. Interviews, observations, and disseminating needs questionnaires were used to analyze needs and target educators and students. The information gathered from these methods was then compiled and presented in Table 8, showcasing the findings from the needs questionnaire administered to both teachers and students.

Table 8. Findings from the needs questionnaire for teachers and students

Respondent	Percentages (%)
Teacher	85
Students	92
Average	88.50

Based on Table 8, the teacher percentage results get a figure of 85%, and the student percentage results get a figure of 92% with an average percentage of 88.50%. Fifth-grade students and teachers need interactive learning media to improve learning outcomes, activate participation, and facilitate the delivery of very complex Ecosystem material.

Design Stage

The design stage is an essential step in developing learning media. The design stage 3 actions are carried out, namely planning, procedure, and evaluation. Planning includes analyzing learning outcomes, learning objectives, and learning materials. In the process stage, researchers developed augmented reality-based flipbook media. Then, in the evaluation, researchers made a questionnaire to measure the reactions of educators and pupils to the media. Table 9 illustrates the attainment of IPAS learning outcomes.

Table 9. Achievements grade V IPAS learning outcomes

Learning outcomes	Learning objectives
Learners investigate how interdependence between biotic-abiotic components can affect the stability of an ecosystem in the area around them	Examine the role of food webs (C4). Analyze the impact of ecosystem imbalance (C4). Draw conclusions about the elements driving initiatives to address the ecosystem imbalance (C5). Present the impact of ecosystem imbalance (P5).

The content of the media is Ecosystems, which is based on Table 9, which lists the learning objectives that serve as the foundation for media creation. The Augmented Reality-based flipbook includes a cover slide, preface, contents table, description of a flipbook,

instructions for use, learning objectives and outcomes, concept map, material, AR barcode, learning video, and word wall quiz.

Development Stage

Researchers developed augmented reality-based flipbook media using ecosystem material during the development phase. Flipbook media is designed using Canva Pro. The media is made with A4 size or 29.7 cm long and 21 cm wide. The media is designed with colors, images, and exciting animations tailored to elementary school students' characteristics. In addition, augmented reality was created using Assemblr Studio 1.4.1 software. The first step to creating AR is establishing a project that enters the marker area page. In the marker area, 3D objects, text, annotations, and supporting animations are added according to the design developed. The next step, namely making an AR indicator in the shape of a QR code, the QR code will be embedded in the flipbook media design that has been made. AR-based Flipbook media is shared as an HTML 5 website accessible via smartphone or laptop, facilitating students' access to the media. The developed media undergoes testing by experts in media, materials, and language. This validation process involves administering a questionnaire to these experts to assess the feasibility of the media before proceeding to further testing phases.

Figure 2 below shows the data from several experts' recapitulation of assessment validation results.

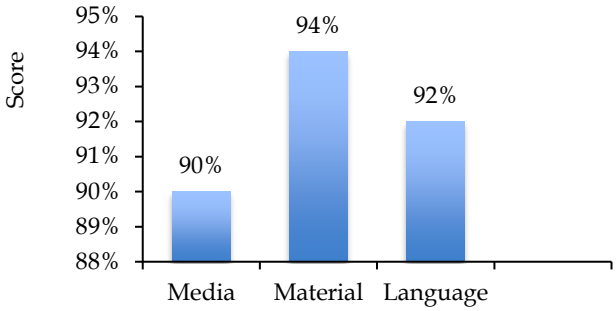

Figure 2. Diagram of Assessment Validation for Every Component

Considering the above figure, the media specialist scored 90%, with the expert confirming that appropriateness, appearance, excellence, and use are feasible to be tested. The material expert scored 94%, with experts showing that competence, suitability, and language are very feasible to be tested. In addition, linguists scored 92%, which confirmed that the language's effectiveness, rigor, interactivity, and appropriateness were feasible to test, suggesting that foreign words should be italicized. The cover before and after revision is shown in Figures 3 and 5, while the augmented reality display is shown in Figure 4.

