Transformasi: Jurnal Pengabdian Masyarakat, 21 (1), 2025: 19-33
p-ISSN 1858-3571 | e-ISSN 2580-9628

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DIGITAL-BASED LEARNING MATERIAL INNOVATION WORKSHOP USING GA-LARIS (GOOGLE SITES, ARTICULATE STORYLINE, AUGMENTED REALITY, PHYSICS LAB AR, LIVEWORKSHEET, AND EDUCATIONAL GAMES) AS A LEARNING SOLUTION IN ERA 4.0

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Abstrak: Transformasi pendidikan di era 4.0, menuntut guru untuk mengintegrasikan teknologi digital secara efektif dalam proses pembelajaran. Kegiatan pengabdian kepada masyarakat ini bertujuan untuk meningkatkan kompetensi guru fisika di tingkat sekolah menengah atas melalui pengembangan media pembelajaran interaktif berbasis digital dengan menggunakan GA-LARIS (*Google Sites, Articulate Storyline, Augmented Reality, Physics Lab AR, Liveworksheets* dan Permainan Edukasi). Kegiatan ini dilaksanakan dalam bentuk hybrid selama tiga hari yang diikuti oleh 51 orang guru fisika se-Kabupaten Bandung Barat, Cimahi, dan Kota Bandung. Kegiatan ini dirancang menggunakan metode Participatory Action Research (PAR), yang terdiri dari tahap identifikasi masalah, pengembangan kolaboratif, dan refleksi. Peserta dibagi menjadi sembilan kelompok yang masing-masing mengembangkan materi pembelajaran berbasis digital. Evaluasi produk menggunakan instrumen kuesioner skala Likert 5 poin yang mengukur aspek desain visual, interaktivitas, dan keselarasan dengan kompetensi fisika. Uji validitas menggunakan indeks V Aiken menunjukkan skor di atas 0,80, sementara uji reliabilitas menggunakan Alpha Cronbach menghasilkan nilai berkisar antara 0,80 hingga 0,97, yang dikategorikan Tinggi hingga Sangat Tinggi. Hasil ini menegaskan bahwa materi pembelajaran valid dan reliabel untuk digunakan dalam pembelajaran fisika SMA. Dalam hal kepraktisan, semua materi pembelajaran dinilai "Baik" hingga "Sangat Baik" (skor antara 80–90%). Sebagai tindak lanjut, kami merekomendasikan pelatihan yang fokus pada eksplorasi teknologi yang lebih maju, seperti Realitas Virtual (VR) dan Kecerdasan Buatan (AI), untuk mendukung pengembangan pembelajaran digital.

Kata Kunci: kompetensi guru fisika, Google-Sites, Articulate-Storyline, Augmented-Reality, Physics-Lab-AR, LiveWorksheets

Abstract: The transformation of education during the 4.0 era requires teachers to integrate digital technology effectively into their teaching. This community service program aims to improve the competence of high school physics teachers through the development of interactive digital-based learning training media using the GA-LARIS (Google Sites, Articulate Storyline, Augmented Reality, Physics Lab AR, LiveWorksheets, and Educational Games). The program was implemented as a three-day hybrid workshop attended by 51 teachers from West Bandung Regency, Cimahi City, and Bandung City. The program was designed using the Participatory Action Research (PAR) method, consisting of problem identification, collaborative development, and reflection stages. Participants were divided into nine groups, each of which developed digital-based learning materials. A product evaluation used a 5-point Likert scale questionnaire instrument that measures aspects of visual design, interactivity, and alignment with physics competencies. Validity testing using Aiken's V index showed scores above 0.80, while reliability testing using Cronbach's Alpha yielded values ranging from 0.80 to 0.97, categorised as High to Very High. These results confirm that the learning materials are valid and reliable for use in high school physics instruction. In terms of practicality, all learning materials were rated as "Good" to "Very Good" (scores between 80% and 90%). We recommend follow-up training that focuses on the exploration of more advanced technologies, such as Virtual Reality (VR) and Artificial Intelligence (AI), to support digital learning development.

