Journal of Science and Education (JSE)
Vol 5, Issue 2, March 2025, Pages 499-519
ISSN: 2745-5351 (Media Online)
DOI: https://doi.org/10.58905/jse.v5i2.466

# Improving the Professional Competence of High School Teachers in Yogyakarta Through the Development of Classroom Action Research Management (PTK) Based on Android Mobile Applications

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**Abstract.** The need and skills to write scientific papers through classroom action research are a must for every educator. Classroom action research is part of evaluating a series of learning processes and continuous professional development (PKB) by the law mandate. The purpose of this research is to develop an Android-based application that supports the management of Classroom Action Research (PTK) for high school teachers in Yogyakarta, test the effectiveness of the application in improving teachers' professional competence and facilitate the planning, implementation, and evaluation of PTK, as well as support efforts to improve education more broadly by providing digital solutions that help teachers in optimizing the PTK-based learning process. This study aims to develop an integrated service system for classroom action research based on Android mobile applications to facilitate educators in developing professionalism competencies on an ongoing basis. This research uses the research and development method with the 4D development model, which includes (1) Define, (2) Design, (3) Development, and (4) Disseminate. The advantages of the products developed in this study are (1) open access, (2) adoption of the latest digital platform-based information technology innovations, (3) improving digital literacy, (4) building Penta helix collaboration between government, private, community, non-governmental organizations, universities, and mass media, (5) easy to apply and economical in access, (6) encouraging unlimited creativity, (7) using sustainable materials, (8) developing application-based PTK training management and encouraging the improvement of professional competence of high school teachers in Yogyakarta.

**Keywords:** Android Application, PTK, Teacher Professional Competence

## 1 Introduction

Improving the quality of education in Indonesia is one of the main priorities to create a competent generation ready to face global challenges. This aligns with the goals of

 

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the Indonesian state, as stated in the fourth paragraph of the Preamble of the UUD 1945 Constitution, which reads, "To educate the nation's life." As stated in the UUD 1945 Chapter 13 Article 31 Paragraph 1, "Every citizen has the right to education." Based on the statements of the two legislative regulations, it can be concluded that education is a vital aspect of national development that must be prepared as early as possible in facing various challenges and global interventions, where every citizen has the right to education as an effort to educate the nation's life.

Teachers as educational personnel in schools have the main tasks of teaching, educating, directing, guiding, training, assessing, and evaluating students in early childhood education in formal education, primary education, and secondary education [1]. In the learner-centered view, the teacher has a prominent role as a guide, coordinator, and facilitator in the learning process. Professional teachers have moral responsibility, responsibility in the field of education in schools, responsibility in the community, and responsibility for teachers' scientific field/academic achievement. A professional teacher is a teacher who has a lot of knowledge and experience who can design and manage learning, with the main task of educating, teaching, guiding, directing, training, assessing, and evaluating students in early childhood education through formal education, basic education, and secondary education. Teacher competence influences values, behavior, communication, goals, and teachings and supports curriculum and educational professional development [2]. Professional competence can be defined as the ability of teachers to master their subjects in depth and how to deliver them appropriately to students. Teachers as educators have a very strategic role in these efforts. The quality and capability of teachers must be continuously improved by participating in various activities that support teacher professional development. School leaders and the national education system are essential in mandating teacher participation in these activities [3]. Therefore, improving the professional competence of teachers continues to be the focus of attention of various parties, including the government, educational institutions, and the community.

Yogyakarta Special Region (DIY), as one of the regions with a reasonably high education level, is still facing challenges in improving the quality of education, primarily related to teacher competence in implementing effective and innovative learning. One way to enhance teachers' professional competence is through Classroom Action Research (CAR). Classroom Action Research (CAR) is action research conducted to improve the quality of learning practices in the classroom. PTK can also be interpreted as a form of research carried out by teachers in their classrooms to enhance the quality of learning [4]. PTK provides space for teachers to identify problems in the teaching-learning process, design corrective actions, implement these actions, and reflect on the results for further improvement [5]. By conducting PTK, teachers act as teachers and researchers who actively seek solutions to the learning problems they face. The implications of PTK also allow for an increase in teacher professionalism, which has implications for improving the quality of learning and national education. Therefore, this study aims to develop an Android-based application that supports PTK management for high school teachers in Yogyakarta, test the effectiveness of the application in improving teachers' professional competence and facilitate the planning, implementation, and evaluation of PTK, as well as support

 

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efforts to improve education more broadly by providing digital solutions that help teachers in optimizing the PTK-based learning process. With this technology-based innovation, it is hoped that teachers can more easily and systematically implement PTK, so that they can contribute to improving the quality of learning and professionalism of educators in a sustainable manner.

Although PTK has enormous potential to improve teacher competence, many teachers face obstacles in its implementation. Some of the barriers often encountered include difficulties in planning and managing the stages of PTK systematically, limited time to conduct research amid busy teaching activities, and lack of understanding of data analysis techniques used in PTK. In addition, writing reports on the results of PTK, which requires an in-depth knowledge of research methodology, is also a challenge for some teachers. Along with the development of information technology, using Android-based mobile devices offers excellent potential to help solve these problems. Android-based applications can be an effective tool that makes it easier for teachers to plan, implement, and evaluate PTK. Through this application, teachers can access various features that can support the PTK process in a more structured and efficient manner. The app can also provide practical guidance, report templates, and features to monitor the progress of the PTK so that teachers can focus more on improving the quality of learning in the classroom. Although digital technology is increasingly developing, using Android-based educational applications to support PTK among teachers is still relatively limited. Therefore, creating an android application for PTK management for high school teachers in Yogyakarta is crucial to bridging the gap between theory and practice in implementing PTK and providing convenience for teachers in improving their professional competence. Based on this background, this study aims to develop and test the effectiveness of an Android-based application that high school teachers can use in Yogyakarta for PTK management. This application is expected to be a practical solution that supports better management of PTK and improves the quality of teachers' professional competence in the Yogyakarta province.

