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# UTILIZING INTERACTIVE TECHNOLOGY AND ARTIFICIAL INTELLIGENCE FOR 21ST-CENTURY TEACHERS

# PEMANFAATAN TEKNOLOGI INTERAKTIF DAN ARTIFICIAL INTELLIGENCE UNTUK GURU ABAD 21

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**Abstract**

This study aims to describe the utilization of interactive technology and artificial intelligence (AI) to enhance the competencies of 21st-century teachers within the Educational Coordination Office of Pangkatan Sub-District, Labuhanbatu Regency, North Sumatra Province. The research employed a descriptive qualitative method with a field study approach through a six-day workshop. The subjects of this study consisted of 20 elementary school teachers who participated in training sessions on Quizizz, Wordwall, and the use of AI tools such as ChatGPT in the learning process. Data were collected through observation, interviews, pre-test and post-test assessments, as well as documentation, and were analyzed through data reduction, data presentation, and conclusion drawing. The findings indicate a significant improvement in teachers' understanding and skills in integrating interactive technology and AI into the learning process. The average pre-test score of 70.00% increased to 89.00% in the post-test, indicating a 19.00% improvement in competency. In addition, teachers successfully developed gamification-based learning media using Quizizz and Wordwall, and utilized artificial intelligence to efficiently design teaching materials and evaluation tasks. The workshop activities also fostered teachers' motivation, creativity, and digital awareness regarding the importance of innovation in 21st-century education.This study affirms that the integration of interactive technology and AI not only enhances teachers' pedagogical competencies but also contributes to the development of a more adaptive, collaborative, and digitally relevant learning ecosystem aligned with the needs of the modern era.

**Keywords :** Interactive Technology, Artificial Intelligence, Gamification, Digital Literacy, 21st-Century Teachers.

**Abstrak**

Penelitian ini bertujuan untuk menggambarkan pemanfaatan teknologi interaktif dan artificial intelegence atau AI dalam meningkatkan kompetensi guru di abad ke-21 pada lingkungan Koordinator Wilayah Bidang Pendidikan Kecamatan Pangkatan, Kabupaten Labuhanbatu, Provinsi Sumatera Utara. Metode yang digunakan adalah metode deskriptif kualitatif dengan pendekatan field study (studi lapangan) melalui kegiatan workshop yang dilakukan selama enam hari. Subjek yang diteliti pada penelitian ini berjumlah 20 guru sekolah dasar yang mengikuti kegiatan pelatihan pada materi Quizizz,

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Wordwall dan pemanfaatan AI seperti ChatGPT dalam proses pembelajaran. Data yang dikumpulkan oleh peneliti melalui kegiatan observasi, wawancara, memberikan tes melalui pre-test dan post-test, serta dokumentasi dan kemudian dianalisis melalui reduksi data, penyajian data dan menarik kesimpulan. Hasil penelitian menunjukkan terjadinya peningkatan yang signifikan pada pemahaman dan keterampilan guru dalam mengintegrasikan teknologi interaktif dan AI pada proses pembelajaran. Nilai rata-rata pre-test sebesar 70,00% meningkat menjadi 89,00% pada post-test, hal tersebut menunjukkan peningkatan kemampuan sebesar 19,00%. Selain itu guru juga mampu membuat media pembelajaran berbasis gamifikasi dengan quizizz dan wordwall serta memanfaatkan artificial inteligence dalam menyusun perangkat ajar dan soal evaluasi secara efisien. Selain itu, kegiatan workshop ini menumbuhkan motivasi, kreativitas serta kesadaran digital guru pada pentingnya inovasi di pembelajaran abad ke-21. Penelitian ini menegaskan bahwa kombinasi teknologi interaktif dan AI bukan hanya meningkatkan kompetensi pada pedagogik guru akan tetapi juga membentuk ekosistem pembelajaran yang lebih adaptif, kolaboratif serta relevan dengan kebutuhan era digital.

