



## **Expectations vs Recognition: An Analysis of the Implementation of a Science Teacher Training Program in Designing Smartphone-Assisted Practicum Activities**

**Rizki Zakwandi<sup>1,2\*</sup>, Alfiansah Sandion Prakoso<sup>1,2</sup>, Ika Mustika Sari<sup>1</sup>, Duden Saepuzaman<sup>1,2</sup>, Dedi Sasmita<sup>1</sup>, Asep Akmal Fadia Nurhalim<sup>1</sup>, Najmi Hiyah Fathinah<sup>1</sup>, Rahma Alliya Aqquilla<sup>1</sup>, Afrizal<sup>1</sup>, Yudhistira Wicaksono<sup>1</sup>, Nisa Naylul Fauzah<sup>1</sup>, Bunga Syahira Maharani<sup>1</sup>, Dianti Azmi Rusydah<sup>1</sup>**

<sup>1</sup>Physics Education Study Program, Faculty of Mathematics and Natural Science Education, Universitas Pendidikan Indonesia, Bandung, Indonesia

<sup>2</sup>Learning Analytics and Digital Assessment Research (LADAR), Universitas Pendidikan Indonesia, Bandung, Indonesia

e-mail: [r.zakwandi@upi.edu](mailto:r.zakwandi@upi.edu)

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### **ABSTRACT**

This study proposes to examine the implementation of a science teacher training program for developing smartphone-assisted practicums, emphasizing the correspondence between expectations and program outcomes. This research depends on the substantial findings regarding the application of smartphones in scientific studies, which remain primarily theoretical and have not been extensively adopted by teachers in schools. The training program consists of three primary phases: self-assessment for science teachers, assessment of school laboratories, and a workshop focused on the utilization of smartphones in experiments. The results indicated that participants responded positively to the training, with the program's achievement level varying from "achieved" to "highly achieved." Educators evaluated the material as pertinent, practical, and capable of enhancing comprehension and proficiency in the design of novel experiments. The reflection results indicated a necessity for additional training on complex practical subjects, including Electricity, Magnetism, Thermodynamics, and Fluids, with instruction in the construction of student worksheets and smartphone sensor-based data analysis. This course connects research findings with educational practices and promotes the transformation of technology-enhanced science learning in schools.

**Keywords:** Evaluation, Learning Expectation, Community Services, Quality of Education.

## Ekspektasi vs Realita: Analisis Implementasi Program Pelatihan Guru IPA dalam Perancangan Kegiatan Praktikum Berbantuan Smartphone

### ABSTRAK

*Studi ini mengusulkan untuk mengkaji implementasi program pelatihan guru sains untuk mengembangkan praktikum berbantuan smartphone, dengan menekankan kesesuaian antara ekspektasi dan hasil program. Penelitian ini bergantung pada temuan substansial mengenai penerapan smartphone dalam studi ilmiah, yang sebagian besar masih bersifat teoretis dan belum diadopsi secara luas oleh guru di sekolah. Program pelatihan ini terdiri dari tiga fase utama: penilaian diri untuk guru sains, penilaian laboratorium sekolah, dan lokakarya yang berfokus pada pemanfaatan ponsel pintar dalam eksperimen. Hasil menunjukkan bahwa peserta merespons pelatihan secara positif, dengan tingkat pencapaian program bervariasi dari "tercapai" hingga "sangat tercapai". Para pendidik menilai materi tersebut relevan, praktis, dan mampu meningkatkan pemahaman dan kemahiran dalam merancang eksperimen baru. Hasil refleksi menunjukkan perlunya pelatihan tambahan pada mata pelajaran praktis yang kompleks, termasuk Listrik, Magnetisme, Termodinamika, dan Fluida, dengan instruksi dalam penyusunan lembar kerja siswa dan analisis data berbasis sensor ponsel pintar. Kursus ini menghubungkan temuan penelitian dengan praktik pendidikan dan mendorong transformasi pembelajaran sains berbasis teknologi di sekolah.*

