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Enhancing the Capacity for Classroom Action Research Utilizing Artificial Intelligence Among Teachers at MAN Bengkayang

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Abstract

Issues Examined in this article: Firstly, the level of comprehension and awareness among teachers at MAN Bengkayang regarding the significance of Classroom Action Research (CAR) in enhancing the quality of education; secondly, the obstacles encountered by teachers at MAN Bengkayang in conducting CAR; thirdly, the identification of effective strategies to improve the capacity of teachers at MAN Bengkayang in implementing AI-based CAR; and fourthly, the extent to which AI-based CAR training programs contribute to the enhancement of teachers' professional competencies at MAN Bengkayang. This article is derived from a community engagement initiative grounded in research utilizing the Participatory Action Research (PAR) methodology. The findings are as follows: first, teachers at MAN Bengkayang exhibit a limited understanding of Classroom Action Research (CAR). Second, teachers at MAN Bengkayang face significant challenges in balancing teaching responsibilities with administrative tasks, which impede the effective implementation of CAR. Third, effective strategies to enhance teachers' competencies in conducting AI-based CAR should encompass technological training, fostering collaboration among teachers, leveraging data for evaluation and feedback, integrating technology into the curriculum, and ensuring the availability of adequate infrastructure. Fourth, AI-based CAR training programs have substantially improved the professional competencies of teachers at MAN Bengkayang. Before participating in the AI-based CAR training, the professional competency of teachers at MAN Bengkayang was assessed at 68.12%, categorized as "adequate." Following the training, this competency level increased to 90.1%, categorized as "excellent".

Keywords: Teacher Capacity Enhancement, Classroom Action Research, Artificial Intelligence

Isu yang dibahas dalam artikel ini: Pertama, tingkat pemahaman dan kesadaran guru di MAN Bengkayang terhadap pentingnya Penelitian Tindakan Kelas (PTK) dalam meningkatkan kualitas pendidikan. Kedua, hambatan yang dihadapi oleh guru di MAN Bengkayang dalam melaksanakan PTK. Ketiga, identifikasi strategi efektif untuk meningkatkan kapasitas guru di MAN Bengkayang dalam menerapkan PTK berbasis AI. Keempat, sejauh mana program pelatihan PTK berbasis AI berkontribusi pada peningkatan kompetensi profesional guru di MAN Bengkayang. Artikel ini berasal dari kegiatan pengabdian masyarakat yang didasarkan pada penelitian dengan menggunakan metode Participatory Action Research (PAR). Temuan penelitian adalah sebagai berikut: Pertama, Guru di MAN Bengkayang menunjukkan pemahaman yang terbatas tentang Penelitian Tindakan Kelas (PTK). Kedua, Guru di MAN Bengkayang menghadapi tantangan besar dalam menyeimbangkan tanggung jawab mengajar dengan tugas administratif, yang menghambat pelaksanaan PTK secara efektif. Ketiga, Strategi efektif untuk meningkatkan kompetensi guru dalam melaksanakan PTK berbasis AI meliputi: pelatihan teknologi, mendorong kolaborasi antar guru, memanfaatkan data untuk evaluasi dan umpan balik, mengintegrasikan teknologi ke dalam kurikulum, serta memastikan ketersediaan infrastruktur yang memadai. Keempat, Program pelatihan PTK berbasis AI secara signifikan meningkatkan kompetensi profesional guru di MAN Bengkayang. Sebelum mengikuti pelatihan PTK berbasis AI, kompetensi profesional guru di MAN Bengkayang dinilai sebesar 68,12% (kategori "cukup"). Setelah pelatihan, tingkat kompetensi ini meningkat menjadi 90,1% (kategori "sangat baik").
Kata Kunci: *Peningkatan Kapasitas Guru, Penelitian Tindakan Kelas, Kecerdasan Buatan*

INTRODUCTION

Education is a key element in national development, and the quality of education is profoundly influenced by the competence and professionalism of teachers. In Indonesia, the role of teachers extends beyond teaching; it also encompasses the responsibility to continuously enhance their competencies to provide better educational services to students (Ruhiyat, 2019). One of the strategies that teachers can adopt to improve their professional competencies is through Classroom Action Research (hereinafter referred to as CAR) (Azizah & Fatamorgana, 2021).

CAR is a research methodology conducted by teachers within their classrooms, aimed at solving existing problems while simultaneously improving the quality of learning. This type of research is crucial for teachers as it not only assists in identifying and addressing issues in the learning process but also contributes to the development of their skills in applying innovative and effective teaching methods (Azizah & Fatamorgana, 2021; Khasimah, 2013). In this context, teachers are encouraged to "embrace change" by leveraging Artificial Intelligence (hereinafter referred to as AI).

State Islamic Senior High School (hereinafter referred to as MAN) in Bengkayang Regency faces unique challenges in the field of education. The limited access to professional training and development opportunities for teachers in this region necessitates effective interventions to enhance the quality of education. One proposed solution is through intensive training and mentoring for teachers in conducting AI-based Classroom Action Research (CAR). Consequently, it is expected that teachers at MAN Bengkayang will be better equipped to identify issues within their classrooms and implement sustainable corrective actions to improve the quality of learning.

CAR also represents a tangible effort to support Continuing Professional Development (CPD) for teachers, which is a critical component in the broader initiative to enhance the quality of education in Indonesia. CPD emphasizes self-development, scientific publication, and innovation, all of which are directly supported by CAR. Through CAR, teachers not only improve and enhance the quality of classroom learning but also contribute to the advancement of knowledge by publishing their research findings. For classroom learning, CAR has a direct impact, as it is specifically designed to address and improve teaching practices (Suyanto, 2002).

Therefore, community service programs conducted by lecturers are essential and should be designed to strengthen the capacity of teachers through training and mentoring initiatives. This article discusses the capacity-building efforts of teachers at MAN in Bengkayang Regency in conducting AI-based CAR. The program aims to enhance teachers' professional competencies, which ultimately contributes to improving the quality of education in the region.

The following research questions are addressed in this article: First, what is the level of understanding and awareness among teachers at MAN Bengkayang regarding the importance of Classroom Action Research (CAR) in improving the quality of learning? It is evident that CAR is one of the essential methods teachers can employ to address challenges encountered in daily teaching practices. However, many teachers have yet to comprehend and recognize the urgency and benefits of CAR fully. Therefore, it is necessary to identify the extent of teachers' understanding and awareness at MAN Bengkayang regarding the significance of CAR.

Second, what are the obstacles faced by teachers at MAN Bengkayang in conducting CAR? Based on preliminary observations and interviews conducted by the author, while CAR offers significant benefits, its implementation often encounters various challenges. These challenges may include limited time, inadequate access to resources or supporting materials, and insufficient skills in designing and executing CAR. Identifying these obstacles is crucial for formulating appropriate solutions.

Third, what are effective strategies for enhancing the skills of teachers at MAN Bengkayang in conducting AI-based CAR? One of the primary objectives of community service initiatives by lecturers for teachers is to improve their skills in designing and implementing AI-based CAR. Thus, it is essential to formulate effective strategies for training and mentoring to enable teachers to independently conduct CAR effectively and in alignment with expected standards by leveraging AI.

Fourth, to what extent can the AI-based CAR training program enhance the professional competencies of teachers at MAN Bengkayang?