## 2 Literature Review

### 2.1 Teacher Professional Competence

Teacher professional competence is one of the keys to the successful implementation of education in schools. Teacher professional competence can be defined as a set of abilities, knowledge, and attitudes that an educator must possess to carry out their duties effectively. This competency is not just a title or certificate but an actual ability reflected in every teacher's interaction with students, curriculum, and school environment [6]. These competencies cover various aspects, from deep mastery of subject matter to practical communication skills. A competent teacher cannot only convey subject matter clearly, but can also create a conducive learning environment, motivate students to learn, and develop the potential of each student. According to Caena & Redecker [7], a professional teacher must constantly update and improve the profile of self-competence and teaching strategies used in learning at school to face the challenges of the 21st century. Essential aspects that must be considered in developing

 

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teachers' professional competencies include in-depth mastery of subject matter, development of innovative learning methods, utilization of educational technology, and continuous and continuous self-development [2]. In addition, collaboration with fellow teachers, attending training and workshops, and reflecting on learning practices are also essential. Thus, teachers can provide effective, engaging, and relevant learning for students to achieve educational goals optimally.

A teacher can be said to have professional competence if he has a high dedication to his duties, an attitude of commitment to the quality of the process and work results, and an attitude of continuous improvement (always trying to improve and update his models or ways of working) by the demands of the times based on a high awareness that the task of educating is the task of preparing the next generation who will live in his time in the future. According to Ruhiyat et al. [8], teacher professional development includes (a) following information on the development of science and technology that supports the teaching profession through various scientific activities, (b) translating textbooks / scientific works, (c) developing various learning models, (d) writing papers, (e) writing / compiling lesson dictates, (f) writing textbooks, (g) writing modules, (h) writing scientific papers, (i) conducting scientific research (action research), (j) inventing appropriate technology, (k) making teaching aids/media, (l) creating works of art, (m) participating in accredited training, (n) participating in qualification education, and (o) participating in curriculum development activities.

### 2.2 Professional Digital Competence (PDC)

In the 21st century, teachers are required to upgrade professional competencies, especially in digital technology. This is due to the rapid advancement of science and information and communication technology (ICT), so with technology integration, teachers are expected to create a practical, efficient, informative, and competitive learning environment within an educational institution's local and global scope. Caena & Redecker [7], argue that teachers are responsible for creating environments and opportunities for profound learning experiences that can uncover and increase student capacity. The demands for teachers in the era of globalization include being a facilitator and a driver of meaningful learning. They must be creative in choosing strategies to suit the learning context and student characteristics [9]. One way for teachers to meet these demands is to improve their digital competence. Teacher Digital Competence (PDC) is an educator's ability to utilize digital technology to enhance learning. It includes the ability to access, manage, and create digital content and use various digital tools and platforms to communicate, collaborate, and evaluate learning. PDC is not only limited to mastering hardware and software but also involves the pedagogical ability to integrate technology in learning effectively and creatively. With PDC, teachers can create a more interactive, relevant, and engaging learning environment for students in this digital era.

PDC arises because of activities that involve the active use of technology in daily life; on the other hand, it is also due to self-professional development that requires everyone to depend on the effective and efficient use of digital technology [9]. According to [6], there are at least four domains of competence in PDC that teachers

 

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need to master: technological competence, competence for pedagogical and educational technology use, beliefs about teaching and learning, and competence in professional education. The four PDC competency domains are key for teachers in integrating technology and play an important role in adopting and implementing digital technology into classroom learning. The transformation and improvement of the quality of education will largely depend on aspects related to PDC obligations that every teacher must possess to integrate and use technology in a pedagogical way. In this regard, Cabero et al. [10] point out that digital competence is one of the key competencies that every citizen in general, and teacher in particular, must master in the future society.

### 2.3 Classroom Action Research (PTK)

Classroom action research is a method conducted by teachers in their own classrooms to improve learning practices. PTK is cyclic, consisting of several cycles involving planning, action, observation, and reflection [11]. Through PTK, teachers can identify problems in learning, design solutions, implement them, and evaluate the effectiveness of these solutions. Indicators of the success of PTK can be improved student learning outcomes, increased student activity in learning, or changes in teacher attitudes toward using new methods. These indicators can be measured through various instruments, such as tests, observations, questionnaires, or interviews. Thus, PTK is a handy tool for teachers to develop professionalism and improve classroom learning quality. Classroom Action Research contains a series of cycles consisting of four stages: planning, action, observation, and reflection [12]. Furthermore, Classroom Action Research encourages teachers to be aware of their responsibilities as teachers and researchers who actively seek solutions to problems faced in the classroom and at school. Classroom Action Research allows for an increase in teacher professionalism, which has implications for improving the quality of learning and national education quality [13].