**Kata kunci:** *Evaluasi, Harapan Pembelajaran, Pengabdian Masyarakat, Kualitas Pendidikan.*

### INTRODUCTION

The utilization of cellphones in scientific research has emerged as a fast-expanding area of research during the past decade. Numerous studies indicate that cellphones possess significant potential as economical yet multifunctional laboratory instruments, equipped with sensors for acceleration, light, sound, and imaging, capable of observing diverse physical, chemical, and biological events (Ozcan, 2014; Xing et al., 2025; Zhao, 2025). The investigations, undertaken by university faculty and students for their final projects and theses, have yielded a range of unique, effective, and easily replicable smartphone-based experimental models.

Nonetheless, a significant portion of this research is confined to theoretical and experimental frameworks, lacking substantial engagement with the practical context of school learning. Teachers, as leaders in the implementation of learning innovations, frequently encounter barriers such as limited access, inadequate support, or insufficient skills to integrate research findings into their teaching and learning practices (Bingimlas, 2009; Christensen et al., 2018). The disparity between academic research outcomes and classroom pedagogical methods presents a considerable obstacle to initiatives aimed at transforming science education through digital technology.

Teacher training programs function as a vital link between innovative research findings and educational practices in schools. The training aims to introduce concepts and research findings related to smartphone-assisted practicums while empowering educators to create experiments that align with specific school conditions and student characteristics (Lellis-Santos & Abdulkader, 2020; Luo & Watts, 2025). The training aims to facilitate knowledge transfer and enhance

teachers' competencies in the design, implementation, and evaluation of technology-based practicums.

Nonetheless, like other professional development initiatives, teacher training often exhibits a discrepancy between anticipated outcomes and the actual execution of practices. Participants expect that trainers will provide practical skills, ready-to-use teaching materials, and continuous implementation support. Conversely, from the organizer's perspective, training programs are typically structured with a limited duration and emphasize concept transfer, often lacking adequate opportunities for post-activity mentoring. Consequently, program outcomes frequently fail to meet the expectations of participating teachers regarding the understanding, implementation, and sustainability of classroom practices.

Therefore, this article analyzes the alignment between science teachers' expectations and the outcomes of training programs for designing smartphone-assisted practicums. This analysis focuses on the implementation of activities from the teachers' perspective as participants. The primary goal of this study is to present an empirical assessment of the effectiveness of teacher training in connecting research findings with learning practices. Additionally, it will provide reflections and recommendations for training organizers better to address the needs of teachers in the field.

### Training Program Design

The scientific teacher training program for developing smartphone-assisted laboratories is structured as a professional development initiative accessible to the public, enabling participation from science educators in both junior and senior high schools. This transparency seeks to enhance the program's influence and establish a collaborative environment for educators to cultivate technology-driven science instructional methods. This activity aims for teachers to comprehend the application of smartphones in laboratories and to tailor their use to the practical circumstances of school labs and the requirements of students.

The training program design has three primary, sequential, and complimentary stages: (1) self-assessment for science teachers, (2) evaluation of the school laboratory, and (3) a workshop on smartphone utilization in the laboratory. The three steps are designed to facilitate a systematic training process, first with the assessment of participant competencies and needs, followed by the analysis of school resource conditions, and culminating in practical, experiential learning activities. The compilation of training activities is presented in Table 1 below.

**Table 1.** Phases and Overview of the Science Educator Training Program for Developing Smartphone-Enhanced Practical Activities

Phase	Main Activity	Description
Science Teacher Self-Assessment	Teachers contemplate their comprehension of practical concepts, experimental experiences, and proficiency in utilizing technology, particularly cellphones, in the learning process.	Assessing training requirements and educator preparedness for technology-driven practical innovations.
School Laboratory Assessment	Teachers evaluate laboratory conditions, availability of tools and materials, and digital support facilities in their respective schools.	Mapping the potential and limitations of implementing smartphone-assisted practicums in the context of participant schools.