**Kata Kunci :** Teknologi Interaktif, Artificial Intelligence, Gamifikasi, Literasi Digital, Guru Abad 21.

## 1. INTRODUCTION

The world of education continues to transform rapidly, particularly in the 21st century, which is characterized by the increasingly intensive use of digital technology in teaching and learning activities. Bates states that this digital transformation requires teachers not only to master technology but also to be capable of designing learning experiences that are relevant to the needs of 21st-century students (Bates, 2019). Teachers in the 21st century are expected to be competent facilitators of learning who are creative, innovative, and digitally literate in order to create learning experiences that are relevant to the needs of the digital generation. This aligns with the views of Rachmadtullah and Zulela, who explain that 21st-century teachers no longer serve as the central source of information, but rather as facilitators who encourage students' collaboration, creativity, and critical thinking through technology integration (R Rachmatullah, 2020). To achieve this goal, teachers are required to integrate technology into the learning process. One approach is the use of interactive technology based on gamification, such as applications like Quizizz and Wordwall. The Ministry of Education and Culture (Kemendikbud) also emphasizes that mastery of digital literacy is an essential part of pedagogical competence that 21st-century teachers must possess in order to adapt to the dynamics of educational technology (Kemendikbud, 2020). These two applications create a learning environment that is enjoyable, interactive, and competitive, while also enabling teachers to objectively evaluate student learning outcomes. Previous studies have also shown that the implementation of gamification fosters a more engaging learning atmosphere and increases students' focus and motivation (N Purwaningtyas, S Hartati, 2021). Recent studies indicate that the use of gamification-based learning media enhances student engagement, strengthens intrinsic motivation, and has a positive impact on academic achievement (Purwaningtyas et al; Basuki & Hidayati; Susanti, 2019).

In addition to the use of interactive technology, the advancement of Artificial Intelligence (AI) has also brought a revolutionary shift in education. AI not only plays a role in automating administrative tasks but also provides adaptive learning systems capable of tailoring

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instructional content to meet individual student needs (Holmes et al,; Zawacki-Richter et al.,) ., 2019). Research by Chen, Chen, and Lin also confirms that AI systems are capable of analyzing student learning data and generating accurate instructional recommendations for teachers. With the presence of AI, teachers can obtain real-time learning data analysis that supports pedagogical decision-making, maps students' learning difficulties, and provides more personalized feedback (L Chen, P Chen, 2020). This reinforces the shift in the role of teachers from merely transmitting knowledge to becoming learning facilitators who encourage students' critical thinking, collaboration, and creativity.

The collaboration between interactive technology and AI serves as an essential strategy for shaping a more effective digital-based educational ecosystem. In addition to being facilitators, teachers are also key agents of educational transformation who must possess digital competencies in order to utilize technology to its fullest potential. UNESCO documents emphasize that the integration of ICT in education should be directed toward expanding access to learning and fostering collaborative skills as well as problem-solving abilities (U.N.E.S.C.O, 2018). In line with the UNESCO ICT Competency Framework for Teachers, educators are required to use ICT to improve the quality of learning, expand educational access, and develop 21st-century skills among students.

Although research on gamification and AI has developed independently, studies that integrate both simultaneously in instructional practices—particularly in Indonesia—remain limited. Most existing research focuses only on the effectiveness of gamification on learning motivation or the application of AI for adaptive learning, yet few have explored how the collaboration between the two can strengthen pedagogical strategies. This situation highlights an urgent need for elementary school teachers to not only master interactive applications but also understand the potential of AI in the learning process. In reality, many teachers continue to face challenges regarding digital literacy and rarely receive training related to the integration of emerging technologies. Therefore, this study is essential to provide an implementation model and strengthen teacher competencies to effectively utilize both gamification and AI in a unified manner within the learning process. Thus, there remains a research gap that offers opportunities to explore the integration of interactive technology and AI within educational context.

As stated by Dewi, digital literacy among educators serves as a fundamental foundation to ensure that technology integration in learning can be implemented effectively and sustainably (F Dewi, 2021). Therefore, the use of interactive technologies such as Quizizz, Wordwall, and Artificial Intelligence is not merely a trend, but a necessity that supports the transformation of education in the digital era. This study seeks to explore how teachers are able to integrate and utilize interactive technology with AI in learning activities, analyze the challenges they encounter, and understand its pedagogical implications. The findings are expected to contribute to the international literature concerning digital-based education development while also offering practical insights to empower 21st-century teachers.

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## 2. RESEARCH METHOD

This study employed a descriptive qualitative method with a field study approach. This approach was selected because the research was conducted directly in the field by implementing a workshop on the use of interactive technology and artificial intelligence (AI) for 21st-century teachers, carried out within the Educational Coordination Office of Pangkatan Sub-District, Labuhanbatu Regency. The purpose of this research method is to systematically and comprehensively describe how the workshop activities were conducted, the participants' engagement, the improvement in teachers' competencies, and changes in their perspectives and skills in integrating interactive technology and artificial intelligence (AI) into the learning process. The descriptive qualitative approach allows the researcher to fully understand the phenomenon within its real context through direct observation, reflection, and analysis of the behaviors, experiences, and learning products of the workshop participants.