### 2.4 Android Mobile Applications

The development of learning media must be based on the competencies and objectives set so that the media can be used properly. Teachers with good professional competencies will undoubtedly be able to present learning according to the times. According to the findings of [14], the most critical indicator of professional teacher competence is the ability to use technology in learning, with the teaching developed engaging and innovative. However, many teachers still have not been able to create information and communication of technology (ICT) based learning media by competency standards and learning objectives [[15]. Therefore, it is necessary to develop an Android mobile application that aims to provide training to improve the professional competence of teachers. Mobile android applications can be developed using brilliant app creator (SAC) software, a computer application to create various kinds of learning media, or the like, with an Android or iOS base without mastering programming lan-

 

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guages [16]. The output produced by the Smart Apps Creator (SAC) application can be HTML5 and .exe [17].

The presentation of learning by the times can be an indicator for teachers to meet the competency standards of teacher professionalism. But remember that creating a mobile Android-based app should involve several approaches, depending on technical expertise and desired results. The official Android Developers guide offers tutorials such as “Basic Android Apps with Kotlin and Jetpack Compose” from the code lab. In addition, Android Studio itself serves as a robust integrated development environment (IDE) for developing Android applications. For some individuals without good coding skills, platforms like Andromo can create Android applications visually without writing code, making it easier for beginners in mobile Android application development mobile [18].

### 2.5 Theoretical Framework

The development of Android-based applications for the management of Classroom Action Research (PTK) in this study is based on the theory of Technological Pedagogical Content Knowledge (TPACK) and the SAMR (Substitution, Augmentation, Modification, Redefinition) model. The TPACK model underscores the importance of integrating technology, pedagogy, and teaching materials in the learning process, which is in line with the purpose of this application to assist teachers in designing, implementing, and evaluating PTK effectively through digital technology. By understanding the technological aspects in the context of teaching, teachers can use this application as a tool that supports planning and reflection on learning practices.

In addition, the SAMR model is used to measure the extent to which this application is able to change and improve the PTK practices carried out by teachers. At the Substitution and Augmentation level, this application replaces and improves the manual process in PTK documentation with more efficient digital features. At the Modification level, the app allows for significant changes in the way teachers design and implement PTK through interactive digital tools. Meanwhile, at the Redefinition level, the app creates a more collaborative and data-driven learning ecosystem, where teachers can share research results and receive feedback from fellow educators.

In the context of developing the technology-based teaching profession, this study also refers to the literature on Professional Digital Competence (PDC), which emphasizes that teachers must have digital skills to support innovative and effective teaching. A study from Caena & Redecker (2019) highlights that the improvement of teachers' professional competence in the digital age depends not only on pedagogical skills, but also on their ability to use technology as a tool for reflection and learning development. Therefore, this application is designed to align with the principles of lifelong learning, where teachers can continuously improve their professional skills through the use of digital technology in classroom action research.

Based on the existing literature, this application not only provides a platform for a more systematic implementation of PTK, but also serves as a continuous learning tool for teachers. By integrating TPACK principles, the SAMR model, and the Professional Digital Competence approach, this application is expected to be able to answer the

 

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needs of teachers in improving professionalism and effectiveness of learning in the classroom.

## 3 Methodology

This research is included in research and development. This development research uses the 4-D model. This model was developed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel [19]. The 4D development model consists of 4 main stages, namely: Define, Design, Develop, and Disseminate. The following 4D model development procedure will be developed in this study:

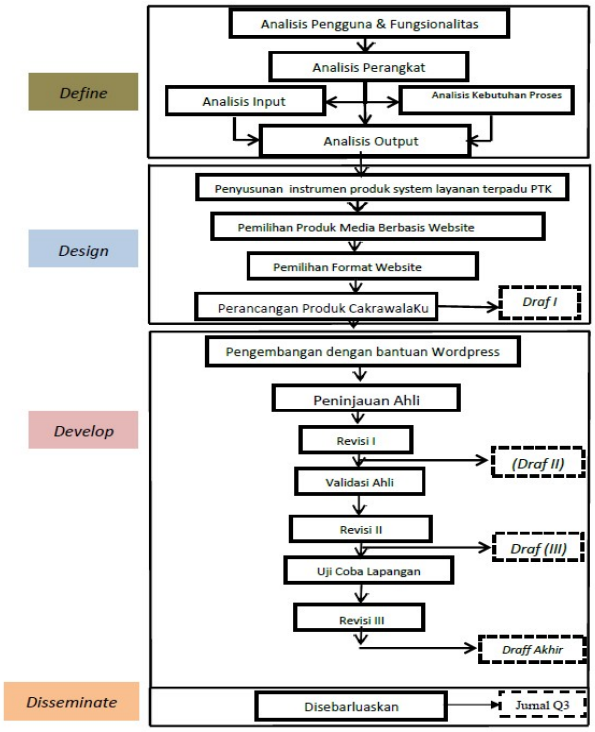


**Fig. 1.** 4-D Development Procedure

Phase I Define: determining and defining the various needs required in the product development process according to the needs in the field, as well as collecting various information relevant to the product to be developed. Harianto et al. [20] argue that the define stage is divided into five, namely: front-end analysis, learner analysis, task analysis, concept analysis, and objectivities of specifying instruction (formulating of learning objectives). The defined stage in this research will be divided into several steps, including a) User and functionality analysis, b) Software analysis, c) Hardware

 

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analysis, d) Input requirement analysis, e) Process requirement analysis, and f) Output requirement analysis.

**Phase II Design:** The results of the needs analysis obtained are then carried out at the product design stage of the integrated service system for classroom action research that can be used as a medium to improve the competence of educators. According to Rachman et al. [21], the design stage is divided into four: construction criterion-referenced test, media selection, format selection, and initial design. The design stage in this study includes: a) Designing a storyboard to arrange a series that will be carried out in the development process to be effective and efficient during the development process, b) Preparation of instruments, Product assessment instruments are prepared to measure product feasibility based on assessments from experts after the product has been developed.