Phase	Main Activity	Description
Workshop on Smartphone Use in the Laboratory	The core training activities consist of two sessions: online (virtual) and offline (face-to-face).	Provide theoretical understanding and practical experience to teachers in designing and implementing experiments using smartphones.

The workshop segment constitutes the essence of this training activity. The program consists of two components: an online session and an offline session involving practical exercises in a physics laboratory. The online workshop emphasizes the conceptual framework and motivation for executing technology-based practicums. The content addresses three primary subjects: (1) The necessity of practicums in scientific education, underscoring the significance of empirical experience in developing scientific comprehension; (2) the hybrid practicum model, which amalgamates hands-on experiments with digital resources to enhance accessibility and efficacy of learning; and (3) the capabilities of smartphone sensors in facilitating science education, accentuating the role of internal smartphone sensors (such as accelerometers, cameras, microphones, and light sensors) as alternative measurement instruments in experimental endeavors.

Concurrently, the offline session is executed in a physics laboratory employing a practical methodology. This session allows participants to utilize online learning outcomes by developing and executing real-world experiments with cellphones. Participants are encouraged to assess measurement data, debate potential adaptations of these activities in their individual schools, and formulate contextual practicum ideas based on available resources.

## METHOD

This study constitutes both a preliminary and conclusive examination of the execution of a science teacher training initiative utilizing smartphone-assisted practicums. A total of 48 scientific educators engaged in this online activity, although only 16 were later invited to the workshop session. This selection was based on several considerations. First, the workshop required more intensive mentoring and active engagement; therefore, participants were chosen according to their level of involvement during the initial online activities, including task completion and responsiveness during discussions. Second, the workshop was carried out with limited facilitation capacity and time allocation, necessitating a smaller group to ensure effective guidance and meaningful interaction. These criteria were applied to maintain the quality and depth of the workshop implementation.

Two distinct instruments were utilized in this study: an initial questionnaire and a concluding questionnaire. The initial instrument was structured to ascertain preliminary participant expectations, encompassing the components: "Expectations Concerning Mentoring Activities" and "Expectations Regarding the Impact of Activities," comprising eight derived items. The final instrument focused on post-intervention evaluation, incorporating two primary dimensions: "Achievement of Activity Objectives" and "Further Needs Analysis." A mixed-format design was implemented for the questionnaire items. Items designated to assess the magnitude of agreement or satisfaction (e.g., measuring the degree of alignment between expected and achieved outcomes) were formulated using a Likert scale featuring a singular, forced-choice response option. This specific format was selected to enable the quantitative measurement of the alignment or

discrepancy between the participants' anticipated and actual learning outcomes. Furthermore, to capture diverse contextual details and elicit more nuanced data, the instruments also incorporated multiple-choice items that permitted the selection of various response options. This inclusion served to identify a comprehensive range of specific variables, such as perceived implementation barriers or diverse future training requirements. Tables 2 and 3 provide a complete delineation of the instruments employed.

**Table 2.** Aspects and Statements of the Initial Questionnaire

No	Aspects	Statements
1	Expectations for Mentoring Activities	How far do you know the concept of smartphone-assisted physics practicals with a hybrid creative problem solving model?
2		What do you expect from this mentoring activity?
3		Do you feel the need to receive training in smartphone-assisted practicum development?
4		What are the main challenges you have faced in carrying out physics practicals at school so far?
5	Expectations regarding the impact of activities	In your opinion, how can this training affect the quality of physics practicals in your class?
6		What results do you expect after attending this training?
7		How do you assess the importance of this training to improve the competence of physics teachers in schools?
8		What are your expectations for this training in the context of your professionalism as a physics teacher?

