GEN AI-TPACK Workshop for Strengthening Teachers' TPACK Competences

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ABSTRACT

This activity aims to provide technical guidance for strengthening TPACK or Technological Pedagogical Content Knowledge using the GEN AI-TPACK Framework approach. TPACK is a 21st-century teacher knowledge framework that helps support teaching skills. Meanwhile, GEN AI-TPACK is an adaptation of teachers' abilities to the use of artificial intelligence in education. This framework introduces TK, TPK, TCL, TPCK, and XK in the model for improving teacher competence. This activity is one of the effective ways to enhance teachers' professional and pedagogical competence. In addition, this training guidance also provides the benefit of digital literacy proficiency for teachers in learning in the digital era.

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Introduction

The latest 2023 West Sumatra Regional Education Balance Sheet (NPD) data shows that 49.7% of high school teachers are certified, meaning more than half are uncertified (Ministry of Education and Culture, 2023). Yet, teacher certification legally identifies a teacher as a professional. This figure is certainly an indicator of the need to improve teacher competency as a performance standard.performanceTeachers (Irmawan, A, 2022). There are two levels of competency assessed in the teacher competency assessment system: pedagogical and professional. Pedagogical competency is a teacher's ability to manage student-centered learning to achieve learning objectives. Meanwhile, professional competency is the ability to master student-centered learning materials (Anam, S, 2020). Strengthening teacher competency in student-centered teaching must be a top priority.. GOne approach to student-centered teaching is a digital concept, without discrediting conventional processes. This is in line with current developments, as technology-based learning continues to be a mainstay in the teaching and learning process. Digitalization is key to creating an education that meets the needs and dynamics of the future.

Improving teacher competence orTeacher Professional Development(TPD) within the GEN AI-TPACK framework applied in teaching is crucial to keeping pace with technological developments in the era of technological disruption and the development of learning 4.0. Teachers, as the vanguard of the education sector, should be proactive in recognizing popular trends in the education sector and implementing innovations that positively impact students. Although there aregap generationbetween

educators and students, where teachers are currently still dominated by Generation X(digital immigrant) who were born between 1965 – 1980 while the students taught were Gen Z who were born between 1997 – 2012.

The integration of education with technology falls under the TPACK framework, which encompasses pedagogical, content, and technological knowledge to enhance professional skills (Koehler, MJ; Mishra, P; Cain, W, 2013). However, field conditions indicate that teacher competency is still relatively low, with a percentage of 54.77%, and many teachers (97.5%) are still unfamiliar with digital technology.(Ningrum, T. A., & Gistituati, N, 2024). This shows that mastery of TPACK components still needs to be improved so that teachers are able to adapt to the demands of 21st-century learning. Pedagogical knowledge is process knowledge, the application of learning and teaching methods that involve understanding how students learn, classroom management, lesson plans, and assessment in learning. Content knowledge refers to teachers' knowledge regarding the content of the subjects being taught. This is very important to master so that knowledge transfer does not deviate from theory (Esposito, M; Zendrian, J, 2020). Technological knowledge is related to the selection of learning technology applications that can be used to support the effectiveness and efficiency of learning (Herring, MC., Koehler, MJ., Mishra, P, 2016). Oakley, G (2020) stated that these three knowledge must continue to be developed and improved to support teacher professionalism to support online and offline learning. The following is the GEN AI-TPACK framework.