The workshop was conducted within the Educational Coordination Office of Pangkatan Sub-District, which oversees 28 elementary schools in the area. The workshop activities were centered at SDN 06 Pangkatan, one of the schools under the coordination office, serving as the venue for the workshop and the practical implementation of interactive learning technology.

This research activity was carried out over six days, namely on:

| No | Hari/Tanggal | Durasi | Keterangan |
|---|---|---|---|
| 1 | Senin/29 September 2025 | 3 Jam | Materi *Quizizz* |
| 2 | Selasa/30 September 2025 | 3 Jam | |
| 3 | Rabu/01 Oktober 2025 | 3 Jam | Materi *Wordwall* |
| 4 | Sabtu/04 Oktober 2025 | 3 Jam | |
| 5 | Senin/06 Oktober 2025 | 3 Jam | Materi AI |
| 6 | Selasa/07 Oktober 2025 | 3 Jam | |

The selection of this location was based on the researcher's consideration that most teachers in the area had not yet optimized the use of digital technology and still required guidance in integrating digital-based learning particularly interactive technologies and AI into their teaching practices.

The subjects of this study consisted of 20 elementary school teachers from several schools under the coordination of the Educational Coordination Office of Pangkatan Sub-District. The participants were selected based on their availability and willingness to attend the entire six-day workshop, which was announced through the Pangkatan Sub-District Teacher Working Group (KKG) WhatsApp Group. The participating teachers were classroom teachers, allowing the researcher to observe the implementation of learning technologies that align with their instructional responsibilities. During the workshop, the researcher served multiple roles as a resource person, facilitator, and observer, being directly involved in the workshop activities, mentoring process, and evaluation of learning outcomes.

In the workshop on the utilization of interactive technology and artificial intelligence, the researcher collected data using several techniques, including direct observation conducted throughout the workshop activities, interviews and reflective discussions administered through reflection sheets using Google Forms completed by the participants, as well as documentation

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in the form of photos, videos, and an official statement letter verifying the implementation of the field study. During the workshop on the utilization of interactive technology and artificial intelligence, the researcher collected data using several techniques, namely direct observation throughout the workshop activities, interviews and reflective discussions by providing a reflection form through Google Forms for participants to complete, as well as documentation in the form of photos and videos of the activities, along with an official letter confirming the implementation of the field study.

The research data obtained from the workshop was analyzed using a qualitative descriptive approach through several stages, including data reduction, where the researcher selected and simplified data from observations, interviews, and participant tests; data presentation, in which the information was displayed in the form of pre-test and post-test score tables, descriptive explanations of participant activities, and reflection results; and conclusion drawing, where the researcher interpreted the improvement in teacher competencies and the impact of the workshop on instructional practices.

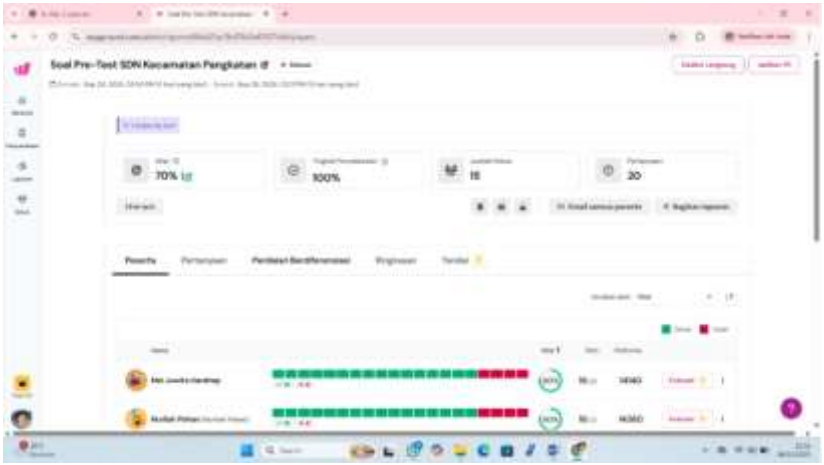
## 3. RESULT AND DISCUSSION

### a. Field Study Achievements (Outcomes Gained from the Activities)

The implementation of the workshop on the utilization of interactive technology and artificial intelligence (AI) for 21st-century teachers within the Education District Coordination Office of Pangkatan produced several results that can be described as follows:

1) Improvement of Teachers' Knowledge

Teachers who participated in the workshop experienced a significant increase in their understanding of 21st-century learning concepts, the importance of digital literacy, and strategies for utilizing interactive technology in the learning process. To measure the participants' initial level of knowledge, the instructor administered a pre-test at the beginning of the activity. The results of the pre-test can be seen in the figure below:



