

Enhancing Pedagogical and Content Knowledge through Preservice Training: A Study on Islamic Religious Teacher Candidates

Hendri Kuswiran¹, Qolbi Khairi²

¹ Universitas Islam Negeri Fatmawati Sukarno Bengkulu; kuswiranhendri@gmail.com

² Universitas Islam Negeri Fatmawati Sukarno Bengkulu; qolbi@mail.uinfasbengkulu.ac.id

ARTICLE INFO

Keywords:

content knowledge;
pedagogical knowledge;
preservice training;
prospective teacher students

Article history:

Received 2024-12-04

Revised 2025-05-21

Accepted 2025-06-29

ABSTRACT

Improving the competencies of future teachers requires innovative approaches, including preservice training aimed at strengthening Pedagogical Content Knowledge (PCK)—a fusion of subject matter expertise and pedagogical skills. This study investigates the effectiveness of preservice training in enhancing PCK among prospective Islamic Religion teachers. A quantitative, one-group pre-test–post-test design was implemented involving 45 students from the Islamic Education Department at Fatmawati Sukarno State Islamic University, Bengkulu, Indonesia. Participants were selected using purposive sampling to target a specific population. Data were collected through tests measuring both content and pedagogical knowledge and analyzed using paired sample t-tests and descriptive statistics. Post-test results indicated a significant improvement in both content and pedagogical knowledge compared to pre-test scores. Statistical analysis yielded a significance value of 0.000 ($p < 0.05$), confirming the training's effectiveness in developing students' PCK. The findings demonstrate that preservice training plays a vital role in advancing prospective Islamic teachers' integrated understanding of subject matter and pedagogy. These results support the inclusion of structured PCK-focused training in teacher education curricula. Preservice training significantly enhances the PCK of future Islamic Religion teachers. Future research could explore the development of a digital literacy-based PCK model to inform the design of effective, subject-specific training programs across various educational disciplines.

Corresponding Author:

Hendri Kuswiran

Universitas Islam Negeri Fatmawati Sukarno Bengkulu; kuswiranhendri@gmail.com

1. INTRODUCTION

The professional development of Islamic Religious Education (IRE) teachers is a continuous and essential process, encompassing both pre-service and in-service training to ensure teachers meet high professional standards. These developmental efforts are guided by educational policies that shape teacher qualifications and establish academic and clinical requirements, such as subject mastery, teaching practice, and fieldwork experience (Arwildayanto, 2022). Such policies are designed to cultivate the pedagogical competencies required for effective teaching, highlighting the need for consistent and structured pedagogical training throughout a teacher's career.

Ongoing pedagogical development, when tailored to specific needs, plays a crucial role in fostering professional growth (Mahdum, 2015). Since many teaching competencies cannot be fully developed in academic settings alone, integrated pre-placement training becomes a critical component of teacher preparation. This type of training accelerates the transition from student to professional educator, providing foundational experiences that link theory with practical teaching. The formation of professional skills should begin at the university level and continue throughout a teacher's service in schools (Sholeh Ridho, 2014).

Pre-service education, conducted before individuals formally enter the teaching profession, is central to this developmental trajectory. It blends the delivery of academic content with hands-on teaching experience, helping candidates understand the realities of classroom instruction. By integrating theory with practice, pre-service training helps future teachers become familiar with school environments, fosters professional confidence, and reinforces their understanding of teaching norms and expectations (Takahindangen, Arwildayanto, & Arifin, 2023).

Pre-placement training is essential for equipping prospective teachers with the necessary knowledge, attitudes, and skills for their future roles. The development of teacher competencies must be carried out systematically and efficiently to improve human resource quality within the education sector (Amin, Indrawati, & Hartati, 2021). As part of this process, teacher education institutions are responsible for designing and implementing effective pre-service programs that produce capable and well-prepared educators.

Effective teacher development programs must include innovative strategies to support continuous improvement and ensure teachers have a deep understanding of curriculum content. Periodic evaluations help assess teacher progress and maintain a high standard of professional growth. Strong academic backgrounds and specialized qualifications, when combined with effective pre-service training, can significantly enhance teacher performance (Takahindangen, Arwildayanto, & Arifin, 2023). Teachers must not only possess pedagogical and content knowledge, but also maintain physical and mental well-being to contribute effectively to national educational goals.