This training and mentoring program is designed to assist teachers in improving their professional competencies in conducting AI-based Classroom Action Research (CAR). Therefore, an assessment is necessary, involving pre-tests and post-tests for each teacher to determine the extent to which this program can have a positive impact on enhancing teachers' professional competencies, particularly in terms of learning innovation and addressing issues encountered in the classroom.

Based on the identified research questions, the objectives of the community service program by lecturers for the teachers at MAN Bengkayang can be outlined as follows: First, to enhance teachers' understanding and awareness of the importance of Classroom Action Research (CAR). This program aims to increase teachers' understanding and awareness at MAN Bengkayang regarding the critical role of CAR in improving the quality of learning. Through training and socialization, it is expected that teachers will

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gain a deeper understanding of CAR as a tool for solving learning problems and enhancing their professional competencies. Second, to identify and address obstacles in the implementation of CAR using AI. One of the primary objectives of this initiative is to identify various obstacles faced by teachers in implementing CAR, both internal and external, in the context of using AI. Additionally, the program will provide practical solutions to overcome these obstacles, enabling teachers to implement CAR more effectively. Third, to improve teachers' skills in designing and implementing CAR. This program aims to provide comprehensive training to teachers on techniques and strategies for implementing AI-based CAR. With enhanced skills, it is expected that teachers will be able to independently design and execute CAR that addresses the learning issues they encounter in their classrooms. Fourth, to enhance teachers' professional competencies through the implementation of CAR. This community service program also seeks to improve the professional competencies of teachers at MAN Bengkayang. By equipping them with the ability to conduct AI-based CAR, it is hoped that teachers will continue to innovate in the learning process and contribute to improving the quality of education at their schools. These objectives are designed to ensure that this community service program can provide a tangible and sustainable impact on enhancing the quality of education at MAN Bengkayang, Bengkayang Regency.

Additionally, based on the review of previous research conducted by the author, studies on this topic remain relatively scarce. However, the author found a study titled The Impact of Utilizing Chat GPT on the Performance of Islamic Education Teachers in Segedong District, FTIK, PAI Study Program, IAIN Pontianak by Fikri Fadian (2024). This study aims to investigate: First, how the performance of Islamic Education (PAI) teachers in Segedong District in preparing teaching modules was before utilizing Chat GPT; Second, how Chat GPT was utilized by PAI teachers in Segedong District; Third, how the performance of PAI teachers in preparing teaching modules in Segedong District changed after utilizing Chat GPT; Fourth, whether there is a significant impact of using Chat GPT on the performance of PAI teachers in preparing teaching modules in Segedong District. This research employed a quantitative approach with a pre-experimental design. The sample consisted of all 22 PAI teachers in elementary schools in Segedong District. Data collection tools included questionnaires, observation guidelines, and documentation. Data analysis was performed using IBM SPSS Statistics 29. The results of the study concluded that:

First, the performance of PAI teachers in preparing teaching modules in Segedong District before utilizing Chat GPT was categorized as “Good” with a percentage score of 88.27%; Second, the utilization of Chat GPT by PAI teachers in Segedong District to prepare teaching modules was categorized as “Excellent” with a percentage score of 100%; Third, the performance of PAI teachers in preparing teaching modules in Segedong District after utilizing Chat GPT was categorized as “Excellent” with a percentage score of 94.7%; Fourth, there was a significant impact of utilizing Chat GPT on the performance of PAI teachers in preparing teaching modules in Segedong District.

RESEARCH METHOD

This article is based on the results of community service research using the Participatory Action Research (PAR) method. According to Kindom Sara (2007), Participatory Action Research (PAR) is a way to build bridges to connect people through a research approach that involves the active participation of community members or groups who are the subject of the research. The primary objective of PAR is to enhance

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understanding of a specific social issue while empowering the community to take actions that can improve their conditions. PAR emphasizes a collaborative relationship between researchers and participants, with the goal of generating knowledge that is directly beneficial to the participants involved.

The selection of the Participatory Action Research (PAR) methodology is based on the following justifications: First, Active Engagement of Teachers as Participants:

PAR places significant emphasis on the collaborative involvement of both researchers and participants. In this context, the teachers at Madrasah Aliyah will assume the role of active partners throughout all stages of the research process, from planning to execution and reflection. Consequently, these teachers are not merely subjects of the research but integral members of the research team, working collectively towards the achievement of the set objectives. Second, the Objective of Empowerment and Transformation of Practice: This study seeks to empower teachers by training them to implement AI-based Classroom Action Research (CAR). Through the application of PAR, the researcher and teachers will jointly design, implement, and assess the integration of AI within their pedagogical practices. This approach is consistent with the core principle of PAR, which aims to empower participants to enact meaningful change and enhance their professional practices through collaborative inquiry. Third, Emphasis on Action and Transformation of Practice: PAR is designed to facilitate direct and tangible changes in field practices. Within the framework of this community service initiative, AI-based training is anticipated to not only enhance teachers' proficiency in conducting CAR but also to elevate the overall quality of teaching at Madrasah Aliyah. This methodology enables teachers to engage in experimental practices and reflective processes regarding the potential of AI to augment the effectiveness of their instructional methodologies. Fourth, Iterative Process and Reflection: A fundamental characteristic of PAR is its iterative nature—researchers and participants collaboratively analyze data and engage in reflective practices to determine subsequent steps. In the context of AI-based CAR training, this process will likely involve the experimentation with specific AI tools, followed by a thorough evaluation, and continuous refinement of the AI-driven teaching methods employed.

Furthermore, several stages have been designed to achieve the objective of enhancing teachers' competencies in implementing Artificial Intelligence-Based Classroom Action Research (CAR). These stages include preparation, implementation, and evaluation, which will be explained in detail as follows:

1. Preparation
   a. Needs Analysis: Before the program begins, a needs analysis is conducted to assess the level of understanding and skills of the teachers at MAN Bengkayang regarding Classroom Action Research (CAR). This analysis is carried out through surveys and interviews with teachers and the school principal. The results of this analysis will be used to design training materials that align with the teachers' needs.
   b. Development of Training Materials: Based on the results of the needs analysis, the training materials are comprehensively designed, covering the basic theory of CAR, data collection techniques, data analysis, and the preparation of CAR reports. These materials are developed by a team of experts with experience in action research and education.
   c. Recruitment of Participants: The teachers at MAN Bengkayang targeted for this program will be recruited through collaboration with the local Education Office and

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relevant schools. The criteria for participation are teachers who have at least 3 years of teaching experience and are interested in enhancing their competencies through CAR.

2. Implementation
   a. Intensive Training: The training will be conducted in the form of a two-day workshop. On the first day, teachers will be introduced to the technical aspects of the training, followed by a session on the Importance of Classroom Action Research (CAR) for Enhancing the Quality of Education. This will be followed by a discussion on the Transformation of Education through Artificial Intelligence (AI), and an introduction to the role of Chat GPT in education, concluding with a case study discussion. On the second day, the session will continue with further discussion on the Use of Chat GPT in Education, followed by a session on Tips and Tricks for Conducting Classroom Action Research Using Chat GPT. This session will involve hands-on practice in designing AI-based CAR proposals, along with technical guidance on the implementation of AI-based CAR and the preparation of research reports. Throughout the training, participants will be given opportunities to work individually and in small groups to design and simulate AI-based CAR that aligns with their classroom context.
   b. Ongoing Mentoring: After the training, teachers will receive continuous support in implementing CAR in their respective classrooms. Mentoring will be conducted through online consultations. The mentoring team will assist teachers in the planning, implementation, data collection, analysis, and report writing phases of CAR.
   c. Feedback and Improvement: The mentoring process will also include providing feedback and suggestions for improvement, enabling teachers to refine and enhance their implementation of CAR.