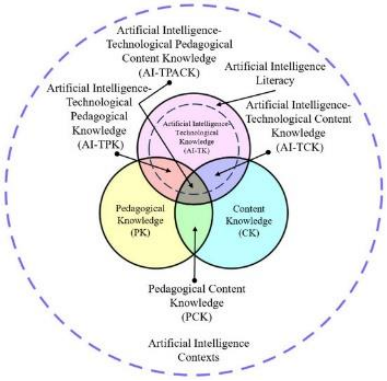

Figure 1. GEN AI-TPACK Framework

The framework contains several components: first, Al-TK encompasses teachers' awareness and understanding of AI-based applications, their ability to interact with these applications, and their ability to use specific AI systems. Second, Al-TCK emphasizes that teachers should use AI-based applications to enhance their expertise in their respective subject content. Third, Al-TPK relates to teachers' awareness of the pedagogical potential of AI-based applications, including how teachers monitor students, interpret meaning, and provide feedback. Al-TPACK is an integration of Al-TK, Al-TCK, and Al-TPK (Goldman, S. R., Carreon, A., & Smith, S. J, 2024). Furthermore, there is an ethics aspect that focuses on teachers' ability to educate students about ethical principles and practices in the use of AI, including responsibility, academic honesty, and the wise use of technology (Ikhsan, I., Artasoma, P., Karliani, E., & Sunarno, A, 2025).

The improvement of teachers' TPACK continues to evolve along with technological advancements in education. One example is the GEN AI, which can be integrated into current learning. Teachers must be able to use AI in a learning context (Ning, Y, et.al, 2014). This tool is claimed to provide benefits for teachers and students related to time efficiency related to student engagement and teacher facilities in the classroom (Salas-Pilco, SZ., Yang, Y, 2022). For students, this model has proven effective in improvingpersonalized learning, direct feedback, a form of effort to hone students' creativity (Izza A, Rusydiyah EF. (2020); M. Zafari, J.S, et.al, 2022; Dayanti F, Hamid A, 2021).Meanwhile, for teachers, this model can also improve TPACK knowledge (Mishra, P, Warr, M, & Islam, R, 2023; Risnanosanti R, et al., 2022). Furthermore, this model can also maximize the learning process provided it is applied according to the contextual situation, learning objectives, learning media, and learning aids (Ummam MK, Maulidah L, Syihabbudin M, 2021), and adheres to the code of ethics in its use (Elayyan, S, 2021).

Teachers at Batang Anai Senior High School, Padang Pariaman, need to be equipped with 4.0 learning materials assisted AI to strengthen their TPACK. There are two underlying problems, namely the uneven distribution of TPACK knowledge, especiallytechnological knowledgeamong teachers and its implementation is not optimal and there has not been a selection of appropriate models to be applied in all subjects.This is because the majority of teachers are overly paranoid aboutdigital learning, even though the existing facilities are adequate and meet the criteria for implementing this model. In addition, teachers also needdigital literary skillin learning in the digital era 4.0. It is assumed that similar training has not been provided to teachers so that educators do not have sufficient provisions regarding assisted learning AI based GEN AI-TPACK for the sake of refreshing and strengthening the TPACK skills of teachers at the school.

Method

This workshop was conducted in several stages. Overall, these stages can be grouped into concept introduction, discussion, structured practice, and evaluation or reflection. Prior to the first meeting, participants were given a pre-test to assess their initial knowledge of GEN-assisted learning AI TPACK. This pre-test consisted of short, open-ended essay questions reflecting on the teachers' previous teaching practices, which participants answered briefly. Participants were also given a task design test for a specific topic, which they then used in microteaching. These two tests measured teachers' prior knowledge of appropriate task design in 4.0 learning.

At the initial stage, the teacher group was given an explanation of the concept of assisted learning AI. In addition, the concept of learning using learning media applications and learning evaluation is also introduced in outline because learning is assistedAIA combination of face-to-face meetings and the use of technology, both offline and online. Concepts are introduced through lectures and discussions, accompanied by examples, followed by a question-and-answer session. These initial activities are expected to enhance understanding, enabling teachers to grasp the concepts and objectives of GEN-assisted learning AI TPACK in order to improve teachers' TPACK.

The next stage is for participants to be shown an example of an assisted learning video.AIThe participants were asked to observe the video and take notes on it. After that, they were divided into small groups (2 people). Each group was asked to discuss their notes and provide their responses. They were then asked to discuss the challenges and difficulties they faced if they implemented assisted learning AI and discuss together strategies to overcome these difficulties. These activities are intended to enable teachers to analyze assisted learning AI as one of the strategies to make them able to see ways to implement and overcome problems in the implementation of assisted learningAIwhich are common and which they may encounter in class.