**Table 3.** Final Questionnaire Aspects and Statements

No	Aspects	Statements
1	Achievement of Objectives	To what extent did this training activity succeed in increasing your understanding of developing smartphone-assisted physics practicals with a hybrid creative problem-solving model?
2		Were your expectations for this activity achieved after participating?
3		How would you rate the quality of the material delivered during this training activity?
4		To what extent is the facilitator's method of delivering material effective in helping you understand the concept of smartphone-assisted physics practicals?
5		To what extent do you feel you can apply the knowledge gained from this training to your daily learning?
6	Advanced Needs Analysis	Do you feel the need for further training activities to deepen the topics related to smartphone-assisted physics practicals?
7		What topics do you think need to be expanded upon for further exploration in future mentoring?
8		What are the biggest obstacles you might face in implementing smartphone-assisted physics practicals in the classroom?

The responses derived from this instrument served as a benchmark for examining the expectations and actual realities encountered by teachers throughout the training program. The quantitative data, collected via the Likert-scale items, were analyzed using descriptive statistical methods. Specifically, means were calculated to characterize the central tendency and dispersion

of participant responses regarding expectations and achievement. These descriptive statistics were then employed to identify significant differences or alignment between the participants' initial expectations and their final perceptions. Additionally, the data from the open-ended questionnaire items were subjected to a qualitative content analysis to evaluate the corresponding thematic responses.

## RESULTS AND DISCUSSION

### Expectations for Mentoring Activities

The data indicates that smartphone-assisted laboratory work is still relatively novel for the majority of science educators, especially those teaching physics. Among the 16 teachers who engaged in the training, merely 37.5% recognized that smartphone sensors can facilitate physics laboratory activities. In contrast, 56.25% reported being clueless, while 6.25% having never encountered this prospect. This finding suggests that the proficiency of science teachers in digital laboratory technology is still restricted, despite various research highlighting the potential of utilizing cellphones in basic classroom experiments (Menon et al., 2020; Ürek, 2024; Wang et al., 2014).

The limited initial understanding serves as a significant hint that training initiatives based on digital laboratory technologies remain critically necessary. In this setting, training acts as a conduit between academic research outcomes generated at universities and pedagogical practices in schools. Previous study, identify the "application gap" as a significant barrier to the transmission of educational innovations, referring to the disparity between academic advancements and teachers' practical capacity to adopt these innovations in the classroom (Liu et al., 2025; Nourimand & Olechowski, 2020).

Concerning educators' anticipations of the training, five principal expectations surfaced. A significant majority of educators (93.75%) expressed a desire to comprehend the development of smartphone-assisted physics laboratories and enhance their proficiency in creating engaging and productive laboratory activities. Seventy-seven percent of educators sought comprehension of the hybrid creative problem-solving laboratory model, while seventy-five percent anticipated that the training would assist them in mitigating constraints posed by laboratory equipment through the use of smartphone functionalities and acquiring technical guidance for the development of innovative laboratory modules.

These expectations suggest that educators are strongly driven to enhance their pedagogical methods to align with technological advancements and the requirements of 21st-century learners. This discovery corroborates earlier studies indicating that needs-based teacher training programs are more efficacious in enhancing instructors' proficiency in developing innovative learning.

The survey results indicated significant problems encountered by educators in the design and execution of physics laboratories. 87.5% of teachers reported limitations due to insufficient laboratory equipment and materials, 62.5% encountered challenges in creating innovative practicum activities, 43.75% lacked comprehension of digital technology applications in practicums, and 56.25% experienced time constraints for the preparation and execution of practicum activities. These issues illustrate that training alone is inadequate for imparting

conceptual knowledge; it necessitates technical assistance and post-training mentorship to enable teachers to effectively apply the outcomes in educational settings (Mahara, 2024; Mwakabenga, 2025).

From a debate standpoint, these findings bolster the assertion that digital transformation in science education should commence with enhancing technology-based practical competencies among educators. A study explored that the effective incorporation of virtual or sensor-based laboratories relies on educators' pedagogical and technological preparedness (Rowe et al., 2020; Tariq et al., 2024). Consequently, training design must prioritize the notion of "learning by doing," enabling educators to comprehend the theoretical potential of smartphone use while also engaging in practical applications through straightforward, realistic experiments that can be duplicated in educational settings.