3. Data Collection

Throughout the duration of the program, data regarding the process and outcomes of the implementation of Classroom Action Research (CAR) by the teachers will be collected. This data will include the distribution of questionnaires, observations, and interviews with the teachers. The collected data will be utilized to evaluate the extent of the teachers' understanding of AI-based CAR, assess the effectiveness of the program, and measure its impact on the quality of classroom instruction.

4. Evaluation
   a. Process Evaluation: The process evaluation is conducted to assess how the training and mentoring activities were implemented and to what extent these activities aligned with the planned objectives. This evaluation includes an assessment of the content, methods, and participant engagement throughout the program.
   b. Outcome Evaluation: The outcome evaluation focuses on measuring the improvement in teachers' competencies in conducting AI-based Classroom Action Research (CAR). This evaluation is carried out by assessing the CAR reports produced by the teachers, as well as through pre-tests and post-tests designed to measure the teachers' understanding and skills before and after participating in the program.

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RESULTS AND DISCUSSION

An Overview of Classroom Action Research and Artificial Intelligence in the Form of Chat-GPT

1. Classroom Action Research

Classroom Action Research (CAR) has long been recognized as a pivotal tool for improving the quality of teaching and learning in schools. The term "Action Research" was first introduced by Kurt Lewin in 1946 as a research methodology involving cycles of reflection, planning, action, and observation within the context of education (Joni TR & Tisno, 2012). In the Indonesian educational context, CAR gained widespread recognition in the 1990s, particularly with the introduction of the Competency-Based Curriculum, which emphasized enhancing the quality of the learning process through action research (Azizah & Fatamorgana, 2021).

According to Suharsimi Arikunto in his book Classroom Action Research, Classroom Action Research (CAR) is a research methodology conducted by teachers to improve and enhance the quality of learning in their classrooms. CAR enables teachers to act as researchers, addressing daily classroom challenges while simultaneously advancing their professional competencies (Arikunto, 1993).

The synthesis of these perspectives underscores that CAR is an essential research method for enhancing the quality of education in schools. Initially introduced by Kurt Lewin in 1946, CAR gained prominence in Indonesia during the 1990s with the implementation of the Competency-Based Curriculum. This curriculum highlighted the importance of action research as a tool for teachers to reflect, plan, act, and observe systematically to improve classroom practices and address challenges. Consequently, CAR not only enhances the quality of learning but also contributes to teachers' professional development.

One of the primary advantages of CAR is its ability to directly identify and resolve issues within the teaching and learning process. As Hopkins (2008) explains in his book A Teacher's Guide to Classroom Research, CAR provides teachers with opportunities to test and implement various teaching strategies tailored to the specific needs of their students and classroom contexts (Hopkins, 2009). This aligns with the views of Kemmis and McTaggart, who argue that CAR serves as both a tool for improving teaching practices and a means for professional development (Azizah & Fatamorgana, 2021).

In Indonesia, CAR has become increasingly relevant in the context of the government's Continuous Professional Development (CPD) policy. CAR is recognized as a core activity within CPD, allowing teachers to continually refine their competencies through reflective practices and independent research.

CAR plays a vital role in enhancing the quality of education by empowering teachers as agents of change who are actively involved in reflecting on and improving teaching practices. This approach supports educational theories that emphasize experiential learning, active participation, and teacher empowerment, ultimately contributing to the advancement of educational quality.

Despite its numerous benefits, the implementation of Classroom Action Research (CAR) in Indonesia continues to face various challenges. Suharsimi Arikunto, in his book *Dasar-dasar Evaluasi Pendidikan*, identifies several obstacles commonly encountered by teachers in conducting CAR, including:

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1. **Limited Time Availability:** One of the most significant challenges in CAR is the limited time available to teachers. CAR requires educators to engage in a continuous cycle of planning, action, observation, and reflection. With their already packed schedules involving teaching duties, administrative tasks, and other responsibilities, teachers often struggle to allocate sufficient time to thoroughly execute the entire CAR process.
2. **Lack of Understanding of CAR**: Many teachers do not fully grasp the fundamental concepts and principles of CAR. Without a clear understanding, they may find it challenging to design and implement CAR effectively. In some cases, CAR is perceived as an additional burden unrelated to their teaching practice, leading to a lack of seriousness in its execution
3. **Limited Access to Resources**: Conducting CAR requires access to resources such as observation tools, student data, and occasionally, technological equipment. However, in many schools, especially those in under-resourced areas, the availability of these resources is inadequate. For instance, the lack of software for data analysis or limited access to educational literature can hinder the research process.
4. **Limited Training to Enhance Teachers' Research Skills**: The success of CAR heavily depends on the support provided by school leadership and peers. Without adequate backing from school principals, such as allocating time for research activities, CAR becomes more challenging to execute. Additionally, the absence of collaborative forums or discussion groups among teachers limits the reflective and developmental aspects of CAR.
5. **Challenges in Data Collection:** Data collection in CAR often presents difficulties, particularly in ensuring the validity and reliability of the data. Teachers may face challenges in gathering objective and consistent data due to subjectivity in observations or difficulties in using appropriate instruments. Moreover, time constraints can further affect the accuracy of data collection.
6. **Resistance from Students:** Some students may be unaware of or disinterested in the experimental teaching methods applied during CAR, especially if these methods differ from their expectations. This resistance can lead to discomfort with the changes or evaluations introduced by teachers, thereby affecting student participation and the desired outcomes of CAR.
7. **Difficulties in Data Analysis**: Following data collection, teachers must analyze the data to draw conclusions and plan subsequent actions. For many educators, this process can be confusing and may require a deeper understanding of statistical or research methodologies. Without adequate data analysis skills, the results of CAR may lack accuracy or practical utility.
8. **Challenges in Implementing CAR Outcomes:** The results of CAR are not always easily applicable in subsequent classes. Even if the actions taken during a CAR cycle improve learning in a specific period, differences in classroom conditions—such as variations in student characteristics, schedules, or resources—may affect the effectiveness of implementing these solutions in the future.
9. **Dependence on Teacher Leadership**: CAR heavily relies on the initiative and commitment of individual teachers. If educators lack dedication or motivation, CAR is unlikely to be executed effectively. This challenge is exacerbated when teachers feel overburdened by their responsibilities and perceive a lack of recognition or appreciation from the school administration.

10. **Limitations in Scalability:** CAR is often conducted on a small scale, such as in a single classroom or with a specific group of students. Consequently, the findings from CAR may be difficult to generalize or apply more broadly across the school or educational system. Not all improvements achieved through CAR can be seamlessly transferred to other classrooms with different conditions.
11. **Difficulties in Assessing Success:** Evaluating the success of CAR can be highly subjective and, at times, unclear. The outcomes achieved in a single CAR cycle may not be immediately apparent or measurable quantitatively. Therefore, more in-depth and long-term evaluations are required to ascertain its impact on the quality of learning (Arikunto, 2005).