Figure 3. Flipbook display before revision

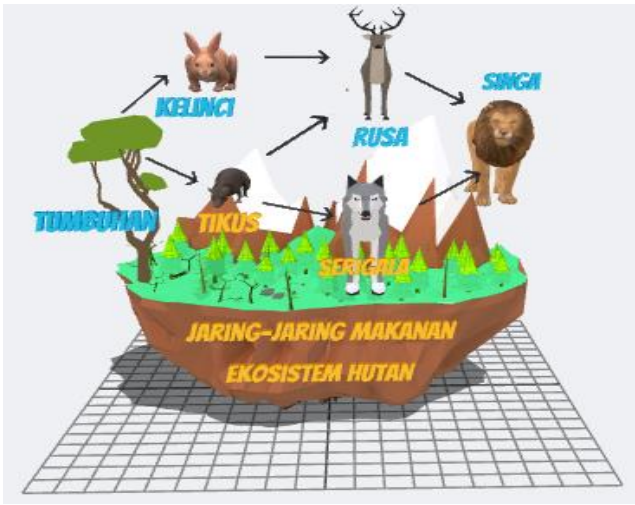

Figure 4. Augmented reality food webs

Depending on the findings of the validation process for each component's assessment, the Augmented Reality Flipbook is highly feasible for use in education IPAS ecosystem material.

Figure 5. Flipbook display after revision

Implementation Stage

The third step of development is the implementation stage. Right now, researchers need to make sure the media evolved can help students achieve learning objectives, overcome problems in learning, and improve student learning outcomes. At this stage, product trials were conducted in class V to ascertain the efficacy and feasibility based on Augmented Reality Flipbook media. The effectiveness of AR-based Flipbook media was demonstrated by the pretest and post-test outcomes of a large group of 16 fifth-grade students of SDN Sidomulyo 3. The pretest was given before using AR-based Flipbook, while the post-test was given after using AR-based Flipbook media.

Table 10. Normality test results

	Statistics	Df	Sig.
Pretest	.96	16	.74
Postest	.91	16	.14

The results of the large group trial's normalcy test are displayed in the table above. The data shows the Sig. Pretest 0.74 > 0.05 and Sig. Post-test 0.14 > 0.05. The data is normally distributed based on these findings so that further data analysis can use the paired sample t-test approach using the t-test.

Table 11. Results of paired sample t-tests

		t	Df	Sig. (2-tailed)
Pair 1	pretest-postest	-18.52	15	.00

The table above is the large group trial's paired sample t-test result. If the data displays Sig. (2-tailed) 0.00 < 0.05, H_a is accepted, and H_0 is denied. The extensive group study shows a substantial difference between the pretest and posttest outcomes. In other words, utilizing augmented reality-driven students in grade V elementary school achieve better learning outcomes while using flipbook media.

Evaluation Stage

This stage is the last in media development. The evaluation stage aims to get instructors and students' input, suggestions, and feedback. Through the evaluation stage, researchers can identify strengths and shortcomings and build better versions of the existing material. Formative and summative assessments are utilized. Testing the medium and examining the n-gain value obtained completes the evaluation stage. Table 12 displays the n-gain test results for AR-based Flipbook material.

Table 12. Results of the n-gain test

Descriptive statistics

	N	Min.	Max.	Mean	Standart deviation
N-gain score	16	.67	.91	.78	.08
Percentage of n-gain (%)	16	66.70	90.10	78	8.30

Based on Table 12, the n-gain value shows several 0.78 with a high category. Augmented Reality-based Flipbook media is effective in learning. Additionally, during the product trial stage, researchers distributed answer questionnaires to teachers and students to gather data on their reactions to the media and the outcomes of the pupil's response questionnaire, as shown in Table 13.

The Table 13 shows that, with a percentage of 90.30%, students reacted favorably to the Augmented Reality-based Flipbook media on the IPAS lesson material of Ecosystem Material. Based on these results, using AR-based Flipbook media is effective in learning.

Table 13. Recapitulation of student feedback questionnaires

Component	The percentage (%)
Small group settings are suitable for utilizing AR-based flipbook media AR-oriented	92
The font size and type used in flipbook media are readable and clear	91
AR-enabled flipbook content is intriguing	86
Every element of AR-based flipbook media may be seen clearly	84
One of the topics covered in the AR-based flipbook medium is ecosystems	90
The content of AR-based flipbook media is straightforward to comprehend	88
AR-powered flipbook content inspires pupils to learn	92
AR-based flipbook media fosters an engaging and enjoyable learning environment	94
One of the topics covered in the AR-based flipbook medium is ecosystems	96
Overall	90.30

Discussion

Utilizing technology will create an exciting and fun learning atmosphere for students (Chang & Chou, 2015). Augmented Reality-based Flipbook media is an innovative learning media with many advantages, so it is the right choice for developing interactive learning media. The advantages of augmented reality-based flipbook media include interactive, practical, widely implemented, and cost-effective manufacturing. It only requires the internet and simple object models, can be accessed anywhere and anytime, and is easy to operate.