Keywords: physics teacher's competency, Google-Sites, Articulate-Storyline, Augmented-Reality, Physics-Lab-AR, LiveWorksheets

Introduction

The 4.0 era has accelerated the development of Information and Communication Technology (ICT), significantly changing patterns of communication, interaction, and access to information in society. The use of smartphones and internet networks has become an integral part of daily activities, particularly in supporting various online activities (Arif, 2024; Rabbani & Najicha, 2023). These changes bring substantial benefits, such as accelerating communication processes, simplifying information access, and increasing the efficiency of social interactions. These developments have also had a profound impact on the field of education, particularly in how learning is delivered and accessed.

The impact also affects the field of education, where digital transformation opens up excellent opportunities for more innovative learning (Juneli, 2022). It is crucial to ensure the strengthening of educational quality, which is highly dependent on the effectiveness of the learning process. The learning process itself is an integral part of an individual's life in achieving specific goals (Ardiansyah & Nana, 2020), and its effectiveness can be enhanced through the use of digital technology. Various digital-based learning media have been developed, including electronic modules or e-modules (Winantha et al., 2018), digital comics (Febriani et al., 2020; Juneli, 2022; Ningrum et al., 2022), learning videos (Dewi & Handayani, 2021; Diajeng & Hasanah, 2021; Husniah et al., 2020; Putri, 2021; Sihombing, 2023), learning applications (Rahmawati et al., 2022; Sugiyono, 2018), interactive media (Atmaja & Samsudin, 2024; Utomo et al., 2024) and educational games (Amelia et al., 2024; Castillo-Cuesta, 2022; Wati, 2021). These digital media enable students to learn flexibly, according to their learning styles, and support the strengthening of learning independence (Amri & Muhajir, 2022).

Although the advancement of digital technology in the 4.0 era offers numerous benefits such as improved communication, access to information, and personalised learning, it also presents significant challenges, particularly in the education sector. One critical issue is the digital divide, where not all teachers have equal access to or competency in utilising digital tools effectively (Arif, 2024; Rabbani & Najicha, 2023). This problem is particularly evident in physics education, which requires approaches that can visualise abstract and complex concepts. Despite the widespread availability of digital technologies, many physics teachers still lack the pedagogical and technical competencies needed to develop interactive, engaging, and contextual learning materials (Anwar, 2024; Nurjanah et al., 2024). Moreover, existing professional development programs tend to be overly theoretical and rarely provide hands-on experiences in digital media development (Djufri et al., 2024; Wahyuni & Haryanti, 2024). These issues highlight a clear gap in teacher training, reinforcing the need for innovative, practice-oriented solutions that enhance digital competence in subject-specific contexts.

To address this gap, a workshop was initiated by graduate students of the Master of Physics Education Program at the Indonesian University of Education, focusing on the innovation of digital-based learning materials using the GA-LARIS (Google Sites, Articulate Storyline, Augmented Reality, Physics Lab AR, LiveWorksheets, and Educational Games). This activity was designed as a strategic solution to support digital transformation in education while

simultaneously enhancing the pedagogical and technological competencies of high school physics teachers. The GA-LARIS serves as an integrated model for developing interactive digital media tailored to physics instruction. This program enables teachers to acquire the skills necessary to produce learning materials that are not only engaging but also facilitate deeper and more contextual understanding of physics concepts.

Methods

Workshop

This community service activity was conducted over three days using a hybrid method (a combination of offline and online formats) and was implemented through the stages of the Participatory Action Research (PAR) model. This method is considered effective in addressing problems, meeting the practical needs of the community, and generating knowledge through participatory processes, including problem identification, collaborative action, and reflection (Dahlan et al., 2023; Samrin et al., 2024; Silaban et al., 2020; Sukirman et al., 2024).

Stage 1: Problem Identification. The first session, held on Saturday, 7 September 2024, took place offline at SMK Daarut Tauhiid Boarding School, Parongpong District, West Bandung Regency. In this stage, participants were introduced to the concept of digital-based learning materials, followed by a showcase of examples developed using the GA-LARIS (Google Sites, Articulate Storyline, Augmented Reality, Physics Lab AR, LiveWorksheets, and Educational Games). This session aimed to build participants' understanding of the issues and potential solutions. Stage 2: Collaborative Product Development. The second session was conducted online via Zoom on Wednesday, 11 September 2024. Participants engaged in sharing and discussion activities regarding the development progress of their digital-based learning materials. During this stage, peer input and facilitator guidance supported collaborative improvement. Stage 3: Reflection and Evaluation. The third session, held online on Saturday, 14 September 2024, focused on the presentation of final products by each group. This reflective stage allowed participants to review the learning media they had developed and receive constructive feedback to enhance future implementation. The total duration of the program was 36 JP distributed across these three stages to ensure active engagement, participatory learning, and iterative improvement.