The next stage is training in creating appropriate tasks to carry out the concept of assisted learning AI. One of the important elements in assisted learning isAIis the assignment of assignments that require students to work together effectively to complete them. Designing assignments with the appropriate difficulty is not easy. Therefore, teachers need to practice doing so. Teachers are given exercises and discussions on how to create simple digital assessments/evaluations through Quizizz, making it easier for teachers to prepare and correct the results from the learning process. Then, teachers practice designing the assignments, while the student-teacher assists and monitors. The designed assignments are discussed in small groups and throughout the class to discuss their usefulness.

In the final stage, teachers plan learning using a guided model AI and implements the learning in two forms, peer teaching, and in the actual classroom.Peer practice The purpose of this activity is to provide teachers with the opportunity to implement all the concepts discussed within a limited scope. The results of the implementation are then discussed with fellow teachers to identify strengths and weaknesses and allow for improvements. Then, each group of teachers voluntarily selects a teacher to practice the assisted learning process AI. This is done using a design previously discussed in a real classroom. Other teachers (a team) observe the learning process and take important notes for use during reflection. At least one teacher is expected to bring a camera to record the learning process.

The final stage is reflection. During the reflection, all team members and community service providers are present. The teacher who practices assisted learning AI. In class, students were given the opportunity to share their perceptions of the learning process. Afterward, other teachers and community service providers shared their observations. The recordings served as a source of data for the teachers' reflections.

Results

The Multidisciplinary Community Partnership Program (PMKM) community service program is implemented in three main stages: preparation, implementation, and evaluation. During the preparation stage, the community service team coordinates with the school leadership (SMAN 1 Batang Anai) regarding the implementation of the program. This stage begins with the initial proposal development and the request for partner availability from the school, which runs from May 14, 2025, to July 2025.

Next, after the preparation stage of the activity, the implementation stage of the activity was carried out, which had previously been confirmed regarding the date, place, and time as well as the number of participants involved. This activity was opened directly by the Principal of SMAN 1 Batang Anai, Mrs. Zulbaidah, S.Pd as a form of direct support for this community service activity. So there were 20 participants in the activity spread across the teacher categories of various fields of study such as English, Indonesian, Sports, History, and ICT. In addition, young teachers or PL teachers who were doing teaching practice at the school were also involved.

Figure 2. Opening of the activity by the Principal of SMAN 1 Batang Anai, Mrs. Zulbaidah, S.Pd

The next step was the provision of materials and a group discussion related to 21st-century learning trends, particularly at the high school level. To provide the widest possible opportunity for participating teachers, the school provided a full day of activities so that all teachers could participate in this community service activity. Therefore, the implementation pattern of this service activity was changed to provide maximum opportunities for teachers in other subjects such as mathematics, physics, Indonesian, science, social studies, and religion because the theme of this service is general in nature and can be applied to learning any subject.

Figure 3. Concept discussionTPACKas a support for 21st century teacher skills by the Head of the Community Service Eni Kurniawati, M.Pd

Before the discussion activity began, an informal pre-test was given to map teachers' initial knowledge and understanding regarding learning in the 21st century with the framework. GEN AI-TPACK. The results of this test show that several teachers have begun integrating technology into their learning and possess good awareness and competence in technology, pedagogy, and content. This is evident from the fact that most teachers already possess teaching certificates. However, most teachers only use computer-based learning. The challenge for teachers is finding suitable and relevant applications that can be used to support learning using artificial intelligence. Teachers have begun utilizing AI-based educational applications that can be used in classroom learning. Examples include Gama and Canva, which have been used for learning media and designing teaching materials, and Quizizz for evaluation. These AI-based applications are already widely known by teachers. However, teachers still struggle to find AI-based applications that suit the characteristics of each subject. Therefore, training is provided within the framework. GEN AI-TPACK with its integrated application to assist learning in the classroom.

Figure 4. Discussion of the GEN framework concept -AI TPACKin learning 4.0

In the introductory stage of TPACK and its relationship with the GEN framework -AI TPACKIn this session, teachers were introduced to several AI-based applications that can be used to create teaching materials or mini-presentations, relying on AI for efficiency and practicality. However, teachers were also given an explanation of the limitations of using these AI-based applications, which still require filtering and proofreading of the materials created by the AI applications to determine whether they are appropriate to student needs and learning topics. Teachers also began to explore each component in GEN AI TPACK, namely TK, TPK, TCL, TPCK, and XK. This activity can be seen in Figure 5.