**Phase III Develop**: This stage aims to produce a website-based classroom action research integrated service system using applicable research procedures. Product development is carried out with the help of WordPress software. After the product is finished, expert validation is performed using an instrument developed to obtain assessment results and input. Based on the validation results, the product was revised to produce a more perfect product. Expert validation was conducted to get experts' assessments, suggestions, inputs, and comments on the products developed. Based on the validation results, the product is improved according to the experts' suggestions and inputs.

**Phase IV Disseminate**: The final results of the product development of the integrated service system of classroom action research are socialized to the target to be used as interactive media to encourage improving educators' professionalism competence in Sleman Regency. The results of this research will be outlined in the form of articles and uploaded to accredited national journals.

This study uses a quasi-experimental approach by comparing the group of teachers who use the application with the group that still applies the manual method in the management of PTK. The sample size used in this study was determined based on the purposive sampling method, taking into account the representation of high school teachers in Yogyakarta who are active in PTK activities.

To ensure the validity and generalization of the findings, the study involved a sizable and diverse sample, including teachers from different schools with different teaching experience backgrounds. Sampling was carried out by considering the balance between the experimental group and the control group, so that the results obtained could objectively describe the impact of the application.

In addition, to avoid bias in research, randomization techniques are used in the division of experimental and control groups. Data was collected through pre-test and post-test to measure changes in teacher competencies after using the application, as well as through in-depth observation and interviews to understand the user experience more thoroughly. With this approach, the research is expected to produce findings that can be generalized and provide broader insights into the effectiveness of the application in improving teacher professionalism.

In this study, the effectiveness of Android-based applications for classroom action research (PTK) management was evaluated using *a mixed-methods research ap-*

 

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*proach*, which combines quantitative and qualitative methods to obtain a comprehensive understanding of teacher competency improvement and learning outcomes in the classroom. The evaluation was carried out through *a quasi-experimental design* by comparing two groups of teachers, namely the experimental group that used the application in the PTK process and the control group that still used the manual method. The evaluation criteria for the effectiveness of the application are based on several key indicators, including the improvement of teacher competence measured through pre-test and post-test based on the professional competency rubric, the quality of PTK implementation evaluated through classroom observation and analysis of PTK reports, as well as the impact on student learning outcomes assessed based on the improvement of academic scores and their involvement in the learning process before and after the use of the application. In addition, teachers' satisfaction and perceptions of the app were collected through questionnaires and in-depth interviews to understand the benefits, ease of use, and challenges in using it. As a step to improve the validity and reliability of the data, this study applies *the triangulation technique* by combining data from various sources, such as observations, questionnaires, and interviews with teachers and students. With the design of this study, it is hoped that the results obtained can provide empirical evidence regarding the role of technology in supporting teachers' professional development, as well as identify factors that affect the adoption and effectiveness of the use of applications in educational environments.

## 4 Result and Discussion

### 4.1 Phase I Define

In the Define stage of this research, systematic steps are taken to understand the basic needs and define the initial parameters of product development based on mobile Android applications designed to improve the professional competence of high school teachers. This stage includes needs analysis, problem identification, and formulation of objectives that form the basis of research and product development. Based on the needs analysis, teachers as educators and professionals are responsible for continuously improving the quality of learning through various efforts, one of which is Classroom Action Research (PTK). However, in its implementation, multiple obstacles often hinder it, such as limited time due to busy work routines, lack of skills in using information technology, lack of support from colleagues and institutions, and different views regarding the PTK approach. These findings indicate an urgent need for technology-based solutions to facilitate the efficient implementation of PTK and support the continuous development of teachers' professional competencies. The needs assessment in this study ensures that the proposed Android-based application can effectively address the specific challenges that teachers face in conducting PTK. Based on the needs analysis, it was found that the main obstacles in the implementation of PTK include lack of time to prepare research reports, limited teachers' understanding of PTK methodology, and lack of access to systematic PTK guidelines and examples. Therefore, the application developed is designed to provide a solution by

 

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providing interactive guidance features, automatic report templates, and an evaluation system that makes it easier for teachers to run PTK effectively and efficiently.

Problem identification in this study revealed that these barriers lead to low teacher engagement in scientific research and publication activities. As a result, there is stagnation in the development of professionalism and the quality of learning in the classroom. To overcome this problem, the solution designed is the development of an Android mobile-based application with comprehensive features such as interactive training modules, discussion forums to share experiences and solutions, and an automatic evaluation system to assess the success and progress of teachers in carrying out PTK. This application is expected to support the practical implementation of PTK and be relevant to the demands of the digital era.

Based on the initial survey conducted in this study, it was found that more than 60% of teachers experienced difficulties in designing and managing PTK systematically. The main obstacles identified include time limitations due to high teaching load, lack of understanding of research methodology, and difficulties in analyzing research data and compiling PTK reports. In addition, interviews with several high school teachers in Yogyakarta showed that many of them felt less confident in conducting PTK due to the lack of specialized training available.

As part of the needs validation, the study also conducted observations in several schools to assess the extent to which teachers can run PTK without the help of digital technology. The observation results show that the majority of teachers still rely on manual methods in documenting and analyzing PTK results, which slows down the process of reflection and improvement of learning in the classroom. With this empirical data, the development of Android-based applications is expected to be an innovative solution that can help teachers overcome these obstacles and encourage a more effective and efficient implementation of PTK.