Workshop Participants

The workshop participants were 51 physics teachers from West Bandung Regency, Cimahi, and Bandung City. After receiving an invitation from the local MGMP, participants registered independently through the link provided. Since all participants were physics teachers, this activity could focus on developing digital learning materials relevant to physics learning.

Data Collection

To obtain valid data, experts and teachers assessed the validity, reliability, and practicality of the digital-based learning materials using a Likert scale questionnaire that includes five levels of assessment, ranging from 5 (very good) to 1 (not good). This questionnaire was compiled by Wahono (2006) which consists of 12 statement items that assess the clarity of learning

objectives, the relevance of learning objectives to the CP Curriculum, the scope and depth of learning objectives, the suitability of the material to the learning objectives, the depth of the material, the clarity of examples and practice questions, the accuracy of the selection of evaluation tools, the provision of feedback on evaluation results, ease of understanding, systematic, clear logical flow, contextual and actuality, communicative/by the message/in line with the wishes of the target. This assessment aims to ensure that the resulting teaching materials are not only innovative but also meet the expected educational standards.

Meanwhile, the media practicality questionnaire also uses sources from Wahono (2006) which consists of 10 statement items consisting of usability/easy to use and simple in operation, effective and efficient in use, clear instructions for using the media, compatibility/can be run on various hardware, level of media durability, type and size of letters, visuals such as layout design, typography and color, text can be read well, appropriateness of writing placement, and moving media (animation and video). After that, the data will be processed using Microsoft Excel and analysed for the validity, reliability, and practicality of the learning materials.

The validity of test instruments was measured using Aiken's V formula. The learning materials are categorised as valid if the resulting V value exceeds the minimum threshold listed in Aiken's V table (Nurakmal et al., 2022; Tanjung & Faiza, 2019). We employed the Alpha formula to analyze the reliability of learning materials and used Microsoft Excel to obtain the Cronbach's Alpha value. Table 1 shows the criteria for the reliability value to classify the result.

Table 1. Reliability Value (Cronbach's Alpha) of Learning Materials

No	Cronbach's Alpha Value (α)	Criteria
1.	$\alpha \geq 0.8$	Very High Reliability
2.	$0.6 \leq \alpha \leq 0.799$	High Reliability
3.	$0.4 \leq \alpha \leq 0.599$	Sufficient Reliability
4.	$0.2 \leq \alpha < 0.399$	Low Reliability
5.	$\alpha < 0.2$	Very low reliability

The practicality test was conducted using a questionnaire completed by the participating teachers. The results of this assessment were then analysed descriptively using percentage analysis and categorised according to the criteria outlined in Table 2 (Atmaja & Samsudin, 2024; Husniah et al., 2020; Riduwan, 2013). The results of this data will be analysed and described, and conclusions will be drawn based on the indicators.

Table 2. Assessment categories

Percentage of Achievement (%)	Category
$80 < P \leq 100$	Very Good
$60 < P \leq 80$	Good
$40 < P \leq 60$	Fairly Good
$20 < P \leq 40$	Not Very Good
$0 < P \leq 20$	Not Good

Result and Discussion

Implementation of Activities

This activity was carried out for three days using online and offline methods. The first meeting was held on Saturday, 7 September 2024, at SMK Daarut Tauhiid Boarding School, Parongpong District, West Bandung Regency, West Java Province. This event was opened by the Secretary of the Physics Education Study Program and attended by representatives of the Education Office and the Chairperson of the Indonesian Teachers Association (IGI), who is also the Chairperson of the MGMP Physics of West Bandung Regency. After the opening ceremony, the first material presentation session was by Professor of FPMIPA as the first speaker, with the topic "Innovation of Technology-Based Physics Learning Materials". Furthermore, the second speaker, who is an education practitioner, presented the theme "Utilisation of VR in Physics Learning" through a hybrid session from Taiwan.

The afternoon session after the break continued with an exhibition and workshop on learning innovations. This exhibition displays the work of students in the Physics Education Master's Program, who are divided into several predetermined groups. All teachers are divided into 6 GA-LARIS groups (Google Sites, Articulate Storyline, AR, Physics Lab Augmented Reality, LiveWorksheets, and Educational Games).