The challenges outlined above are also evident in the fact that many teachers in remote areas face significant difficulties in accessing training and guidance necessary for the implementation of Classroom Action Research (CAR). Numerous studies have demonstrated that intensive training and mentorship programs for teachers in these regions are vital to ensuring the successful execution of CAR.

While CAR has substantial potential to enhance the quality of education, these challenges necessitate focused attention and resolution. For CAR to be effectively implemented, it is imperative to enhance teachers' understanding of the methodology, secure robust support from school leadership, and address the resource constraints that exist.

To mitigate the barriers to CAR implementation, it is crucial to develop targeted strategies aimed at improving teachers' research competencies. According to Elliott (1991) in Action Research for Educational Change, one effective approach is to provide comprehensive, ongoing training that integrates both theoretical knowledge and practical application. Such training should be specifically designed to address the unique needs of teachers in the field, while ensuring consistent mentorship to facilitate the successful application of CAR (Elliott, 1991).

A successful mentoring program was also reported by Rust & Clark (2010) in Teachers Researching Their Practice, where intensive mentoring during the implementation of Classroom Action Research (CAR) significantly improved teachers' skills and confidence in designing and conducting their own research (Meyers & Rust, 2003).

Based on the literature discussed, it can be concluded that CAR is an effective method for enhancing teachers' professional competence and improving the quality of classroom learning. However, the successful implementation of CAR requires adequate support, particularly in the form of training and mentoring, to help teachers overcome the various challenges they face. With the application of appropriate strategies, CAR can serve as a powerful tool in advancing education in Bengkayang Regency.

2. Artificial Intelligence in the Form of Chat-GPT

Chat GPT (Generative Pre-Trained Transformer) is a chatbot or robot that utilizes artificial intelligence (AI) to interact and assist humans in performing various tasks (Faiz & Kurniawaty, 2023). Chat GPT is an AI-based system designed to engage and interact in text-based conversations (Suharmawan, 2023). It is a development service produced by OpenAI, a research and implementation laboratory for artificial intelligence (AI) based in San Francisco, United States (Priowirjanto et al., 2023).

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Based on the aforementioned opinions, it can be concluded that Chat GPT (Generative Pre-Trained Transformer) is a robot or chatbot that uses AI to interact and assist humans in performing various tasks. The advantages of Chat GPT include its ability to interact and assist humans in completing various tasks. Chat GPT can respond to human inquiries in the form of text entered into the application (Pontjowulan et al., 2023). One of its key strengths is its ability to process data quickly and accurately, making Chat GPT highly effective in supporting decision-making and improving work efficiency. Additionally, Chat GPT can replace human workers in repetitive tasks, helping to reduce costs and increase consistency (Misnawati, 2023).

Meanwhile, the main drawback of Chat GPT is its inability to replace human capabilities in tasks that require creativity and empathy. Additionally, special attention must be given to issues related to security and data privacy. The potential for data misuse and cyber security threats are critical concerns that need to be addressed when utilizing AI technologies like Chat GPT (Misnawati, 2023). Limitations in understanding context and the lack of specialized domain knowledge in Chat GPT can present significant barriers, particularly when providing relevant assistance in educational settings (Pontjowulan et al., 2023).

One of the primary benefits of using Chat GPT is its ability to enhance accessibility and availability of information. This, of course, makes it easier for individuals to access various types of information at any time and from any location (Sholihatin et al., 2023). The benefits of Chat GPT can be experienced across various fields, including education, healthcare, and financial management. With its technology, Chat GPT can handle multiple conversations simultaneously, thereby improving time efficiency (Iriyani et al., 2023).

Chat GPT can be utilized for a wide range of purposes, such as translating languages, creating original texts, assisting programmers in solving coding problems, simplifying complex concepts, drafting or even outlining articles, and other capabilities that ease the user's workload (Suharmawan, 2023). To maximize the use of Chat GPT, a certain level of technical understanding is required. This understanding involves knowing the steps for effectively using Chat GPT (Fahada et al., 2023). Suharmawan (2023) explains the following steps for using Chat GPT:

1. First, open a browser on your phone or PC.
2. Visit the website https://chat.openai.com.
3. Then, sign up to create an account by clicking on "Create an OpenAI account."
4. Register using your email, Microsoft, or Google account.
5. OpenAI will then send a verification code to your WhatsApp.
6. Once the code appears, enter it, and you will be redirected to the platform's dashboard.
7. Enter the desired command.
8. Wait a few seconds for the AI to provide a response.
9. Done

The Objective Condition of Teacher Competence at MAN Bengkayang in Relation to Classroom Action Research (CAR) and the Implications

Based on observations and interviews at MAN Bengkayang, several factors contribute to the weak capacity of teachers to implement Classroom Action Research (CAR), which subsequently impacts the quality of teaching. These include: First: a lack of knowledge and skills in Artificial Intelligence (AI), with many teachers at MAN Bengkayang being unfamiliar with AI concepts and their application in CAR, hindering

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their ability to integrate cutting-edge technology into their teaching methodologies; second: limitations in CAR training, where teachers may lack the understanding and skills necessary for conducting effective action research, which restricts the effectiveness and innovation in their teaching practices; Third: dependence on conventional methods, where the use of traditional approaches in CAR leads to a lack of innovation and efficient problem-solving in the learning process; Fourth: teaching quality, as the lack of knowledge and skills in AI and CAR negatively affects the quality of instruction, which in turn impacts student learning outcomes; and Fifth: a lack of innovation, as without the application of the latest technology, the learning process may fail to adapt to modern developments, affecting student engagement and motivation.

In response to these challenges, several interventions can be implemented: 1) enhancing teacher capacity by improving their knowledge and skills in utilizing AI and Classroom Action Research (CAR) to elevate the quality of teaching and learning processes at MAN Bengkayang; 2) providing comprehensive AI training, focusing on AI concepts and practical applications in the educational context; 3) offering CAR training to develop teachers' abilities in designing and implementing AI-based CAR, thus enhancing their teaching practices; and 4) facilitating the integration of AI technology into CAR to improve the effectiveness and efficiency of the learning process.

Furthermore, the program strategy can focus on interventions through: 1) designing a training curriculum that includes basic AI theory, relevant AI tools and platforms, and CAR techniques. The curriculum should be tailored to meet the specific needs of teachers and adapted to their educational context; 2) employing interactive teaching methods, such as workshops, simulations, and case studies, to facilitate the understanding and application of AI and CAR. This approach enables teachers to learn through hands-on practice and real-life experiences; and 3) conducting regular evaluations to assess participants' understanding and progress. Constructive feedback should be provided, and training strategies should be adjusted based on the evaluation results.

Description of the Classroom Action Research Capacity Building Program Based on Artificial Intelligence for Teachers at MAN Bengkayang

The community service activity conducted by the PKM Team from the Islamic Religious Education (PAI) Study Program of IAIN Pontianak at MAN Bengkayang, West Kalimantan, was a great success in providing training on “Classroom Action Research Based on Artificial Intelligence for Teachers.” This training was designed to strengthen the capacity of teachers in remote areas to utilize modern technology, particularly artificial intelligence, to enhance the quality of education. The two-day event received enthusiastic participation from the teachers, who were eager to absorb new knowledge and skills highly relevant to the current educational needs.