### **Expectations regarding the Impact of Activities**

Teachers exhibited a highly favorable outlook and considerable enthusiasm over the anticipated impact of the training, particularly its potential to enhance the quality of practical learning through smartphone utilization. The survey results indicate four primary components of anticipated effects from the training. Ninety-three point seventy-five percent of educators aspired to autonomously create smartphone-assisted practicals, indicating a robust inclination to attain practical abilities in transforming basic technology into effective measuring instruments for scientific studies. Secondly, 56.25% of educators expressed a desire to enhance their comprehension of the significance of innovative practicals, signifying an acknowledgment of the necessity for a paradigm shift from mere demonstrations to exploration- and inquiry-based experiments. Third, 87.50% of educators indicated optimism over enhanced proficiency in utilizing the hybrid creative problem-solving practical model, a technique that transcends traditional laboratory apparatus by integrating aspects of creative problem-solving facilitated by digital technology. Fourth, 75% of educators anticipated that this activity will yield innovations in executing more efficient and engaging practicals, perhaps alleviating time and resource limitations in schools. Within the realm of teacher professionalism, the articulated requirements are distinctly focused on enhancing pedagogical and professional competencies. Ninety-three percent of participants stated that this activity was expected to improve professional skills in learning innovation, in line with the view that teachers need to continuously adapt to developments in digital technology in science education (Mahara, 2024). Additionally, 31.25% of educators anticipated enhanced support and collaboration from peers following the training, underscoring the significance of professional learning communities in sharing training results at the institutional level (Wang et al., 2014). Simultaneously, 37.50% of educators anticipated that the training would enhance happiness and creativity in pedagogy, demonstrating the strong correlation between educational innovation and teacher motivation and professional fulfillment.

The elevated expectations articulated by educators signify a disparity between industry requirements and existing educational methodologies. Another observation that the utilization of cellphones in physics investigations enhances access to laboratory operations at a minimal cost while ensuring precise outcomes (Ozcan, 2014). Nevertheless, in the absence of specialized training, educators often fail to fully leverage this potential. Another study highlighted that the effective execution of technological innovation in education is significantly affected by the degree of teacher readiness and institutional support from the school. This training serves as a vital link

between academic research and educational methods, while also equipping instructors to adapt to advancements in scientific learning technologies.

The elevated expectations of educators for this training indicate its considerable capacity to facilitate cultural transformation in scientific pedagogical practices inside educational institutions. This training, which prioritizes creativity, collaboration, and technology, not only improves technical skills but also expands teachers' understanding of practicums as a means to cultivate students' scientific thinking (Xing et al., 2025). This activity enhances learning quality and strategically supports the objective for modernizing scientific education in the digital age.

### **Achievement of Objectives**

The training activities outlined in this program have been executed effectively and have successfully met the established objectives. The evaluation results and participant responses indicate that most teachers had a favorable response to the entire training process. The program's achievement levels varied from "quite achieved," "achieved," to "very achieved," signifying that the training effectively enhanced the professional competence of science instructors. The replies show that the training was tailored to address the requirements of teachers in the field, encompassing material, delivery methods, and applicability to their current pedagogical practices in schools.

Participants rated the material highly, with most indicating that the training content was very pertinent to instructors' refresher requirements in laboratory-based science education. The evaluation concluded that the program offered novel perspectives on optimizing basic technology, such as smartphones, as instruments for physics and chemistry research. Numerous educators remarked that the training unveiled new insights into the capabilities of smartphone sensors, which had hitherto been underexploited in formal educational settings. The training material was considered thorough and offered a complete grasp of the fundamental ideas, potential applications, and practical methods for incorporating this technology into school laboratory activities.