Flipbook is one of the well-known visual communication media to convey information (Akçayır et al., 2016). The content of the flipbook material is tailored to suit the requirements of educators and learners, as well as the desired learning outcomes. The presentation of short, engaging, and colorful material is the advantage of a flipbook (Kristina et al., 2023). Flipbook collaborated with Augmented Reality technology to increase innovation in learning so that the knowledge transfer process can be adequately achieved (Arifitama, 2018).

Augmented reality media can facilitate student understanding because it has a 3D form. This aligns with research by Suroiya & Prasetya (2021), which explains that AR educational materials can alter one's perspective and pupils' comprehension initially abstract due to verbalism. However, with this media, students get direct experience. Another research by Putri & Frans (2020) stated that augmented reality is one of the alternatives to obtaining accurate and comprehensive knowledge.

Another advantage of the Augmented Reality-based Flipbook is that it can be downloaded through the Canva platform and Assembly Studio 1.4.1; it provides a range of outputs, making it more straightforward for educators to select the best alternative to their own and their students' needs. The website is one of the readily available outputs. However, this media has disadvantages, including the need for smooth internet support and current smartphones. Smooth internet access is necessary for this media and will lack assistance if it is available using an old gadget version.

Augmented reality-based Flipbook media is needed for learning. An average percentage of 88.50% was obtained from the validation process, which included teacher and student needs questionnaires. This indicates strong acceptance and effectiveness. Furthermore, linguists, media specialists, and material experts have thoroughly tested the viability of AR-based Flipbook media. The evaluation, which several specialists have validated, attempts to determine whether a developed media is appropriate and helps identify its developed appropriateness, as well as its advantages and weaknesses. Media validation is assessed on suitability, appearance, use, and advantages. Material validation was assessed based on suitability, competence, and language. Language validation is assessed based on effectiveness, standardization, interactivity, and language suitability. The validation results from both media and material experts indicate that augmented reality-based Flipbook media focusing on the maple ecosystem within IPAS has been well-received and deemed effective, getting a value of 90 and 94%, respectively, with a highly feasible category to be tested. In comparison, linguist validation receives a 92% rating with a feasible category to be tested, suggesting that foreign words should be written using italics.

The data tested were given a Sig value and dispersed normally Pretest Sig. 0.74 > 0.05 Postest 0.14 > 0.05 results in H_a acceptance and H_0 rejection. The result of using augmented reality-based Flipbook media to measure learning objectives prior to and after education can be seen from the paired sample t-test findings; this displays the Sig value. two-tailed) 0.00 < 0.05, at which point H_a is accepted and H_0 is denied. The effectiveness of AR-based Flipbook on IPAS maple Ecosystem content is analyzed from the value of large group post-test and pretest results, which have a 0.78 average gain (n-gain) with a high category. Questionnaires of student responses to the media got a positive response of 90.30%, and it is clear that using

Flipbook media with augmented reality to improve student learning results works.

Overall, augmented reality-based flipbook media for grade V SD effectively improves student learning outcomes on ecosystem material. The n-gain test results support this, with 20 pupils receiving a score of 0.75 in the high group (Susanto et al., 2023). AR-based flipbook media can increase student participation in learning. Other studies also explain that augmented reality-based digital flipbook media are valid, practical, and highly attractive (Crew et al., 2022; Fatih et al., 2023). Therefore, researchers developed augmented reality-based Flipbook that stimulates students to participate actively in learning.

Conclusion

Researchers have developed Flipbook media with AR used as a method of R&D and ADDIE model. Media, material, and language expert validation scored 90, 94, and 92% with very feasible categories. The normality test results indicate that the data is normally distributed, with the Sig. The pretest value was 0.74 > 0.05, and the Sig. Postest value of 0.14 > 0.05. A paired sample t-test showing the impact of employing Augmented Reality-based Flipbook media in learning, with a Sig. (2-tailed) 0.00 < 0.05. The n-gain test shows 0.78 with a high category. It may be said that augmented reality-based Flipbook media is feasible and effective for learning IPAS Ecosystem content in grade V elementary school.