The second workshop day was online via Zoom Meeting on Wednesday, 11 September 2024, at 15.00 WIB until finished. This meeting was held to report on the creation process, provide a forum for discussion between participants and supervisors regarding creating learning materials, and follow up on the first meeting. Participants were divided into several breakout rooms according to their respective groups. Participants reported the results of their learning device work to each group's person in charge (PJ).

The third day of the workshop was held online via Zoom Meeting on Saturday, 14 September 2024, at 07.00 WIB until finished. This last meeting focused on presenting the results of each group's creation of learning materials and the closing of the Community Service (P2M) activity. Followed by a question-and-answer session with other participants. After all groups had finished reporting the results of their work, this activity was officially closed by the Head of the Physics Education Study Program for undergraduate and master's levels.

Results of Making Learning Materials

Instructional Media is one of the critical factors in improving the quality of learning because the development of technology in education demands effectiveness in learning (Kristanto, 2016). Learning technology has the potential for learning as a means to improve students' reasoning, problem-solving skills, and support inquiry-based learning (Asari et al., 2023). For example, several platforms and applications such as GA-LARIS (Google Sites, Articulate Storyline, Augmented Reality, Physics Lab AR, LiveWorksheets, and Educational Games) have been introduced to 51 teachers. These teachers were then divided into nine groups of 4-5 people each. Each group produces digital-based learning materials according to the tasks and materials that have been selected and determined. The following are the results of each group's work:

1. The Augmented Reality (AR) group produced one learning material for measurement material (vernier callipers). Figure 1 shows the display of Augmented Reality learning materials.

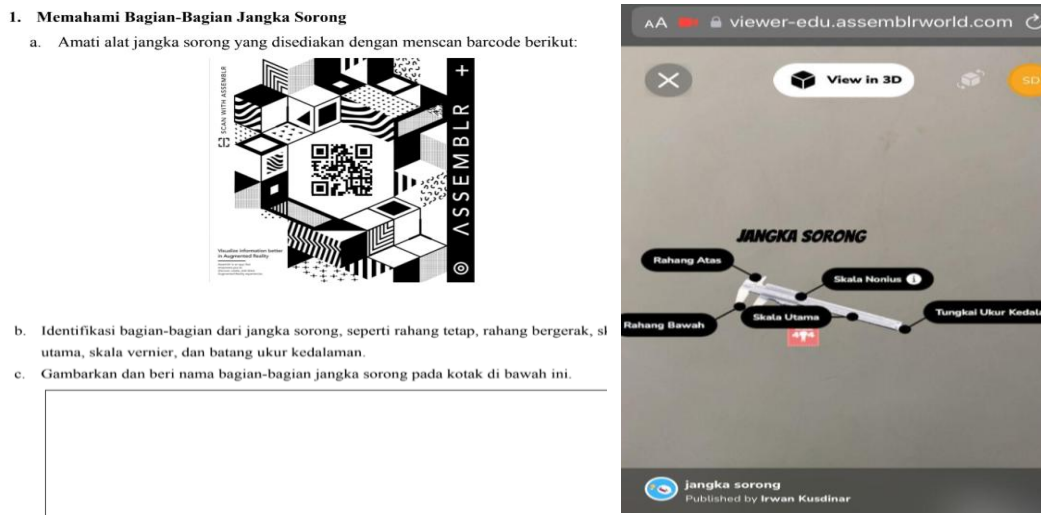

Figure 1. Display of Augmented Reality learning materials for measurement

2. The Articulate Storyline group produced a learning material for renewable energy. Figure 2 shows the learning material for renewable energy

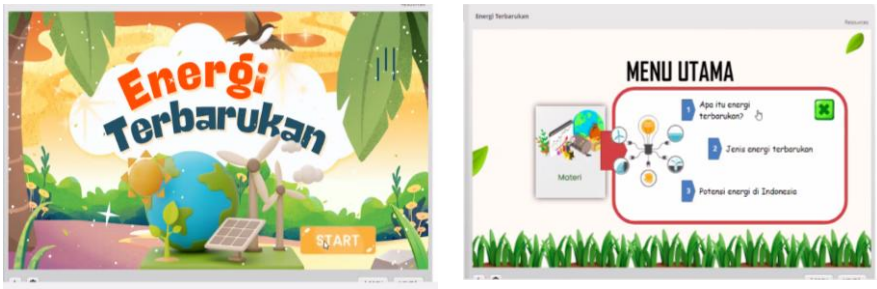

Figure 2. Articulate Storyline learning materials for renewable energy

3. The Educational Games Group produced two learning materials for renewable energy and Newton's Laws. Figure 3 shows an example of educational game learning materials created by a teachers' group.