The training was led by Mrs. Helva Zuraya, M.Ag, with field implementation managed by Mrs. Nopita Sari, M.Pd. The main speakers included Feni Nurhaliza, S.Pd., an AI practitioner in education who shared valuable insights, and Dr. Syamsul Kurniawan, a research practitioner and the head of the PAI program. The well-organized training agenda ensured that each topic was delivered in depth, ranging from the importance of classroom action research to practical tips for using Chat GPT in education.

The event began with a speech from Dr. Syamsul Kurniawan, S.Th.I., M.S.I., emphasizing the importance of technology adaptation for teachers in remote areas such as MAN Bengkayang. For Dr. Syamsul, this activity was not just a training session but also a demonstration of academic support for education in regions with limited access.

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The Head of MAN Bengkayang, Mr. Ridwan, S.Pd., also welcomed this initiative and expressed hope that the training would have long-term benefits for the teachers at MAN Bengkayang.

The training began with an introduction to the importance of classroom action research, presented by Mr. Ridwan. He highlighted how CAR can serve as a tool for teachers to evaluate and improve their own teaching practices. This session laid a solid foundation for participants to understand how artificial intelligence could be integrated into classroom action research.

Feni Nurhaliza then led a session on "Transforming Education with AI," explaining the fundamentals of AI and its potential benefits for education. She provided examples of how AI could assist teachers in collecting and analyzing student development data, making learning more tailored to individual needs. Participants were highly engaged as they listened to Feni's explanations and saw examples of AI applications that could be directly used in the classroom.

After a coffee break, Feni continued her training by introducing Chat GPT and various features that could be utilized in education. The teachers were intrigued as Feni demonstrated practical ways to use Chat GPT, such as generating ideas for assignments, creating exam questions, or providing additional explanations to students. In this session, Feni ensured that each participant understood how to operate this tool through easy-to-follow examples.

The second day of training began with tips and tricks for using Chat GPT in classroom action research, presented by Dr. Syamsul Kurniawan. He provided guidance on how teachers could frame the right questions for Chat GPT to develop more effective teaching strategies. This guidance helped teachers maximize their interactions with Chat GPT. Throughout the training, participants were also given the opportunity to work in groups to create classroom action research reports based on AI. This hands-on session allowed teachers to directly apply what they had learned. Each group received direct guidance from Feni to ensure that their reports met research standards and effectively integrated AI technology.

In the final session, the teachers presented their work, and Feni provided constructive feedback to each group, ensuring that their CAR reports were relevant and applicable to their respective classrooms. She also praised the creativity and dedication displayed by the teachers in completing their tasks. From this activity, it was clear that the teachers at MAN Bengkayang greatly benefited from the training. They felt more confident in utilizing technology in their teaching practices. One teacher, Mr. Muslimin, expressed that the training had expanded his understanding of AI and provided new ideas for improving the quality of teaching.

The Head of MAN Bengkayang, Mr. Ridwan, expressed his appreciation to the PKM team from IAIN Pontianak for providing this valuable training. According to him, the training had a significant impact on the teachers at MAN Bengkayang, especially in facing the challenges of the rapidly evolving digital era. Through this training, MAN Bengkayang successfully enhanced its human resource capacity in educational technology. This program is expected to be the beginning of a transformation in teaching at MAN Bengkayang, where teachers are no longer unfamiliar with technology and are ready to innovate in their teaching practices.

At the end of the training, the PKM team expressed hopes for continued collaboration with MAN Bengkayang on future development programs. It is hoped that

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this initiative will inspire other madrasahs in remote areas to begin adapting to modern technology for the advancement of education.

Stages of Strengthening the Classroom Action Research Capacity Building Program Based on Artificial Intelligence for Teachers at MAN Bengkayang

The strengthening of the training program at MAN Bengkayang was carried out through several key stages, one of which was the assessment of participants' abilities before and after the training through pre-tests and post-tests. In the initial phase of the training, a pre-test was conducted to measure the teachers' initial understanding of Classroom Action Research (CAR) and the use of AI in education. The results of the pre-test served as a basis for the training team to identify areas that required more focus during the training, and helped tailor the content to better meet the participants' needs.

After the training progressed according to plan, a post-test was conducted as a final evaluation to measure the improvement in participants' understanding of the material presented. The post-test results showed a significant increase in the teachers' understanding and skills in designing and implementing AI-based CAR. This indicated that the training successfully achieved its primary goal of enhancing teachers' competencies in integrating AI for more effective learning analysis and development.

The program was further strengthened by intensive mentoring during the training. Each session was supplemented with time for discussions and direct guidance, where teachers were given the opportunity to ask questions and address any difficulties they encountered. Feni Nurhaliza and Dr. Syamsul Kurniawan, as mentors, provided the necessary practical guidance to help the teachers better understand and apply the concepts of AI and CAR.

In addition to in-class mentoring, participants were encouraged to engage in hands-on practice by developing classroom action plans that could be implemented in real classroom situations. The teachers were divided into small groups and tasked with designing research instruments and planning teaching actions tailored to the students' needs. Each group was guided by the resource persons to ensure that their research designs were applicable and in accordance with proper CAR procedures.

The next step in strengthening the training outcomes was ensuring that the teachers' CAR results had the potential for publication in journals. The PKM team from IAIN Pontianak provided guidance on the criteria for writing academic journals and how to compile CAR reports that were suitable for publication. This became a great opportunity for the teachers at MAN Bengkayang to develop their professional careers and contribute to the academic world by publishing their research findings.

The encouragement to publish research in academic journals added significant value to the training. Publishing research results not only benefits the teachers' careers but also contributes to the development of education at MAN Bengkayang as a whole. It allows the innovations made by the teachers in their classrooms to be recognized more widely, inspiring other schools in remote areas that may face similar challenges in applying educational technology.

With the opportunity for publication, the teachers were further motivated to produce high-quality and beneficial research. This is also expected to foster a research culture among educators, ensuring that innovations in teaching continue to be developed and shared with the broader educational community. The PKM team hopes that these research outcomes will foster collaboration between educational institutions in remote areas and a broader academic community to improve the quality of education in underserved regions.

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At the end of the program, it was clear that the teachers at MAN Bengkayang not only acquired new skills but also gained greater confidence to innovate in managing their classrooms. This training has become a strong foundation for the development of education in remote areas, and it is hoped that MAN Bengkayang will serve as an example of a school that successfully adapts to technology, proving that limited access is not an obstacle to progress.

The outcomes of the Capacity Strengthening Program for Classroom Action Research (CAR) Based on Artificial Intelligence (AI) for Teachers at MAN Bengkayang

1. **The level of understanding and awareness among teachers at MAN Bengkayang regarding the importance of Classroom Action Research (CAR) in enhancing the quality of learning.**

Classroom Action Research (CAR) is an essential method that teachers can use to address challenges faced in everyday teaching. However, many teachers still do not fully understand or recognize the urgency and benefits of CAR. Therefore, it is necessary to assess the level of understanding and awareness among the teachers at MAN Bengkayang regarding the importance of CAR. At this level, several key indicators were explored through questions about their basic understanding and awareness of CAR, education and training, as well as teaching experience.