Acknowledgments
The researcher expresses gratitude to the principal, teaching staff, teachers, and students of SDN Sidomulyo 3, who have allowed, provided services, and helped the researcher during the research. Additionally, the researcher is grateful to the supervisor who provided guidance and directed and motivated the researcher to complete this article.

Author Contributions
Conducted research, collected data, developed and tested learning media, made needs questionnaire instruments, response questionnaires, media, material, and language expert validation assessment questionnaires, processed data, and wrote articles, K.L.C.; as the supervisor, is in charge of guiding, directing, and validating research instruments, K.B.

Funding
This research received no external funding.

Conflicts of Interest
The authors declare no conflict of interest.

References

Abadiyah, R., Prihatin, J., & Murdiyah, S. (2018). Development of Biology Interactive Digital Flipbook on Animal Growth and Development. *Bioedukasi*, *April*, 61-68. https://doi.org/10.19184/bioedu.v16i1.7723

Akçayır, M., Akçayır, G., Pektaş, H. M., & Ocak, M. A. (2016). Augmented Reality in Science Laboratories: The Effects of Augmented Reality on University Students' Laboratory Skills and Attitudes Toward Science Laboratories. *Computers in Human Behavior*, *57*, 334–342. https://doi.org/10.1016/j.chb.2015.12.054

Amania, M., Nugrahanta, G. A., & Kurniastuti, I. (2021). Pengembangan Modul Permainan Tradisional sebagai Upaya Mengembangkan Karakter Adil pada Anak Usia 9-12 Tahun. *Elementary School: Jurnal Pendidikan dan Pembelajaran Ke-SD-An*, *8*(2), 237–251. https://doi.org/10.31316/esjurnal.v8i2.1230

Arifitama, B. (2018). Bahan Ajar Flipbook Online Matakuliah PTI Menggunakan Pendekatan Augmented Reality. *Jurnal Teknodik*, *22*(1), 15. https://doi.org/10.32550/teknodik.v21i3.336

Atut, R., Patonah, S., & Agustini, F. (2023). Pengembangan Media Flipbook Berbasis Augmented Reality pada Materi Siklus Air Kelas V SDN Bugangan 01. *Indonesian Journal of Elementary School*, *3*(24), 263–274. Retrieved from https://journal.upgris.ac.id/index.php/ijes/article/view/17148%0Ahttps://journal.upgris.ac.id/index.php/ijes/article/download/17148/7494

Azhar, A., Herfana, P., Nasir, M., Irawan, D., & Islami, N. (2021). Development of 3D Physics Learning Ledia Using Augmented Reality for First-Year Junior High School Students. *Journal of Physics: Conference Series*, *2049*, 012036. https://doi.org/10.1088/1742-6596/2049/1/012036

Chang, C. M., & Chou, C. (2015). An Exploratory Study of Young Students' Core Virtues of E-Character Education: The Taiwanese Teachers' Perspective. *Journal of Moral Education*, *44*(4), 516–530. https://doi.org/10.1080/03057240.2015.1048791

Crew, M., Siregar, T. M., Ritonga, A., Darma, J., & Dongoran, F. R. (2022). The Development of Digital Books Aided Augmented Reality (AR) to Improve Self Efficacy in Favor of Distance Learning. *Journal of Education, Health and Sport*, *12*(9), 61–67. https://doi.org/10.12775/JEHS.2022.12.09.008

Damayanti, N. S., Handoyo, E., & Suratno, S. (2022). Developing A Local Wisdom-based Interactive Flipbook with a Problem-based Learning Model to

Enhance Critical Thinking Skills. *Journal of Primary Education*, *11*(2), 178–190. Retrieved from https://journal.unnes.ac.id/sju/index.php/jpe

Elan, E., Muiz, L. D. A., & Feranis, F. (2017). Penggunaan Media Puzzle untuk Meningkatkan Kemampuan Mengenal Bentuk Geometri. *Jurnal Paud Agapedia*, *1*(1), 66–75. https://doi.org/10.17509/jpa.v1i1.7168

F, R., Rohiat, S., & Elvinawati, E. (2022). Pengembangan Multimedia Pembelajaran Interaktif Berbasis Problem Based Learning (PBL) Menggunakan Aplikasi Articulate Storyline pada Materi Ikatan Kimia. *Alotrop*, *6*(1), 70–79. https://doi.org/10.33369/alo.v6i1.21799