In the implementation of digital-based applications to support PTK, there are several challenges that need to be overcome, such as diverse levels of teachers' digital literacy, resistance to the adoption of new technologies, and limited access to devices and internet connectivity. To overcome this obstacle, this study implements several mitigation strategies designed so that the application can be widely and effectively adopted by teachers.

One of the main steps is to provide training and mentoring for teachers to improve their digital literacy. This training program not only focuses on the use of applications, but also covers basic technology aspects that help teachers be more confident in integrating technology in their PTK. In addition, a community-based approach is applied through discussion forums and teacher working groups to encourage experience sharing and support the gradual adoption of technology.

To overcome resistance in adopting new technologies, this study also adopts a participatory approach by involving teachers from the early stages of application development. By providing space for teachers to provide input and adjust the app's features according to their needs, it is hoped that their acceptance and engagement rate in using the app will increase.

Another challenge faced is limited access to devices and internet connectivity. As a solution, this application is designed to run optimally on various device specifications,

 

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including low-capacity phones. In addition, the app's features are developed to be accessible offline to reduce reliance on a stable internet connection. With this mitigation strategy, the research is expected to minimize technical and social barriers in the implementation of the application, as well as ensure that these digital innovations can be used effectively by teachers in improving their professional competence.

This research aims to develop an android application-based service system that can improve teachers' professional competence through PTK-based training, integrate information technology in supporting learning and scientific development, and facilitate collaboration between educators on a national and international scale. Based on the theoretical foundation, PTK has been proven to be an effective and sustainable strategy in teacher professional development. Implementing information technology, primarily through mobile applications, is an innovative approach that answers modern challenges in managing teacher training and research. This research utilizes the 4D development model, which consists of the Define, Design, Develop, and Disseminate stages to ensure the product is relevant to user needs.

The initial specifications of this application product include key features such as access to training materials and PTK guidelines, a project-based evaluation system, ease of navigation through various devices such as smartphones, laptops, or computers, and integration of user account homes that allow personalized and quick access. This Define stage provides a solid foundation for the development of innovative products that are expected to positively impact teachers' professional competence while supporting the quality of education in general.

The development of this Android-based application for Classroom Action Research (PTK) management is designed to be in line with the national education policy that emphasizes teacher competency improvement and digital transformation in education. One of the main policies that supports this initiative is *Freedom of Learning* launched by the Ministry of Education, Culture, Research, and Technology (Kemendikbudristek). In this policy, teachers are encouraged to be more independent and innovative in developing learning that suits the needs of students. This application can be a tool for teachers to identify learning problems in the classroom, design improvement strategies through PTK, and systematically evaluate their impact.

In addition, this application is also relevant to the *Continuous Professional Development* (PKB) program which requires teachers to continue to improve their competence through various forms of training and research. With the digital mentoring feature in the application, teachers can more easily access PTK guidance, prepare research reports, and share experiences with peers online. This is in line with the government's efforts to improve teacher professionalism through a technology-based approach.

To ensure effective and sustainable implementation, this application can be collaborated with various educational institutions and the government, such as the Regional Education Office, the Education Quality Assurance Institute (LPMP), and the Driving Teacher Center (BGP). Through this partnership, applications can be introduced in teacher training programs, both in certification schemes, *Teacher Driving* programs, and community-based training such as Teacher Working Groups (KKG) and Subject Teacher Deliberations (MGMP). In addition, this application can be integrated into

 

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*the Merdeka Teaching Platform*, which is currently one of the main sources for teachers in developing more innovative learning methods.

With the support of existing education policies and collaboration with various parties, it is hoped that this application will not only be a solution for teachers in Yogyakarta but can also be adopted nationally to improve the quality of learning and professionalism of teachers in Indonesia.

### 4.2 Phase II Design

At the design stage of this research, product design was carried out in the form of a mobile android application designed to support the development of teachers' professional competencies through classroom action research (PTK)-based training. This design is carried out systematically to ensure that the product developed meets user needs, is efficient in use, and can answer the challenges identified in the previous stage. This stage began with determining the application design framework, identifying key features, and developing technical specifications and an intuitive user interface.

The application design framework refers to the research objective of creating a platform that supports collaboration, efficiency, and innovation in implementing PTK. Therefore, the application design was designed by integrating the latest technology based on a digital platform that can be accessed through various devices, such as smartphones, laptops, and computers. The app has excellent features, including interactive training modules, Question and Answer forums, PTK classes for hands-on training, and project result evaluation features. In addition, the app provides an intuitive navigation menu that makes it easy for users to access training materials, create work plans, monitor training activities, and evaluate work results.

The design process also includes drafting the app's technical specifications. The app was designed to be flexibly accessible through a browser or downloaded directly through an app store. The app design considers three main user categories: admin, reviewer, and author/researcher, with each category having different access as needed. Users are also given the ability to manage their accounts in an integrated manner through an email-based account home, making communication and notifications easier. The system is expected to increase user productivity by accelerating the process of reporting, collaboration, and training completion.

In this design stage, the research team designed an application known as "PTK Pro Guide" as an innovative solution that supports the improvement of teachers' professional competencies. A thorough design of the application's features, user interface, and workflow was carried out at this stage based on the needs analysis results from the defined stage. This process ensures that the application developed is intuitive and easy to use and can meet users' needs in conducting Classroom Action Research (PTK) efficiently. This stage includes identifying the main elements of the application, prototype design, and drafting the feature structure.