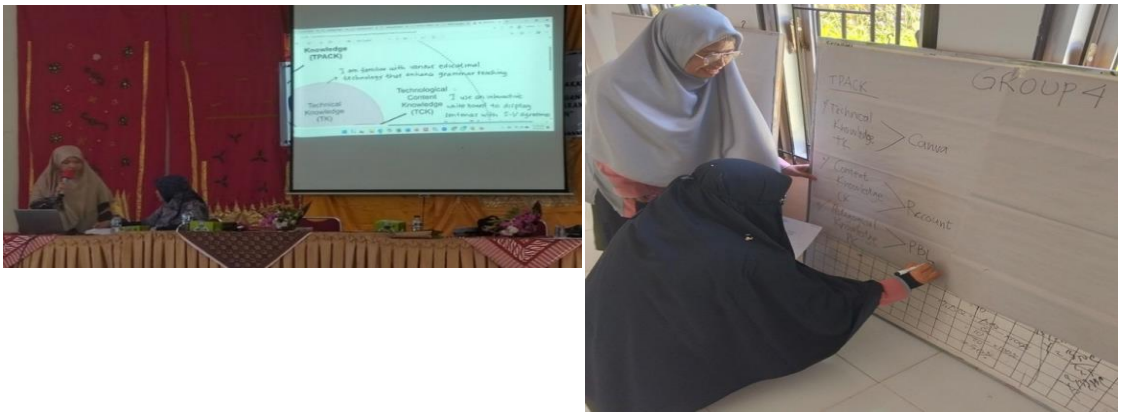

Figure 5. Implementation of components in GEN AI TPACK, namely TK, TPK, TCL, TPCK, and XK with teacher skills

After each teacher understood the concept of GEN-AI TPACK, teachers were asked to share good practices of reflecting on conceptual understanding in their respective subject groups. They were asked to choose a learning topic and create teaching materials, assignments, and announcements. Teachers were also asked to practice creating materials in AI features that suited the characteristics of each subject. Then, a question and answer session and discussion were held to solve problems in applying and using the GEN-AI TPACK-based application. One obstacle was the limitation of basic accounts where teachers could not access the features offered in their entirety. Owever, teachers were still able to maximize the features in their respective basic accounts.

Gambar 6 dan 7. Diskusi TPACK dengan framework GEN *-AI TPACK*

In this activity stage, teachers are expected to be able to possess and improve technological knowledge or technological knowledge in the teaching process that is integrated with pedagogical and content knowledge. Technological knowledge is where teachers can explore existing technology and adapt it to the characteristics of their respective subject areas. Content knowledge is where teachers see and match the suitability of the context of the teaching material produced by

the AI application whether it is in accordance with the content of the teaching material that should be. Pedagogical knowledge is how teachers apply pedagogical skills in relation to the use of AI applications in the classroom without replacing the teacher's role as a facilitator, mediator, and mentor in learning. Finally, teachers' understanding in the integration of context and ethics related to the use of GEN AI-TPACK (XC) - (eTHICS).

Figure 8. FGD in small groups per subject

Furthermore, the teachers were very enthusiastic and began to understand the 21st century learning model even though this activity was carried out in 4 sessions which included providing discussions on learning materials in the 21st century, discussions on conceptsframework GEN AI TPACK, and application or workshops on selecting appropriate AI-based applications for each subject. Teachers are beginning to gain knowledge about AI-based educational applications.GEN AI TPACKwith its implementation in the classroom, which can be used to facilitate the teaching and learning process and have the ability to apply this model to improve their TPACK. This activity emphasizes teachers' content and pedagogical knowledge in exploring digital learning materials and media. It is hoped that through this activity, teachers can produce digital teaching materials thatuser friendlyboth in terms of device and data usage.

The next topic discussed how to create simple digital assessments/evaluations to make it easier for teachers to prepare and correct learning outcomes. The application introduced was Quizizz. This app was chosen because it offers many conveniences for creating exam questions and can be used anywhere and anytime. Furthermore, teachers can access exam results in real time.