Fatih, M., Khomaria, A., Aswitama, L. D., Latif, N. A., & Hidayat, M. M. (2023). Flip Book Digital Berbasis Aughmented Reality Materi Balok dan Kubus Siswa Kelas V SDN Sumberjo 01 Kabupaten Blitar. *Jurnal Pendidikan: Riset dan Konseptual*, *7*(3), 524-532. https://doi.org/10.28926/riset_konseptual.v7i3.770

Gama, I. G. B. S., Mahadewi, L. P. P., & Jampel, I. N. (2016). Pengembangan Multimedia Tutorial Interaktif Sumber Daya Alam dan Teknologi pada Mata Pelajaran IPA Kelas IV di SDN 3 Banyuasri. *Jurnal Undiksha*, *4*(1), 12–23. https://doi.org/10.23887/jeu.v4i1.20209

Hakim, L. (2018). Pengembangan Media Pembelajaran PAI Berbasis Augmented Reality. *Lentera Pendidikan: Jurnal Ilmu Tarbiyah dan Keguruan*, *21*(1), 59–72. https://doi.org/10.24252/lp.2018v21n1i6

Johan, H., Putri, D. H., Risdianto, E., Johan, S., Sudirman, S., & Widiasih, W. (2023). Development of Supplementary Basic Physics Practicum Based on Problem-Solving Method Assisted with Augmented Reality (AR) Technology. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *9*(1), 41–54. https://doi.org/10.21009/1.09105

Kholiq, A. (2020). Development of BDF-AR 2 (Physics Digital Book Based Augmented Reality) to Train Students in Scientific Literacy on Global Warming Material. *Berkala Ilmiah Pendidikan Fisika*, *8*(1), 50-58. https://doi.org/10.20527/bipf.v8i1.7881

Kristina, K., Fatih, M., & Alfi, C. (2023). Pengembangan Media 3D Berbasis Augmented Reality Menggunakan PBL Materi Penggolongan Hewan untuk Meningkatkan Self Esteem Siswa Kelas V SD. *Jurnal Pemikiran dan Pengembangan Sekolah Dasar (JP2SD)*, *11*(1), 59–72. https://doi.org/10.22219/jp2sd.v11i1.25677

Maulidah, A. N., & Aslam, A. A. (2021). Penggunaan Media Puzzle Secara Daring Terhadap Hasil Belajar IPA Kelas V SD. *Mimbar Ilmu*, *26*(2), 281-286. https://doi.org/10.23887/mi.v26i2.37488

Meldina, T., Agustin, A., & Harahap, S. H. (2020). Integrasi Pembelajaran IPS pada Kurikulum 2013 di Sekolah Dasar. *AR-RIAYAH: Jurnal Pendidikan Dasar*, *4*(1), 15–26. https://doi.org/10.29240/jpd.v4i1.1572

Nevyanti, R. U., Hodidjah, H., & Respati, R. (2017). Media Puzzle Suku Kata dalam Pembelajaran Membaca Menulis Permulaan (MMP) di Kelas I Sekolah Dasar. *PEDADIDAKTIKA: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, *4*(2), 189–198. Retrieved from https://ejournal.upi.edu/index.php/pedadidaktika/article/view/7179

Nikmah, A. K., & Suryanti, S. (2018). Pengaruh Penggunaan Media Puzzle Sumber Energi (Puber Egi) Terhadap Hasil Belajar IPA Siswa Kelas IV Sekolah Dasar Negeri Krian 3 Sidoarjo. *Jurnal Penelitian Pendidikan Guru Sekolah Dasar*, *6*(8), 1448–1457. Retrieved from https://ejournal.unesa.ac.id/index.php/jurnal-penelitian-pgsd/article/view/24199

Oktavia, A., & Agustin, H. (2020). Umbul Card: A Traditional Game as Nutrition Education Media Among Elementary School Students. *International Journal of Educational Research Review*, *5*(1), 1–9. https://doi.org/10.24331/ijere.646821

Permana, H., Bakri, F., Salsabila, I. H., Ambarwulan, D., Muliyati, D., & Sumardani, D. (2021). The Development of Augmented Reality Application to Explore Fluid Concepts. *JPPPF (Jurnal Penelitian dan Pengembangan Pendidikan Fisika)*, *7*(1), 53–60. https://doi.org/10.21009/1.07106

Pramana, I. P. Y., & Suarjana, I. M. (2019). Pengaruh Model Pembelajaran Time Token Berbantuan Media Video Terhadap Hasil Belajar IPA Kelas V SD. *Journal of Education Technology*, *2*(4), 137-144. https://doi.org/10.23887/jet.v2i4.16425

Priyatno, D. (2018). *SPSS: Panduan Mudah Olah Data bagi Mahasiswa dan Umum* (1st ed.). Yogyakarta: CV. Andi Offsite.