The design stage begins with the identification of the main elements that the PTK Pro Guide application must have. Based on user requirements, the app was designed to have key features such as a login page, trainer selection, PTK training modules,

 

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project-based evaluation, and an interactive discussion system. The main focus of the design was to ensure the app could be accessed easily by teachers through mobile devices and provide a simple yet functional user experience. The initial design began with creating a login page that allows users to access the app using various credentials, such as mobile phone number, username, or email. The prototype featured a "Forgot Password?" option to help users with difficulty remembering passwords. In addition, users who do not yet have an account are allowed to register, making the app's accessibility more inclusive. This design ensures that the app's initial steps are smooth and intuitive. The prototype of the app can be seen in Figure 2.

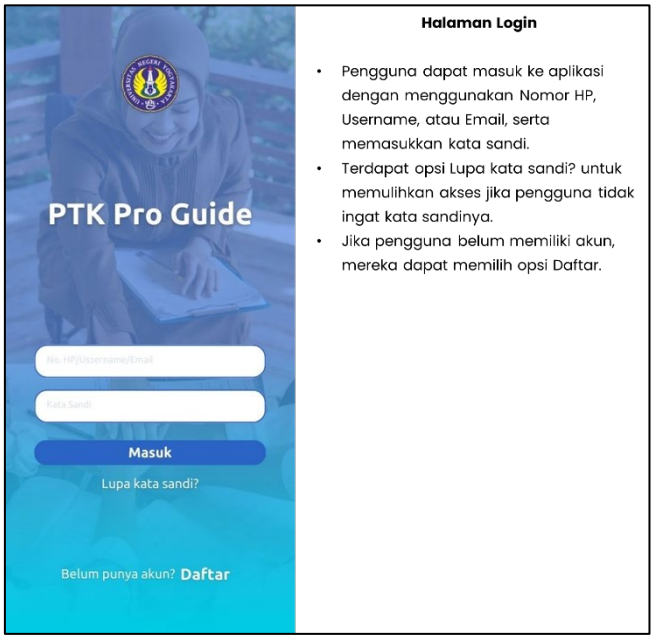


**Fig. 2.** Main Layer View of Mobile Application Login

Furthermore, the application provides a trainer selection feature, one of the featured elements. Users can select a trainer from the list provided, which consists of experts in the field of education, such as Prof. Dr. Aman, M.Pd., Dr. Muh. Nur Rokhman, M.Pd., and Dr. Danu Eko Agustinova, M.Pd. This feature is designed to personalize and support users' specific needs when implementing PTK. After selecting a trainer, users can proceed to the next stage by pressing the "Next" button, which creates a seamless and structured workflow. The application prototype can be seen in Figure 3.

 

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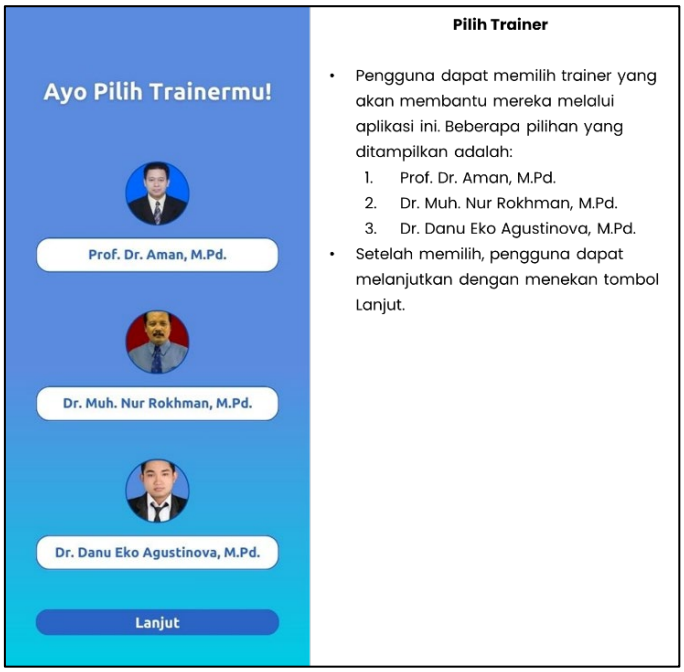


**Fig. 3.** Mobile Application Screen Display on Trainer Selection Feature

Furthermore, the main page is arranged with interactive icons designed to be visually appealing and intuitive, making it easier for users to recognize the main functions. Some of the main features presented on this page include access to training materials through the Material icon, allowing users to read or download guides according to the module they are following. The Plan feature is designed to help users create or view training schedules and plans, making it easier for them to organize the stages of activities in a structured manner.

In addition, there is a Training icon that provides direct access to various training modules or pre-prepared activities and a Projects icon that lists the projects users are working on or have worked on during the training process. The Results feature displays the achievements or evaluations that users have made, while the Evaluation icon allows users to get feedback on their progress during the training. Last, the Guide icon provides additional information to help users who need further guidance in using the app. At the same time, the More option includes additional features that complement the other main functions.

At the bottom of the page is a navigation menu containing several essential icons, such as Home to return to the Main Page, Browse to browse further training materials or content, Search to find content quickly, and Profile to access user settings or profile information. The page also includes a Gallery feature, which allows users to view photos or media related to the training activity. All these features are designed with a neat layout and attractive color combinations to ensure a comfortable and efficient user experience. The prototype of the application can be seen in Figure 4.