Figure 3. Display of educational game learning materials for renewable energy and Newton's Laws

4. The Google Sites group produced a learning resource on dynamic electricity. Figure 4 shows the appearance of Google Sites learning materials for this material.

Figure 4. Google Sites learning materials for the dynamic electricity material

5. Physics Lab AR Group produces two learning materials for electromagnetic and direct current circuit materials. Figure 5 shows Physics Lab AR learning materials in Electromagnets and Direct Current Electric Circuits.

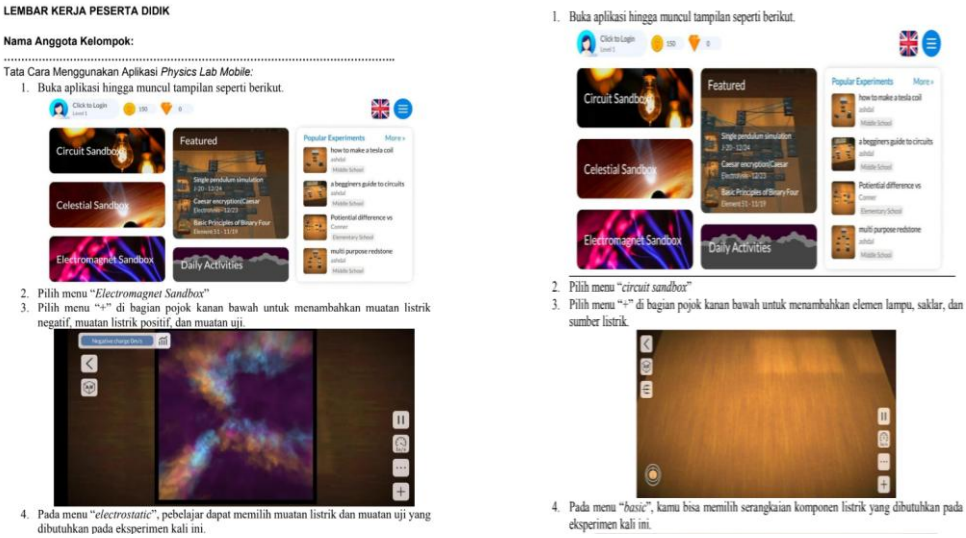

Figure 5. Physics Lab AR learning materials for the Electromagnets and Direct Current Electric Circuits

6. The LiveWorksheets group produced one learning material for Measurement, Magnitude and Units, and Parabolic Motion. Figure 6 shows an example of LiveWorksheet's display.

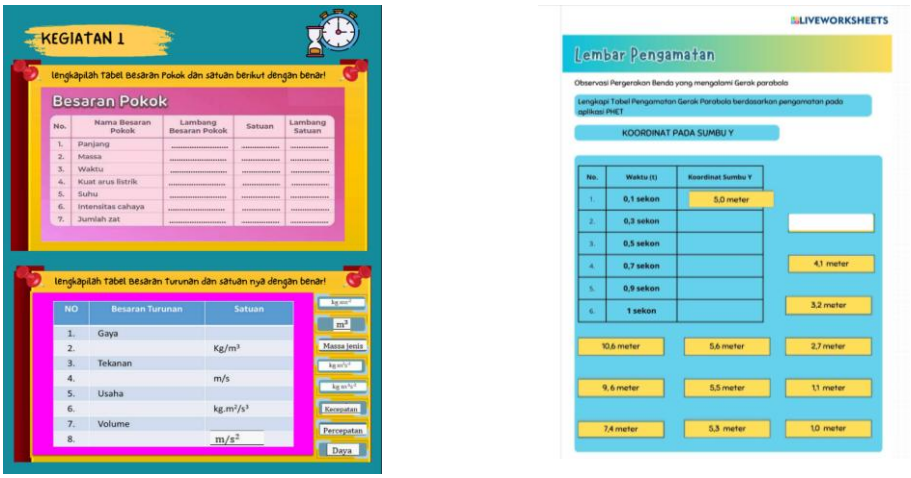

Figure 6. Display of LiveWorksheets Learning Materials for measurement, quantities, units, and parabolic motion

Subsequently, validity and reliability tests were conducted on the developed learning materials. Table 3 shows the results of the assessments.