**Picture 1. Pre-Test Results of Workshop Participants**

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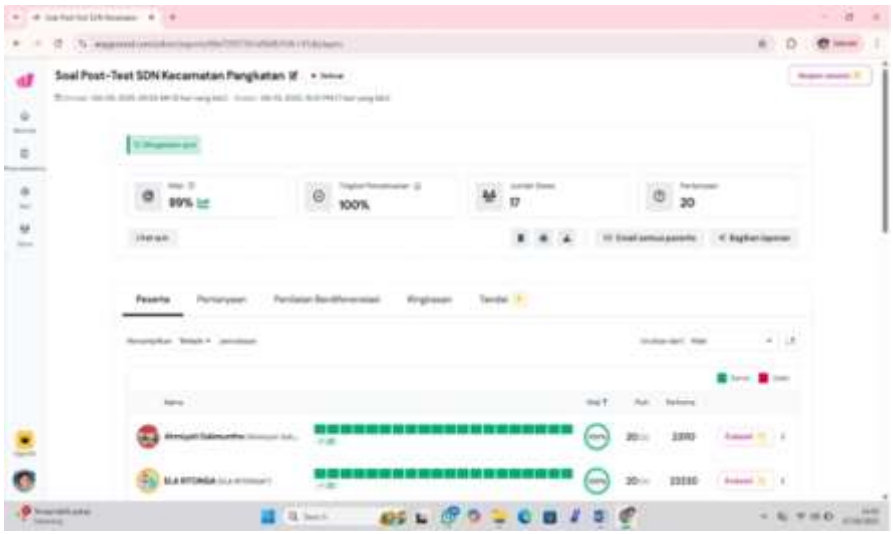
Based on the figure above, it can be concluded that from the 15 participants who completed the pre-test, the average score achieved was 70%, which falls into the "fairly good" category. Following the pre-test, participants received material related to the utilization of interactive technology and the use of artificial intelligence to broaden their knowledge. After the six workshop sessions were conducted, a post-test was administered to evaluate the improvement in participants' knowledge throughout the program. The post-test results provided by the instructor to the participants are presented in the following picture:




**Picture 2. Post-Test Results of Workshop Participants**

Based on the figure above, it can be concluded that from the 17 participants who completed the post-test, the average score achieved was 89%, which falls into the "excellent" category. This improvement indicates a significant increase in teachers' knowledge, as shown by the higher post-test results (class average score: 89.00%) compared to the pre-test results (70.00%). In other words, there was an increase in participants' understanding by 19.00%. This result demonstrates that the teachers were able to utilize Quizizz, Wordwall, and AI tools effectively, indicating that the workshop materials were well absorbed by the participants. These findings are also in line with Rusman's assertion that hands-on, practice-based training programs can effectively enhance teacher professionalism and support mastery of digital learning strategies in contextual settings (Rusman, 2021).\

2) Improvement of Practical Skills

In addition to strengthening their conceptual understanding of interactive technology and artificial intelligence (AI) utilization, the participants demonstrated improved practical skills in operating digital learning applications such as Quizizz and Wordwall. They successfully created interactive quizzes and learning media aligned with the subjects they teach, making the outcomes directly applicable in classroom instruction. Several teachers were even able to integrate diverse features—such as

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matching, puzzles, and spin-the-wheel—showing their ability to implement gamification elements to enhance student engagement during the learning process.

3) Utilization of AI Applications in Education

The workshop also facilitated the teachers' ability to adopt AI-based applications, particularly ChatGPT, in developing instructional materials more efficiently. Participants were able to produce teaching documents such as lesson modules, practice questions aligned with learning competency targets, and problem-solving guidance for student tasks. These results indicate that teachers have begun to embrace the integration of artificial intelligence as a supportive tool in daily teaching practices. This finding aligns with Chen et al., who stated that AI-based systems can streamline instructional design, support personalized learning needs, and enrich teacher creativity in developing learning resources (L Chen, P Chen, 2020) also helps teachers develop teaching materials and formative assessments more efficiently, accurately, and in accordance with students' learning needs.

4) Concrete Products Produced

The concrete result of this workshop activity is the development of technology-based teaching modules integrated into the Quizizz, Wordwall, and Artificial Intelligence (AI) applications. The products produced were presented through microteaching activities in which each material such as Quizizz was presented by one group, and Wordwall and Artificial Intelligence were presented by other groups. From these activities, it can be seen that there was an increase in participants' creativity as well as an improvement in collaboration skills.