Figure 9. Discussion of Quizizz as an AI application for evaluation

Next, teachers will practice creating quizzes or exam questions. In this practice, teachers are asked to create questions that can be used to evaluate the learning process. This is integrated with content knowledge. Teachers are asked to explore the questions themselves, using various formats such as essays, multiple-choice questions, and images, tailored to the characteristics of their respective subjects.

Figures 10 and 11. Practice of making Quizizz as AIEd for evaluation

The final stage is evaluation and closing. The community service team opened a question-and-answer session with the teachers in the form of a group discussion forum to review and provide feedback on what had been implemented in the previous activity. In this case, the teachers were given a final test or post-test to measure TPACK knowledge in the form of:online self-assessement.

Discussion

Steps that can be taken to improve the 4Cs of generation Z are by implementing assisted learning AI because today's students are very close to this. This step has been proven to have various benefits such as increasing students' interest in learning (Kindenberg, B, 2025), improving students' learning achievement (Tantry, F., Sofi, T, 2022), sharpening conceptual understanding and mastery of learning competencies (Mahawan AM., Celedonio M, 2023), increasing students' learning productivity per hour (Ito H., Kasai, K., Nishiuchi, H., Nakamuro, M, 2021), students are more focused on

independent learning (personalized learning) (Phan, KY, 2020). However, as stated in the introduction, the problem that teachers often face in learning in the digital era is confusion in choosing the right educational tools/media and applications that can be integrated in real classes and the right learning model to support the use of these applications. In addition, the assignments given by teachers when students are asked to complete in groups tend to be less challenging so that most students are less able to develop their critical and creative thinking because there is no sharing of ideas. Furthermore, the absence of filters means that bias in the use of AI for learning tends to have no positive impact.

In addition to the benefits mentioned above, the results of this study indicate that the application of AI in learning plays a significant role in strengthening collaboration and digital social interaction among Generation Z (Laka, L., Darmansyah, R., et al., 2024). Utilizing AI platforms for group discussions or collaborative projects allows students to share ideas more broadly, thus optimally developing their communication and teamwork skills. Furthermore, AI also encourages the development of metacognitive skills, as students can evaluate their own learning process through automated feedback and suggestions for improvement, which further enhances critical and creative thinking skills (Sari, T. M., Nurjanah, S. S., & Rachman, I. F., 2025). Wider access to quality learning resources through AI enriches students' perspectives and broadens their horizons, supporting project-based learning and creative exploration. The implementation of AI also allows teachers to utilize real-time student learning data, allowing teaching strategies to be tailored to individual needs, reducing gaps in understanding, and increasing learning effectiveness (Liriwati, F. Y., 2023).

However, these findings also emphasize the need for ethical guidelines and policies in the use of AI to minimize dependency and enable teachers to guide students in using technology critically and responsibly. Furthermore, the integration of AI into learning 4.0 requires curriculum adaptation, including the explicit determination of achievement indicators that measure the 4C skills. This ensures that technology use is not merely operational but also supports the holistic achievement of core competencies. (Pare, A., & Sihotang, H, 2023). Thus, the application of AI in learning can strengthen 21st-century competencies, as long as it is accompanied by teacher mentoring, challenging task design, and strengthening digital literacy, thus having a real impact on the development of Generation Z's 4C skills.

Conclusion

From the series of community service activities that have been carried out, it can be concluded several points that teachers already have a good knowledge of 21st-century learning trends. However, because most of some teachers have started to try several AI-based educational applications that can be used in teaching and learning. However, Forum Group Discussion activities related to this are very necessary to be carried out so that all teachers know and are able to follow the development of 21st-century teaching and learning patterns more comprehensively and with a better level of TPACK. In addition, it is also to anticipate the negative impacts of the use of these AI applications. Furthermore,

GEN AI TPACK as a digital classroom learning framework greatly helps teachers in improving TPACK knowledge and developing learning patterns that use AI-based. Where teachers can minimize time in preparing teaching materials and evaluation materials. This activity can be done anytime and anywhere.

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