Table 3. Validity and Reliability Test of Learning Materials

No.	Application	Material	Validation	Criteria	Reliability	Criteria
1.	Augmented Reality	Measurement (Vernier Caliper)	0,80	Valid	0,80	High
2.	Articulate Storyline	Renewable energy	0,86	Valid	0,96	Very High
3.	Educational Games	Renewable energy	0,80	Valid	0,96	Very High
4.	Educational Games	Newton	0,80	Valid	0,95	Very High
5.	Google Sites	Dynamic Electricity	0,80	Valid	0,97	Very High
6.	Physics Lab AR	Direct Current Electrical Circuit	0,80	Valid	0,93	Very High
7.	Physics Lab AR	Electromagnet	0,81	Valid	0,95	Very High
8.	LiveWorksheets	Measurement, Quantities, and Units	0,84	Valid	0,96	Very High

Based on the Table 3, the validity of the interactive digital learning materials developed using the GA-LARIS (Google Sites, Articulate Storyline, Augmented Reality, Physics Lab AR, LiveWorksheets, and Educational Games) shows that all media obtained scores above 0.80 using Aiken's V index, which are categorised as valid. This score meets the minimum standard required for content validity based on assessments from five expert validators using a five-point rating scale, indicating that the media are valid in terms of content suitability and instructional relevance.

The reliability analysis of the evaluation instruments produced Cronbach's Alpha values ranging from 0.80 to 0.97, indicating that the learning materials fall into the High to Very High reliability category. This result signifies that the learning materials possess excellent internal consistency, ensuring reliable and stable assessments across multiple evaluators. Therefore, all of the developed learning materials are confirmed to be both valid and highly reliable for use in high school physics instruction.

In addition to evaluating the validity and reliability of the developed learning materials, a practicality test was also conducted to assess how feasible and user-friendly the materials are for classroom implementation. This test involved teacher respondents who provided feedback through a questionnaire. The results of the practicality assessment are shown in the following Table 4.

Table 4. Practicality Test of GA-LARIS Learning Materials (Google Sites, Articulate Storyline, Augmented Reality, Physics Lab AR, LiveWorksheets, and Educational Games)

No.	Application	Material	Mark (%)	Criteria
1.	Augmented Reality	Measurement (Vernier Caliper)	80	Good
2.	Articulate Storyline	Renewable energy	89	Very good
3.	Educational Games	Renewable energy	80	Good
4.	Educational Games	Newton	80	Good
5.	Google Sites	Dynamic Electricity	85	Very good
6.	Physics Lab AR	Direct Current Electrical Circuit	83	Very good
7.	Physics Lab AR	Electromagnet	82	Very good
8.	LiveWorksheets	Measurement, Quantities, and Units	90	Very good
9.	LiveWorksheets	Parabolic Motion	83	Very good

Table 4 shows that the group that created learning materials used Augmented Reality for measurement materials (vernier callipers) with a score of 80% with the criteria of "Good." This indicates that AR technology was effectively used to produce interactive visualisations that enhance students' understanding of vernier callipers. Such visualisation allows abstract measurement concepts to become more concrete, facilitating active learning. AR combines real and virtual environments in real-time and three dimensions (Dewi & Anggaryani, 2020; Kurniawan, 2017; Mustaqim & Kurniawan, 2017; Waliyatusshofiyyah, 2020). Assemblr Edu, a popular AR application, was utilised for this project. It offers ready-to-use 3D assets and allows customisation through Assemblr Studio. By applying AR, the teachers were trained not only to use technology but to create their digital learning content, transitioning from consumers to producers of contextual educational media (Padang et al., 2022). AR enables simulations of complex physical phenomena and supports improved student learning outcomes in cognitive domains (Qorimah & Sutama, 2022). It also benefits schools with limited physical lab tools by providing virtual experimentation experiences. Teachers act not only as users but also as designers of learning media responsive to students' learning needs. This capability reflects the shift in the teacher's role from technology consumers to producers of contextual educational content.