 

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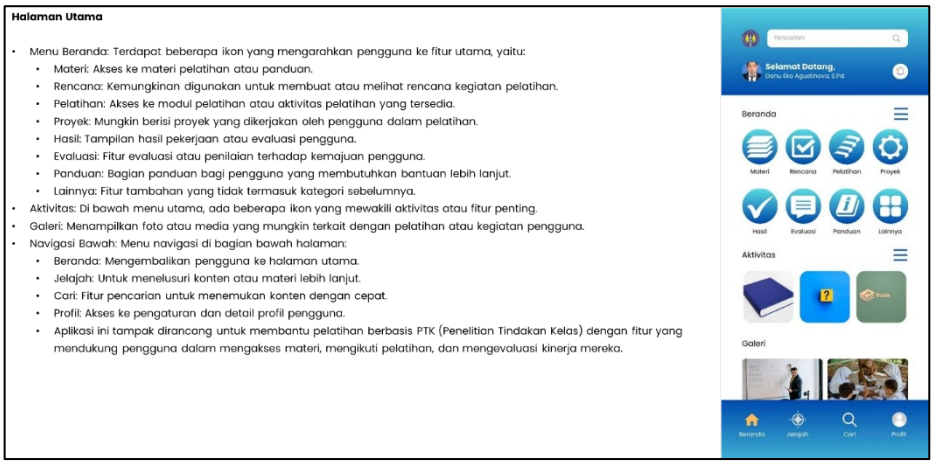


**Fig. 4.** Main Page of Mobile Application Prototype View

This design process was carried out by considering user needs and responsive and user-friendly interface design principles. Each element of the Home Page was tested incrementally to ensure that the available features could run optimally and meet user expectations. With a structured design and high accessibility, the main page of this application is expected to be an effective control center for users in managing training activities, accessing materials, evaluating performance, and supporting the comprehensive implementation of PTK.

User interface design (UI/UX) was a significant concern. Attractive color combinations and simple but informative graphic elements ensure that the application is functional and comfortable to use in the long run. The placement of buttons and features is strategically designed to minimize confusion and provide an efficient experience for users. For example, using clear icons and text helps users understand each step quickly, even for those less familiar with technology.

In addition to the visual design, the application's workflow was designed to support users in completing PTK-related tasks. Each feature is designed to be logically interconnected, from login, trainer selection, and access to training modules to completing evaluations. This structure ensures that users can complete each stage seamlessly, while the guidance system included in the app helps them understand each step. As part of the design stage, the prototype was tested internally to identify design and user interface flaws. Feedback from this initial pilot test became the basis for refining the prototype before entering the development stage. As such, the design of the PTK Pro Guide app was carefully crafted to ensure that the final product was not only relevant to user needs but also provided an optimal experience. This stage emphasizes the importance of in-depth and strategic design in producing innovative and robust applications.

In the development of this Android-based application, a comparative analysis was carried out with several similar applications that have been available to support teachers in research or learning planning. The results of the analysis show that most of the

 

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existing applications focus more on the administrative aspects of PTK, such as report preparation and document management, but do not provide interactive features that support the overall research process. Some of the existing digital-based education applications also tend to be general in nature and are not specifically designed for the needs of PTK teachers in Indonesia.

The main advantage of this app over other devices lies in its innovative features that are developed based on the needs of teachers in the field. This application not only functions as a documentation tool, but also as an interactive learning platform that guides teachers through each stage of PTK, from problem identification, action planning, implementation, to reflection and evaluation. Features such as video-based training modules, automated feedback systems, and discussion forums between teachers are differentiating elements that provide added value compared to existing applications.

With this thoughtful design approach, the developed product is designed to meet current user needs and adapt to future needs. This application is expected to be an innovative solution to overcome various challenges in implementing PTK, improve teachers' professional competence, and significantly improve national education quality. This Design stage is a crucial step in ensuring that the product developed is relevant and has a real impact on its users.

### 4.3 Phase III Develop

At the development stage in this research, the main focus is the development of Android mobile application products based on the design prepared in the previous stage. This development process is carried out gradually and systematically, including prototyping, functionality testing, design validation, and continuous improvement based on user feedback. These steps aim to produce a product that meets user needs and can support the implementation of Classroom Action Research (PTK) effectively and efficiently.

The first step in the development phase was the creation of an application prototype. This prototype includes all the main features that have been designed, such as interactive training modules, Q&A-based discussion forums, PTK classes, project evaluation systems, and intuitive navigation features. The prototype was developed using the latest technology by considering compatibility with various devices, such as smartphones, laptops, and computers (PCs). At this stage, attention was paid to the operation of the application so that it could be accessed through an internet-connected browser or downloaded directly from the app store. This allows users to choose the access method according to their needs.

Once the prototype was complete, functionality testing was conducted to ensure each feature worked according to specifications. This testing involved simulating usage scenarios by different categories of users, namely admins, reviewers, and authors/researchers. Each user category was given access according to their needs, such as the ability to manage accounts, moderate discussions, or upload PTK project results. This testing process aims to identify potential problems or bugs in the system so that they can be fixed before the product is further tested at the validation stage.

 

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**Fig. 5.** Android Mobile App Development Forum

The development stage involves initial product trials through active collaboration between participants. Through forums attended by participants with various backgrounds and roles, including product designers, evaluators, and representatives of end users. This aims to refine the designed product components or materials. Each participant reviews elements that must be adjusted or improved to optimize the final product. The development stage also includes application design validation. Experts and users conducted validation to assess whether the design and functionality of the app met their needs. This validation process provided valuable feedback, especially in improving the user experience and interface aspects. Based on the validation results, improvements and enhancements were made to the prototype. One of the most significant improvements was the integration of email-based user account settings to ensure notifications and communication run smoothly, as well as adjustments to the app's navigation to make it easier to use by different levels of technology skills.