5) Growth of Motivation and Digital Awareness

This workshop activity also succeeded in fostering a new spirit among the participants, who are teachers, to be more active in innovating in learning. The workshop also ran effectively, which had a positive impact on the participants. All participants felt very enthusiastic and motivated to always integrate technology in the classroom learning process, understand the material delivered well, and gain new insights related to the implementation of interactive technology and artificial intelligence in the field of education. The workshop also fostered self-confidence, creativity, and awareness of the importance of cooperation among teachers, accompanied by the understanding that technology is a supporting tool while teachers still have the main role in classroom learning. This finding is in line with Purwaningtyas and Hartati who explain that gamification-based media not only affects student learning outcomes but also increases teachers' motivation to continue innovating in learning (N Purwaningtyas, S Hartati, 2021). Teachers also realized that the use of interactive technology is not just an additional option but a primary need in dealing with the characteristics of the digital generation in this era. This can be seen from the reflection sheets provided by the instructor, which can be accessed through the link:

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https://docs.google.com/spreadsheets/d/1PMTA458KM9umRew6Zg3Fuh0inm_OcJ6R0m6a9shcThM/edit?resourcekey=&gid=965325452#gid=965325452

**b. Barriers and Solutions (Technical, Communication, and Method Constraints)**

In the implementation of the workshop related to the use of interactive technology and Artificial Intelligence (AI), several obstacles emerged, both technical and non-technical. The barriers encountered and the solutions that can be taken are described as follows:

1) Digital Literacy Barriers
2) Limited Internet Connectivity
3) Time Constraints
4) Variation in Technology Mastery Levels
5) Limited Facilities

Some teachers did not bring adequate devices such as laptops, which made it less convenient to use applications like Quizizz, Wordwall, and AI. Specifically, when creating questions using Quizizz, the process became longer due to the limited screen size on mobile phones that do not display all features of Quizizz, and the same happened with Wordwall. In addition, using a mobile phone makes it difficult to copy teaching modules because it is more challenging to operate. To minimize these facility limitations, the instructor suggested that participants use Chromebooks because the workshop venue was located at the instructor's school, allowing the Chromebooks to be utilized by teachers who only brought mobile phones.

**c. Student Reflection (Experience, Lessons Learned, Benefits for Academic and Professional Career)**

The implementation of this field study activity became a very valuable experience for me as a postgraduate student in the Master of Primary Education program. The workshop focused on the utilization of interactive technology and Artificial Intelligence (AI) provided me with the opportunity to interact directly with teachers in the field, particularly those in Pangkatan District, understand the real challenges they face, and actively contribute in providing solutions related to the use of technology. Through this workshop, I learned a great deal about effective communication, managing training activities, and adapting teaching approaches to accommodate diverse participant characteristics.

This field study also served as an important learning experience because I gained deeper understanding about the importance of digital literacy and adaptive skills for teachers. The integration of interactive technology and AI in learning has proven to improve student motivation and the effectiveness of the learning process when implemented appropriately. Additionally, I learned how to design training that is not only theoretical but emphasizes hands-on practice to ensure participants truly understand the application of technology in teaching and learning activities. This experience strengthened my awareness that the success of 21st-century learning greatly depends on teachers' competence in innovation and collaboration. This aligns with Bates' view that the success of technology implementation in education is determined by educators' readiness to adapt

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to paradigm shifts in learning (Bates, 2019).

From an academic and professional career perspective, this field study activity provides significant benefits in developing my competence as a teacher and educational practitioner. The experience of teaching, mentoring, and developing technology-based learning tools becomes an important asset to support future research and community service. Moreover, this field study expands professional networks with schools and the education office, which will be highly valuable for future academic collaboration and educational development projects.

## 4. CONCLUSION

The implementation of the Field Study through a Workshop on the Utilization of Interactive Technology and Artificial Intelligence (AI) for 21st-Century Teachers at the Education Coordination Office of Pangkatan District has been successfully carried out and has achieved the expected objectives. This field study activity, conducted in the form of a workshop, has effectively improved teachers' understanding and skills in utilizing digital technologies such as Quizizz, Wordwall, and Artificial Intelligence (AI) to support the learning process.

Through the workshop activities, teachers gained new insights regarding the importance of digital literacy, interactive learning, and the integration of technology in classroom instruction. The results of the pre-test and post-test revealed a significant increase in participants' competencies. In addition, the workshop fostered motivation and awareness among teachers to continue innovating in facing the challenges of learning in the digital era.

From an academic perspective, this field study provided practical experience for students in applying theoretical knowledge in real contexts, developing communication skills, leadership, and professionalism. Therefore, this Field Study has successfully served as a collaborative learning platform between the university and partner schools in developing 21st-century teachers who are creative, adaptive, and digitally literate.

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