Meanwhile, the group that created learning materials using Articulate Storyline for renewable energy material scored 89% with the criteria of "Very Good". This percentage of achievement shows that the effectiveness of creating interactive and engaging digital learning focuses on delivering material in a structured and easy-to-understand manner. Articulate Storyline is software with a simple interface similar to Microsoft PowerPoint, making it very suitable for teachers who are not yet familiar with the process of creating interactive learning media (Leztiyani, 2021; Nurmala et al., 2021). The learning media products resulting from Articulate Storyline can be used with laptops on the web or Android-based devices in the form of applications. An example of creating learning media utilising this software is by adding a

trigger or command button if the user wants to enter a specific part of the media by clicking or double-clicking the screen. The triggers or commands used also vary; they can be clicked, double-clicked, right-clicked, and so on. Media creators can add command buttons according to the needs of the media being developed. Media creators can also add assessments such as quizzes in the application, learning materials whose contents can be easily accessed by simply sliding the button to display the material, and so on. This software can use Many other features, such as adding website links, games, videos, images, animations, simulations, and so on, so that the learning media resulting from Articulate Storyline products can be used online and offline (Sari & Harjono, 2021). The improvement in teacher competency is evident in their ability to package content structurally with Articulate Storyline's interactive and user-friendly features. This media holds significant potential for classroom use, both online and offline via laptops or Android devices. Teachers can integrate many tools that enable a dynamic learning experience tailored to student learning styles. This significantly enriches teachers' instructional methods.

The group that created learning materials using Educational Games produced two learning materials for renewable energy and Newton's Laws, both of which received a score of 80% with the criteria of "Good". Although promising, this educational game-based learning material has the potential to be further developed, especially in terms of learning strategies. Educational games in physics learning refer to using games specifically designed for educational purposes, focusing on improving understanding of physics concepts through fun and in-depth interactions. These educational games are often called "serious games", where students play and learn (Sarji & Mampouw, 2022; Ullah et al., 2022). Educational games are also called applied games that can be applied to several fields, such as education (Sabirli & Çoklar, 2020), health care (Brauner & Ziefle, 2020), engineering (Sousa, 2020), sports (Ullah et al., 2021), and defence (Avery et al., 2011). Its classroom potential is very high for motivating students and making challenging physics concepts more accessible and appealing. Teachers now possess the tools to apply educational games as an innovative teaching method.

Furthermore, the group that created learning materials using Google Sites for dynamic electricity material received a score of 85% with the "Very Good" criteria. This site presents structured material and lots of information, uses interactive media, and makes it easy for students to access it because this learning material does not require the installation of applications on each student's smartphone. Google Sites is a platform from Google that can make it easier to create sites or websites. Google Sites can be used to develop web-based learning media. The use of websites has become commonplace for both students and teachers. Learning media using Google Sites can be integrated with several pieces of information, including text, images, videos, presentations, and attachments (Sulasmianti, 2021). Google sites have advantages, including being able to collaborate with anyone, being flexible in their creation and operation, having easy and complete features, being integrated with other Google tools such as Drive, Google Maps, and free access or not requiring fees for use, searchable (easy to search) using the Google search engine (Islanda & Darmawan, 2023; Jatilinuar et al., 2023). Creating media using Google Sites can add pages/ slides, layouts, backgrounds, font types, hyperlinks, insert files, insert YouTube videos, and many other features. Its potential for

classroom use is highly practical as a central learning hub for students, also indicating an increased ability of teachers to leverage the digital ecosystem for learning.

Groups that create learning materials using Physics Lab AR produced two learning materials for the material of Direct Current Electric Circuits and Electromagnets. The Direct Current Electric Circuit material got a value of 83% with the criteria of "Very Good". In the Electromagnet material, it got a value of 82% with the requirements of "Very Good". Physics Lab AR Application strongly supports visual physics experiment simulations, so teachers can use them in physics learning activities. However, adding more interesting learning activities for students can improve this learning material. Next is Physics Lab AR. Turtle Sim developed this innovative application and supports learning in Computer Science, Information Systems, Physics, and Mathematics. This application includes astrophysics, electrical circuits, informal learning, demonstrations, electromagnetics, and modelling. Physics Lab AR is an ideal solution for teachers to demonstrate physics experiments in class while allowing students to explore physics concepts inside and outside the classroom. With a better AR technology virtual laboratory, students and teachers can learn science through interactive experiments, play with several electrical circuit components, build 3D electrical circuits, and observe how they work in real-time, providing a more engaging and immersive learning experience (The Pennsylvania State University, 2025). This significantly improved teacher competency in performing virtual physics experiments, thereby overcoming limitations of physical laboratory equipment. Teachers now possess the capability to visualise phenomena that are difficult to observe directly.