In terms of basic understanding and awareness, teachers at MAN Bengkayang have limited knowledge of Classroom Action Research (CAR). They know that CAR is related to efforts by teachers to improve teaching methods and help students learn better, but they do not fully understand its implementation. Teachers also have not applied CAR in their teaching because they are more focused on the materials and methods they are already familiar with, and they feel they lack the time to conduct research. This was evident from several questions posed before the training began, such as: "What do you know about Classroom Action Research (CAR)?" One teacher responded, "Actually, I don't know much about CAR. I've heard about it, but I thought it was just a type of research done by teachers to improve teaching methods, although I don't really understand how it works. So far, I am more focused on daily teaching." Another question asked, "What is the main purpose of CAR, according to you?" A teacher answered, "The purpose might be to improve teaching or help students learn better, but I'm a bit confused about how it is implemented. Maybe it's more about research conducted by the teacher to see what works or doesn't work in the class." When asked, "Have you ever applied CAR in your teaching? If so, can you share a bit about your experience?" a teacher replied, "I have never applied it. I'm more focused on the materials and teaching methods I'm used to. CAR seems to require more time for research, and I don't feel I have enough time for that."

Regarding education and training, the teachers had not attended any specific workshops or training on CAR and had only heard limited information about it in general seminars. They felt that the formal education they received focused more on teaching theory rather than classroom research or CAR, which made it insufficient to deeply understand CAR. Respondents also expressed that training focused on applying CAR, including how to start and measure research outcomes in the classroom, would be very helpful in strengthening their understanding of CAR, as demonstrated in the current training. This was reflected in the following questions posed before the training: "Have you ever attended a training or workshop on CAR? If so, how was your experience in that

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training?" One teacher answered, "Honestly, I've never attended a training specifically on CAR. I've only heard a little about it in general seminars."

Another question asked, "To what extent has the CAR training you attended helped you understand and implement CAR in the classroom?" A teacher responded, "I haven't attended any CAR training, so I can't give a clear answer. If there were a training, I think it would help." When asked, "Do you feel your formal education has adequately prepared you to understand CAR in depth? If not, what do you think is lacking?" a teacher replied, "My education focused more on teaching theory, not research. In formal education, I feel I wasn't taught enough about how to conduct research in the classroom or about CAR. I think this training will help me understand CAR more deeply." The question, "What type of training or additional education do you think could strengthen your understanding of CAR?" was answered with, "Maybe if there was training focused on applying CAR, including how to start research in the classroom and measure its results, it would be very helpful. Right now, I don't understand the process."

Regarding personal teaching experience, teachers provide many lessons, but they have never considered integrating research into their teaching activities. The challenges they face are more related to classroom management and delivering the material, not finding solutions through research. Teachers also do informal reflections on students' understanding, but they have never conducted a systematic evaluation of their teaching methods, as done in CAR. This was evident from the following questions posed before the training: "To what extent does your teaching experience influence your understanding of CAR? Are there specific problems or challenges in the classroom that encourage you to seek solutions through CAR?" One teacher responded, "My teaching experience has certainly taught me a lot, but I never thought about integrating research into teaching activities. I think the problems I face are more about managing the class and teaching the material, not finding solutions through research." When asked, "How have you previously reflected on or evaluated your own teaching?" a teacher answered, "The reflection I do is more informal, like thinking whether the students understood the material or not. I've never conducted a systematic evaluation of my teaching methods like what is done in CAR."

The teachers at MAN Bengkayang have a limited understanding of Classroom Action Research (CAR). Although they understand that CAR is related to improving teaching and student learning, its implementation has not been applied because they focus on familiar materials and teaching methods, and they feel they lack time for research. Furthermore, the formal education they received did not include specific training on CAR, focusing more on teaching theory rather than classroom research. Teachers have expressed that training more focused on the application of CAR would be extremely helpful in deepening their understanding and implementation of CAR in the classroom.

As an integral part of efforts to improve the understanding and awareness of quality learning, Classroom Action Research (CAR) offers teachers the opportunity to actively develop their professional competencies. CAR not only focuses on improving teaching methods but also encourages teachers to become researchers who critically assess the teaching practices they conduct. Thus, CAR serves as a tool that allows teachers to continuously develop and adapt to the increasingly dynamic learning needs. This aligns with the theory that CAR plays an important role in teacher professionalism development.

Through CAR, teachers not only become educators but also researchers who can analyze and improve the teaching methods implemented in their classrooms. This is highly relevant to the concept of Community of Practice as explained by Etienne Wenger

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(1998), where teachers conducting CAR participate in a community that learns and shares experiences to enhance their practices in the classroom.

2. The challenges encountered by educators at MAN Bengkayang in the implementation of Classroom Action Research (CAR)

Although Classroom Action Research (CAR) offers significant benefits, its implementation is often hindered by various obstacles. These obstacles include time constraints and administrative burdens, lack of access to supporting resources or materials, and limited skills in designing and conducting CAR.

In the section on time constraints and administrative burdens, it was found that teachers experience difficulties in balancing time between teaching duties and other administrative tasks. Most of their time is spent on lesson planning and preparing teaching materials, which often leads to CAR activities being neglected due to limited time. Administrative tasks, such as grading and report preparation, also present a significant barrier to the implementation of CAR. Respondents consider their daily teaching duties as the top priority, and CAR is only undertaken if time permits after completing teaching and administrative responsibilities. They also express confusion in implementing CAR, particularly due to a lack of understanding of its execution. Overall, administrative burdens and limited understanding of CAR hinder its implementation. This was evident from several questions posed during the training, such as: "As a teacher, how do you manage your time between teaching duties and other administrative activities? Do you feel the available time is sufficient to carry out CAR?" "I have great difficulty balancing my time between teaching and other administrative tasks. Most of my time is used for lesson planning and preparing teaching materials. CAR activities are often neglected because I feel I don't have enough time for them." "Do you feel that the administrative burden at school hinders the implementation of CAR? If so, in what aspects?" "The administrative tasks I have to complete, such as grading and reports, take up a lot of my time." "Do you feel that daily teaching is a higher priority than conducting CAR? Why is that?" "Teaching is my main priority. When there is time left after teaching and completing administrative tasks, I try to work on CAR. However, due to my limited understanding, I often feel confused."

In the section on limited access to resources or supporting materials, it was found that although the school facilities are adequate, such as computer laboratories, teachers feel that these resources are underutilized to support the implementation of CAR. The main obstacle is the lack of understanding about CAR and the absence of specialized training on research methodology. Teachers also revealed that support from the school and leadership is still minimal, with no specific policies or time allocated for CAR. The school's primary focus is on teaching and routine administration, which means that CAR does not receive sufficient encouragement. This was evident from several questions posed during the training, such as: "Do you have sufficient access to facilities or resources (e.g., technology, rooms, or teaching tools) that support the implementation of CAR?" "The facilities at the school are actually quite adequate, including the computer laboratory that can be used. However, I lack understanding of how to conduct Classroom Action Research (CAR) and do not utilize the available technology or online resources, including the computers in the lab, to support the research. I should be able to access journals and books related to CAR more easily, but the lack of understanding and utilization of these resources is a major obstacle for me." "Have you ever received specialized training on how to conduct CAR? If not, do you feel such training is important to improve the quality

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of the CAR you conduct?" "I have not received any specialized training or workshops on CAR. Most of the training I have attended has been related to teaching, and I feel unprepared to conduct CAR because there has been no training directly addressing research methodology." "Do you feel there is sufficient support from the school in terms of time, resources, or recognition for the research efforts you undertake?" "The support from the school for the implementation of CAR is still minimal. There are no specific policies or time allocated for research. I feel that the school is more focused on teaching and routine administration."