The evaluation of the effectiveness of the application is carried out through an approach that includes usability testing, assessment of learning outcomes, and analysis of user experience. This study uses a quasi-experimental design to compare the group of teachers who use the application with the control group who still use the manual method. The effectiveness of the application was measured through pre-test and post-test using the professional competency rubric to measure the improvement of teachers' abilities. In addition, the quality of PTK implementation is evaluated through classroom observation and analysis of PTK reports generated by teachers before and after using the application.

Technical aspects are tested using application functionality trials, including simulation of usage scenarios for different categories of users, such as admins, reviewers, and researchers. This process aims to identify bugs, navigation constraints, and ensure that the feature runs optimally on various devices. The findings from this trial are used to iterate on the design, including improvements to navigation features and integration of email-based account settings to facilitate communication and notifications.

 

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From a pedagogical perspective, the impact of the application on the learning process was explored through user satisfaction surveys and in-depth interviews with teachers. Data is collected to understand the benefits, ease of use, and challenges in app adoption. In addition, the data triangulation approach is carried out by combining the results of observations, questionnaires, and interviews to improve the validity and reliability of research findings. With this evaluation approach, the application is expected to be not only technically robust, but also effective in supporting the development of teachers' professional competencies in a sustainable manner.

As part of the development phase, field testing was conducted to see how the app is used realistically. This field testing involved the teachers who were the research target and were asked to use the application to support the implementation of PTK. This testing obtained empirical data on the app's effectiveness in improving teachers' professional competence. The field test results provided a strong basis for refining the app before it was finally launched widely. This development stage is the core of the research and development process because this is where the app starts to be realized from concept to actual product. With a structured and iterative approach, the resulting product meets user needs and can provide innovative solutions to overcome various obstacles in implementing PTK. This application is expected to significantly improve teachers' professional competence and positively contribute to the quality of national education.

### 4.4 Phase IV Disseminate

At the dissemination stage, this research focuses on disseminating Android mobile application products developed to support improving teachers' professional competence through Classroom Action Research (PTK)-based training. This stage involves various strategies to ensure the application can be widely accessed, used, and accepted by teachers, educational institutions, and other stakeholders. The dissemination process is conducted through various distribution channels, training, scientific publications, and collaborative efforts with multiple parties to expand the impact of the developed app.

The first step in dissemination is product dissemination through digital platforms. The app was designed to be downloaded from an app store or accessed through an internet browser, making it easier for users to access the available features directly. In addition, an app usage guidebook was prepared to help users understand how to operate the app and make the most of its features. The product was also promoted through seminars and training workshops, where teachers were invited to get to know and test the application directly in the context of conducting PTK. These activities not only introduced the app but also provided space for participants to provide feedback, which was then used to improve the quality of the product.

The dissemination phase also includes scientific publications as part of the dissemination strategy. Articles describing the research results and advantages of the app were published in accredited national journals and Scopus-indexed international journals. These publications aim to reach the scientific community and contribute to relevant educational literature. In addition, researchers also presented the findings and

 

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application in scientific forums, such as international seminars, which provided academic recognition and expanded the acceptance of this application globally. Dissemination efforts do not stop at the academic aspect but involve collaboration with educational institutions, education offices, and professional teacher organizations. This collaboration aims to ensure that the app can be widely applied in various high schools, especially in Yogyakarta, and adopted as an official tool to support teachers' professional development. Within the framework of this collaboration, an agreement document was created that governs the app's implementation and ongoing training for users.

In addition, intellectual property rights (HAKI) were filed as legal protection for this product innovation. By obtaining HAKI, the app is expected to provide security and official recognition of copyrights while increasing user credibility and trust. Video documentation explaining the development process and the app's advantages were also produced to strengthen the promotion strategy, primarily through social media and other digital platforms. This dissemination stage is the end of the entire research and development process, where the developed app is known and actively used by teachers in implementing PTK. Through a planned and inclusive dissemination strategy, this product is expected to have a significant impact in supporting the improvement of teachers' professional competence, strengthening collaboration in education, and contributing to the continuous improvement of the quality of national education.

Although the app was originally developed for high school teachers in Yogyakarta, its scalability potential allows for implementation in different regions and other educational environments. To ensure that the application can be widely adapted, the first step is to develop features that are flexible and can be adapted to the needs of teachers in different regions. This includes the integration of relevant language and content with the local curriculum and the provision of broader training materials to keep the app applicable at different levels of education and learning contexts. In addition, the app is designed to be compatible with a wide range of operating systems and devices, making it accessible to teachers with different technological infrastructures.

In ensuring long-term adoption and use, the main strategy implemented is collaboration with educational institutions and teacher communities. Cooperation with the Ministry of Education, regional education offices, and teacher training institutions will be an important step in expanding the scope of this application. Regular training and workshops will help teachers understand and integrate the application in their PTK practice. In addition, a continuous application update system will be implemented to adapt to technological developments and teacher needs, including improvements to user feedback-based features. With a holistic and sustainable approach, it is hoped that this application can not only be widely applied, but also become a tool that continues to grow in supporting teacher professionalism and improving the quality of learning in various regions.

 

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DOI: https://doi.org/10.58905/jse.v5i2.466

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