In addition to the content elements, participants also reacted well to the pedagogical method employed during the course. The online courses offered a theoretical framework via interactive conversations and idea presentations, but the offline sessions allowed teachers to immediately experiment with numerous smartphone applications in the laboratory (Chung et al., 2019). This integration of theory and practice effectively enhanced participants' comprehension and bolstered their confidence in implementing learning innovations. Numerous participants indicated that the program offered a significant collaborative experience, enabling them to share ideas and methods with colleagues from diverse locations and educational tiers.

The initiative effectively connected academic research with teaching practices in educational institutions. Extensive research on the application of cellphones in physics experiments, formerly confined to conceptual studies, can now be executed in practical environments by educators through this program (Hochberg et al., 2018; Rochadel et al., 2013). This exercise not only enhanced the individual competencies of participants but also initiated a more innovative, efficient, and technology-driven culture of science education in schools.

## Advanced Needs Analysis

The final segment of the survey concentrated on a subsequent needs analysis, intended to assess and delineate the actual requirements in the domain of science practicum training for educators. Feedback from participants revealed that the training offered substantial advantages; however, educators expressed a desire for more comprehensive and elaborate themes to tackle learning issues in educational institutions (Donnelly, 2006). The majority of educators evaluated that the training subjects need additional refinement, especially those previously deemed difficult to use in practicums, either due to inadequate equipment or the intricacy of the concepts imparted to students.

Participants identified several topics as priorities for continued development, including: sound, kinetic theory of gases, thermodynamics, pressure, electricity and magnetism, fluids, modern physics, optics, waves, dynamics, and alternative energy. These subjects are fundamental elements of the physics curriculum in junior and senior high schools, however they frequently prove challenging to conceptualize without sufficient laboratory apparatus. In this context, educators perceived cellphones as possessing significant promise as alternative experimental instruments due to their integration of numerous sensors, including accelerometers, magnetometers, microphones, and light sensors, which facilitate the straightforward yet precise measurement of physical quantities (Lavric et al., 2024; Oprea & Miron, 2014).

Alongside grasping ideas and employing tools, educators emphasized the significance of creating supplementary learning resources, especially smartphone-based student worksheets. These worksheets are intended to function as practical resources for students undertaking independent experiments, both in educational settings and at home, while concurrently enhancing the inquiry-based learning methodology. Educators articulated the necessity for enhanced training centered on practical data analysis methodologies, especially in the reading and interpretation of measurement outcomes from smartphone sensors (Giannakos et al., 2021; Hong et al., 2025). This element is vital since many educators continue to struggle with transforming raw data from measuring applications into scientifically significant knowledge.

The findings of this comprehensive needs analysis demonstrate that digital practical technology-based training possesses much potential for enhancement. Advanced programs focusing on the integration of smartphone sensor utilization, innovative worksheet development, and practical data analysis skills would strategically enhance the capabilities of science teachers and address the disparity between curriculum requirements and inadequate school laboratory facilities.

## COCLUSION

The implementation and analysis of the training activities indicate that the science teacher training program for designing smartphone-assisted practicums successfully met its objectives. Educators reacted positively to the significance, depth, and advantages of the instruction in enhancing their professional skills. This activity introduced the use of smartphone sensors in practicums and connected academic research findings with educational practices in schools. This program enhanced teachers' knowledge of the significance of creativity in practicum activities and fostered their capacity to devise more effective, creative, and contextually relevant

experiments utilizing existing resources. Moreover, the reflection results revealed that educators required additional training on complex practicum subjects, alongside the creation of student worksheets (LKPD) and data analysis utilizing smartphone sensors. This program is a deliberate initiative to enhance technological literacy for scientific educators, while facilitating the change of science education towards a more innovative and digital-oriented approach. However, a limitation of this study is its localized scope, as the findings are based solely on the participation of teachers from one specific region, which may constrain the generalizability of the results to a broader population of science educators. Future research is recommended to involve a wider and more diverse group of teachers, explore long-term impacts on classroom practice, and examine the integration of smartphone-assisted practicums across different scientific topics and educational levels.

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