In the section on limited skills in designing and implementing CAR, it was found that overall, I feel that my skills and knowledge in carrying out CAR are still limited. Although I understand the basic concept of CAR, I struggle with designing the appropriate research methodology, analyzing data, and writing reports. A lack of confidence often arises, especially due to the insufficient guidance and support available. To implement CAR effectively, I need a deeper understanding and more intensive practice at every stage of the research process. This was evident from several questions posed during the training, such as: "Do you feel you have sufficient skills in research methodology to carry out CAR effectively? If not, where do you feel lacking?" "I feel that my research skills are still limited. Although I know what CAR is, I struggle with designing and implementing the appropriate research methodology. I feel less skilled in data analysis and writing research reports." "Do you feel confident enough to conduct CAR, or do you have doubts about your research abilities?" "I often feel less confident when attempting to conduct CAR. Sometimes, I doubt whether the methods I have chosen are appropriate or whether the research I am conducting will have a real impact. Without adequate guidance, I feel uncertain about carrying out this research." "Do you feel you have a good understanding of the concept and purpose of CAR? Or are there aspects that still confuse you?" "My knowledge of CAR is limited to a general understanding, and even that is still insufficient. I often feel confused when trying to apply CAR theory in practice, especially when trying to relate it to the context of different classrooms."

3. Effective Strategies to Enhance Teachers' Skills at MAN Bengkayang in Conducting Classroom Action Research Based on Artificial Intelligence

To enhance teachers' skills at MAN Bengkayang in conducting Classroom Action Research (CAR) based on Artificial Intelligence (AI), it is essential to understand that AI-based CAR not only leverages technology to facilitate research but also integrates AI as a tool for analyzing learning data and providing insights to improve the teaching process. Effective strategies to develop teachers' skills in this area involve several approaches, including targeted training, the provision of resources, and the utilization of AI to support both research and teaching practices.

a. AI-Integrated Training

Training is a key factor in enhancing teachers' skills in implementing AI-based Classroom Action Research (CAR). Teachers need to be equipped with training on the fundamentals of AI and how this technology can be utilized in educational research. Key components of the training include:

1. Fundamentals of AI and Machine Learning: Teachers must understand the basic concepts of AI and machine learning relevant to analyzing learning data, such as identifying student learning patterns and processing classroom data.

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2. Applications of AI in Education: The training should provide insights into various AI applications that can be utilized in CAR, such as sentiment analysis (to monitor student feedback), learning outcome prediction, and recommendation systems that assist teachers in designing more effective teaching strategies.
3. Use of Tools and Software: Teachers should also be equipped with the skills to use AI-based software tools that support CAR, including AI-driven data analysis tools (e.g., Python, R, or other AI-powered educational applications).

b. Encouraging Collaboration and Social Learning

The next strategy involves fostering collaboration among teachers, both within the school (among teachers at MAN Bengkayang) and with external parties (e.g., technology developers or AI experts). Such collaboration can help teachers learn from the experiences and insights of others in utilizing AI for Classroom Action Research (CAR).

Teachers can establish communities focused on AI-based CAR, where they share knowledge, best practices, and collaborate on research projects that leverage AI technology. Initiatives such as mentoring programs—pairing experienced teachers with those new to AI—and promoting team-based learning to address challenges in AI-based CAR can further enhance their capabilities. These collaborative efforts encourage mutual learning and innovation, creating a supportive ecosystem for integrating AI into educational research.

c. Utilizing Data for Feedback and Evaluation

The utilization of AI in Classroom Action Research (CAR) enables more effective analysis of learning data. Therefore, another critical strategy is equipping teachers with the skills to collect, analyze, and evaluate learning outcome data using AI-based tools.

Teachers should be trained to gather data from the teaching and learning process, such as test results, student participation, and feedback. AI can process this data more quickly and accurately, generating valuable insights to improve teaching strategies. Additionally, AI can provide automated feedback to teachers regarding the effectiveness of their instructional methods, assisting them in making more informed decisions to enhance the learning process.

d. Integration of Technology-Based Learning into the Curriculum

Another strategy is to integrate technology-based learning, particularly AI, into the CAR curriculum itself. This approach ensures that teachers are not only trained to use technology but also gain a deeper understanding of how it can be utilized to facilitate student learning. Curriculum management and development that incorporate AI-based educational technology will accelerate the adaptation and implementation of AI by teachers. By embedding AI tools and methodologies into the curriculum, teachers can explore practical applications of AI in enhancing instructional practices, fostering an environment where technology and pedagogy work seamlessly to improve learning outcomes.

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e. Provision of Supporting Resources and Infrastructure

To ensure the smooth implementation of AI in Classroom Action Research (CAR), the provision of adequate resources and infrastructure is crucial. This includes hardware (computers, mobile devices), software (AI-based applications), and sufficient internet access. Providing computers or tablets with specifications capable of running AI-based applications, as well as a stable internet connection, is essential to support the implementation of AI-based CAR.

An effective strategy to enhance teachers' skills at MAN Bengkayang in conducting AI-based CAR must encompass technology training, collaboration among teachers, the use of data for evaluation and feedback, integration of technology into the curriculum, and the provision of adequate infrastructure. By leveraging relevant theories, such as constructivism, social learning, and decision-making theory, teachers' skills in conducting AI-based CAR can develop significantly, ultimately improving the quality of learning at the school.

f. The Impact of AI-Based Classroom Action Research Training Program on the Enhancement of Teachers' Professional Competence at MAN Bengkayang

This training and mentoring program is designed to assist teachers in enhancing their professional competence in AI-based Classroom Action Research (CAR). Therefore, it is necessary to conduct assessments by administering pre-tests and post-tests for each teacher to identify the extent to which the program has a positive impact on improving teachers' professional competence, particularly in terms of learning innovation and addressing challenges faced in the classroom.

A descriptive analysis of teachers' professional competence at MAN Bengkayang before participating in the AI-based CAR training, using the SPSS version 29 application, yielded the following results:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	25	30,00	45,00	30,6545	1,57233
Valid N (listwise)	25				

Based on the descriptive analysis of the pre-test results for teachers' professional competence at MAN Bengkayang before participating in the AI-based Classroom Action Research (CAR) training, it was found that the minimum score was 30.00 and the maximum score was 45.00. The mean score was 30.6545. Based on the percentage analysis, the results are as follows:

$$p = \frac{\bar{x}}{Skor\ Max}\ x\ 100\% = \frac{30{,}6545}{45{,}00}\ x\ 100\% = 68{,}12\%$$

Assessment Criteria

Percentage (%)	Category
90 – 100	Very Good
80 – 89	Good

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65 – 79	Satisfactory
55 – 64	Fair
0 – 54	Very Poor

Based on the percentage analysis results above, the professional competence of teachers at MAN Bengkayang before participating in the AI-based Classroom Action Research (CAR) training was 68.12%, falling within the "Satisfactory" category. This indicates that the majority of teachers possess a reasonably good understanding and skill set in terms of their professional competence, but there is still room for further improvement.