Putri, K. E., & Frans, A. W. (2020). Augmented Reality-Based Learning Media in Photosynthesis Material. *Jurnal Penelitian Pendidikan IPA*, *5*(1), 1–5. https://doi.org/10.26740/jppipa.v5n1.p1-5

Roemintoyo, R., & Budiarto, M. K. (2021). Flipbook as Innovation of Digital Learning Media: Preparing Education for Facing and Facilitating 21st Century Learning. *Journal of Education Technology*, *5*(1), 8-13. https://doi.org/10.23887/jet.v5i1.32362

Sesmiyanti, S., Antika, R., & Suharni, S. (2019). N-Gain Algorithm for Analysis of Basic Reading. *Proceedings of the 2nd International Conference on Language, Literature and Education, ICLLE*. 22-23 August 2019, Padang, West Sumatra, Indonesia.

https://doi.org/10.4108/eai.19-7-2019.2289527

Sidabutar, Y. A., Ansari, K., & Eviyanti, E. (2017). The Effect of Learning Media and Creative Thinking Ability to Skill of Writing Narrative Text for Student in Class V SD Negeri 060841 Medan. *Journal of Education and Practice*, *8*(28), 119–126. Retrieved from https://www.iiste.org/Journals/index.php/JEP/article/view/39239/40346

Sugiyono, S. (2019). *Metode Penelitian dan Pengembangan*. Bandung: Alfabeta.

Suroiya, M., & Prasetya, S. P. (2021). Pengembangan Media Pembelajaran Augmented Reality pada Materi Peninggalan Kerajaan Hindu-Budha di Indonesia. *SOSEARCH: Social Science Educational Research*, *1*(2), 93–104. https://doi.org/10.26740/sosearch.v1n2.p93-104

Susanto, R., Widyaningsih, S., Afandi, A., & Mardikaningsih, A. (2023). Pengembangan Media Flipbook untuk Meningkatkan Hasil Belajar di Era Pandemi Covid 19. *Pandega: Jurnal Kajian Pendidikan dan Kepramukaan*, *1*(1), 1–5. https://doi.org/10.26858/Pandega.v1i1.45535

Utami, F., Rukiyah, R., & Andika, W. D. (2021). Pengembangan Media Flashcard Berbasis Augmented Reality pada Materi Mengenal Binatang Laut. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *5*(2), 1718–1728. https://doi.org/10.31004/obsesi.v5i2.933

Utami, N. (2023). Penerapan Pendekatan Kontekstual untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa Sekolah Dasar. *Jurnal Pendidikan Guru Sekolah Dasar*, *1*(2), 1-9. https://doi.org/10.47134/pgsd.v1i2.134

Waisakanitri, I. D. A. T., Ganing, N. N., & Wulandari, I. G. A. A. (2023). Media Komik Digital Berbasis Problem Based Learning Muatan IPA (Ekosistem) Kelas V Sekolah Dasar. *Jurnal Ilmiah Pendidikan Profesi Guru*, *6*(1), 57–70. https://doi.org/10.23887/jippg.v6i1.58651

Wicaksana, I. P. G. C. R., Agung, A. A. G., & Jampel, I. N. (2020). Pengembangan E-Komik dengan Model Addie untuk Meningkatkan Minat Belajar Tentang Perjuangan Persiapan Kemerdekaan Indonesia. *Jurnal Edutech Undiksha*, *7*(2), 48-59. https://doi.org/10.23887/jeu.v7i2.23159

Wisada, P. D., Sudarma, I. K., & Yuda, S. A. I. W. I. (2019). Pengembangan Media Video Pembelajaran Berorientasi Pendidikan Karakter. *Journal of Education Technology*, *3*(3), 140-146. https://doi.org/10.23887/jet.v3i3.21735

Wulandari, Y., Ruhiat, Y., & Nulhakim, L. (2020). Pengembangan Media Video Berbasis Powtoon pada Mata Pelajaran IPA di Kelas V. *Jurnal Pendidikan Sains Indonesia*, *8*(2), 269–279. https://doi.org/10.24815/jpsi.v8i2.16835