The group that created learning materials using LiveWorksheets produced two learning materials for the Measurement, Magnitude, and Units and Parabolic Motion materials. The Measurement, Magnitude, and Units material scored 90% with the "Very Good" criteria. The Parabolic Motion material received a score of 83% with the requirements of "Very Good". Learning materials using LiveWorksheets support learning through direct practice that can be accessed and evaluated, making this learning material effective in increasing student involvement in Physics learning. Then LiveWorksheets. Electronic Student Worksheets (e-LKPD) are an innovation in the world of education that allows the learning process to be more interactive and flexible. One of the digital platforms that supports the development of e-LKPD is LiveWorksheets. This platform makes it easy for teachers to convert traditional worksheets into interactive digital formats. In the context of physics education, LiveWorksheets can facilitate learning abstract and mathematical physics concepts (Sarifah, 2023). Physics learning requires an innovative approach so that students can understand complex material. The use of digital technology is one alternative to meet these needs. LiveWorksheets provides several features, such as automatic assessment, interactivity through drag-and-drop, and ease in customising worksheets to curriculum needs. These features allow teachers to present physics material in a more enjoyable and relevant way (Sarifah, 2023). In addition, by utilising interactive e-LKPD based on mobile learning using the LiveWorksheets platform, it is hoped that teachers can improve learning outcomes in the cognitive domain and motivate students in the learning process because this media can be accessed online via smartphones. Its potential for classroom use is very high in boosting student engagement in physics learning, as it facilitates self-paced

practice with instant feedback. Features such as automatic assessment, drag-and-drop interactivity, and ease of customising worksheets to curriculum needs empower teachers to prepare innovative formative assessments, which, in turn, can improve cognitive learning outcomes and student motivation.

Conclusion

This community service activity effectively supported the digital transformation of education by enhancing the competence of high school physics teachers in developing interactive digital learning media using the GA-LARIS (Google Sites, Articulate Storyline, Augmented Reality, Physics Lab AR, LiveWorksheets, and Educational Games). Conducted over three days in a hybrid format, the program engaged 51 teachers from West Bandung Regency, Cimahi City, and Bandung City. Validity testing using Aiken's V index yielded scores above 0.80, indicating that the materials meet the standards for content validity. Reliability testing using Cronbach's Alpha produced values ranging from 0.80 to 0.97, which fall into the "High" to "Very High" categories. These results confirm that the developed learning materials are both valid and reliable for use in high school physics instruction. In terms of practicality, all learning materials received ratings within the "Good" to "Very Good" range (scores of 80–90%), demonstrating their usability and effectiveness in supporting the teaching and learning process. Moreover, participant feedback indicated increased confidence and readiness in integrating digital tools into classroom practices, reflecting the program's tangible impact on teaching competencies. As a follow-up, it is recommended to conduct further training focused on more advanced technologies, such as Virtual Reality (VR) and Artificial Intelligence (AI). This recommendation is based on participant reflections and facilitator observations during the workshop, which revealed both strong interest and a clear need for deeper support in utilising emerging digital innovations.

Acknowledgment

The project team extends its deepest gratitude to Universitas Pendidikan Indonesia for providing the grant, funding, and unwavering support that made the successful implementation of this community service program possible. This initiative, led by the Master's students of Physics Education, Class of 2023, was greatly enriched by the collaboration and contributions of the Musyawarah Guru Mata Pelajaran (MGMP) Fisika of Bandung Barat Regency and our esteemed school partner, SMK Daarut Tauhiid Boarding School. We also would like to express our sincere gratitude to the lecturers from the Magister's Program in Physics Education, Faculty of Teacher Training and Education, Universitas Pendidikan Indonesia, for their invaluable guidance and support throughout this project. Lastly, we sincerely thank Majelis Telkomsel Taqwa (MTT) for their generous sponsorship, which was crucial in bringing this program to fruition.

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