The assessment of teachers' professional competence before the training used the criteria established by Aprian & Abdullah (2019), which categorize scores into five levels: very good, good, satisfactory, fair, and very poor. In this case, the professional competence of teachers at MAN Bengkayang before the training falls into the "Satisfactory" category, which suggests that although most teachers show adequate understanding, they have not yet reached a high or very good level of competence. The average score of 68.12% reflects that teachers have gained a basic understanding of CAR, but they still require further development to enhance the effectiveness of teaching and research in the classroom.

In the context of teacher professional development, Shulman's (1987) theory of Professional Competence, through the concept of Pedagogical Content Knowledge (PCK), reveals that mastery of subject matter, the ability to deliver content effectively, and skills in designing and assessing learning are three key components of a teacher's professional competence. The results of this analysis indicate that while teachers at MAN Bengkayang have acquired basic knowledge, they need further strengthening in applying more innovative and effective teaching strategies, especially in integrating technology and research-based approaches like CAR.

Furthermore, the Tuning Educational Structures in Europe (2003) theory on professional competence also explains that a teacher's professionalism is not only determined by theoretical knowledge but also by practical skills in implementing that knowledge in the classroom. This competence includes the ability to address learning challenges faced by students, adapt to curriculum developments, and utilize technology to support more effective learning. In this regard, the AI-based CAR training is expected to address the gaps identified through the pre-test results, allowing teachers' professional competence to improve to a higher category after the training.

Kolb (1984) in his Experiential Learning Theory also provides a relevant framework for explaining the importance of practice-based training in enhancing teachers' professional competence. Kolb stated that the best learning occurs through a process of direct experience, reflection, conceptualization, and active experimentation. By participating in AI-based Classroom Action Research (CAR) training, teachers not only receive theoretical knowledge but also engage in hands-on experiences that allow them to develop more practical skills. Therefore, this training is expected to provide enriching experiences that enhance teachers' competence in utilizing data and AI technology to design and assess more effective learning.

This analysis also underscores the importance of continuous self-development for teachers, aligning with the concept of Continuous Professional Development (CPD) proposed by Day (1999). Day emphasized that teacher professional development is an ongoing process involving self-reflection, lifelong learning, and the

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application of innovation and technology in teaching practice. The AI-based CAR training is expected to serve as a strategic step in encouraging teachers to not only master theory but also implement it in their daily teaching, leveraging technology to improve the quality of education.

Thus, the descriptive analysis indicates that teachers' professional competence at MAN Bengkayang before the training was categorized as "Satisfactory," suggesting there is still room for further development, particularly in the application of AI-based CAR. This training is expected to enhance teachers' understanding of implementing technology-driven classroom action research and motivate them to continuously improve and innovate in managing more effective learning.

Next, a descriptive analysis of teachers' professional competence at MAN Bengkayang after participating in the AI-based CAR training, using the SPSS version 29 application, yielded the following results:

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Posttest	25	45,00	50,00	45,4545	2,85736
Valid N (listwise)	25				

Based on the descriptive analysis of the post-test results for teachers' professional competence at MAN Bengkayang after participating in the AI-based Classroom Action Research (CAR) training, it was found that the minimum score was 45.00 and the maximum score was 50.00. The mean score was 45.4545. Based on the percentage analysis, the results are as follows:

$$p = \frac{\bar{x}}{Skor\ Max}\ x\ 100\% = \frac{45{,}4545}{50{,}00}\ x\ 100\% = 90{,}1\%$$

Based on the percentage analysis results above, the professional competence of teachers at MAN Bengkayang after participating in the AI-based Classroom Action Research (CAR) training was 90.1%, categorized as "Very Good." This result indicates a significant improvement in teachers' professional competence after the training, suggesting that the AI-based CAR training was highly effective in enhancing their teaching quality.

One theory that can be used to understand this improvement is the TPACK (Technological Pedagogical Content Knowledge) model developed by Mishra & Koehler (2006). TPACK emphasizes the integration of pedagogical knowledge (P), content knowledge (C), and technological knowledge (T) in education. The AI-based CAR training provided teachers with deeper skills in combining these three components—using AI technology to design, implement, and evaluate more effective learning. The significant improvement in the post-test results reflects that the teachers successfully integrated technology into their teaching, aligning with the TPACK model, and demonstrating a better understanding of how to deliver content using relevant technology.

Additionally, Kolb's (1984) theory of Experiential Learning is also relevant in explaining this significant result. Kolb argued that effective learning occurs through direct experience, followed by reflection and active experimentation. In the context of the AI-based CAR training, teachers not only received theoretical information about technology usage but also directly applied it in real classroom settings. By combining theory and practice, this training allowed teachers to learn from direct experience, which proved to enhance their skills in designing and evaluating technology-based learning.

Furthermore, Vygotsky's (1978) theory on the zone of proximal development (ZPD) and the importance of social support (scaffolding) in the learning process can also be applied here. Through the AI-based training, teachers received scaffolding in the form of guidance, feedback, and resources that helped them overcome challenges in integrating technology into their teaching. Vygotsky suggested that social interaction and support from instructors or mentors are crucial in accelerating learning and mastering higher-level skills. Therefore, the AI-based CAR training acted as an effective mediator in developing teachers' professional skills.

Lastly, this result also highlights the effectiveness of the constructivist theory popularized by Piaget (1972), which emphasizes the importance of active teacher engagement in constructing their own knowledge through experience and reflection. The AI-based training allowed teachers to explore and apply technology in their classroom contexts, which not only enriched their understanding of how technology can enhance learning but also strengthened their skills in addressing specific learning challenges in more innovative and data-driven ways.

CONCLUSION

Based on the results and discussion above, the following conclusions can be drawn:

First, Limited Understanding of Classroom Action Research (CAR): The teachers at MAN Bengkayang have a limited understanding of CAR. While they recognize that CAR is related to efforts to improve teaching and student learning, its implementation has not been fully realized. This is primarily due to a focus on familiar teaching materials and methods, as well as time constraints for research. Additionally, formal education and training received by teachers have not covered CAR-specific training, which tends to focus more on teaching theory rather than classroom research aspects. Teachers expressed that training focused on the application of CAR would significantly help deepen their understanding of how to implement CAR in the classroom.

Second, Challenges in Time Allocation: Teachers at MAN Bengkayang face difficulties in balancing teaching duties and administrative burdens, which hinders the implementation of CAR. Limited time, along with prioritization of teaching and administrative tasks, often leads to CAR being overlooked. Furthermore, the lack of understanding about CAR and the underutilization of school resources, such as computer laboratories, present additional barriers to CAR implementation.

Third, Effective Strategies for Enhancing Teacher Competence: To enhance the competence of teachers in implementing AI-based CAR, strategies should include technology training, teacher collaboration, data use for evaluation and feedback, as well as the integration of technology into the curriculum and provision of adequate infrastructure. By leveraging relevant theories, such as constructivism, social learning, and decision-making theory, teachers' competence in implementing AI-based CAR can develop significantly, ultimately improving the quality of education at the school.

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Fourth, Impact of AI-Based CAR Training: The AI-based CAR training program has proven to be effective in improving the professional competence of teachers at MAN Bengkayang. The professional competence of teachers before the training was rated at 68.12%, categorized as "Satisfactory," while after the training, the rating increased to 90.1%, categorized as "Very Good." This indicates a significant improvement in teachers' competence following the AI-based CAR training.

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