A key focus in teacher education is the development of Pedagogical Content Knowledge (PCK), which combines subject matter expertise with instructional strategies. The link between pre-service training and PCK is critical in shaping the competencies of future teachers. PCK enables educators to teach specific content effectively by understanding how students learn, identifying common misconceptions, and selecting suitable teaching methods (Shulman, 1987). It develops through experience and targeted training, particularly during pre-service programs. Research supports that structured training can significantly improve teachers' abilities to plan lessons, assess student needs, and choose appropriate instructional approaches—core elements of PCK.

Grossman (1990) emphasized that PCK development in teacher education should involve in-depth content study, reflective pedagogical discussions, and meaningful teaching experiences. These practices form the foundation of effective instruction and must begin during the pre-service stage. Pre-service training is, therefore, not merely preparatory; it is transformational in developing essential professional skills for effective teaching.

However, current observations reveal gaps in the preparedness of many teacher candidates. For instance, limited proficiency in using technology for instructional purposes, inadequate mastery of teaching materials, and a reliance on traditional lecture-based methods hinder the effectiveness of classroom instruction. These issues reflect a need for more interactive and innovative teaching strategies that address students' cognitive, emotional, and physical development.

To address these gaps, pre-service training must focus more explicitly on building PCK competencies (Amin, Indrawati, & Hartati, 2021). By equipping future teachers with the skills to integrate content knowledge with appropriate teaching techniques, training programs can enhance student engagement and learning outcomes. Such programs also boost teachers' confidence in applying diverse instructional tools, including educational technologies (Everling et al., 2015).

Pedagogical Content Knowledge plays a vital role in helping teachers adapt their instructional strategies to meet students' varied learning needs. It enables teachers to present subject matter in ways that are comprehensible, relevant, and meaningful (Akerson et al., 2017). Developing PCK through pre-service education ensures that future teachers are better equipped to navigate complex classroom environments and foster meaningful student learning.

To meet this goal, teacher preparation must include activities that enhance both subject matter expertise (Content Knowledge) and instructional ability (Pedagogical Knowledge). PCK, as defined by Lee and Luft (2008), represents the integration of these two knowledge domains and is central to the professionalism of teachers.

Numerous studies have reinforced the importance of PCK in improving teacher performance. Henze et al. (2008) and Nilsson (2008) have demonstrated how teacher education programs focused on PCK can better prepare future educators across various subject areas, particularly in science education. These programs involve targeted lesson studies, collaborative teaching practices, and reflective learning that encourage the practical application of theoretical knowledge.

Training programs have been shown to significantly improve teacher competence in areas such as lesson planning, classroom management, assessment practices, and research literacy. Aziz and Akhtar (2016) found that teachers who participated in such programs performed better than their peers who had not received similar training. Additional research suggests that frequent and well-structured training interventions contribute to ongoing improvements in teacher effectiveness (Angga Kutiba Alhuda, 2020).

Moreover, the quality of teacher training has a direct impact on the ability of educators to fulfill their professional responsibilities. As Jahangir, Saheen, and Kazmi (2012) note, higher-quality training leads to better teaching outcomes, which ultimately benefits students. PCK includes multiple components such as knowledge of common student misconceptions, understanding curriculum structures, and familiarity with instructional challenges (Kirschner et al., 2016). These elements are aligned with key teacher competencies and must be cultivated through targeted training.

Effective pre-service training strengthens future teachers' abilities not only to understand complex subject matter but also to convey it in ways that resonate with students. It enables them to use educational technology effectively and apply diverse teaching strategies suited to varied classroom contexts. As Kim (2018) asserts, teacher professionalism must be rooted in learning-centered development practices, particularly those that build PCK. The greater the depth of pedagogical understanding, the stronger the teacher's instructional capacity (Resbiantoro, 2016).

Given the increasing demands of modern classrooms, pre-service training must evolve to address gaps in pedagogical preparation and content mastery. This study, therefore, seeks to explore the effectiveness of pre-service training programs in enhancing the PCK competencies of future Islamic Religion teachers. It aims to contribute both theoretically and practically: theoretically, by reinforcing models of professionalism and pedagogical development; and practically, by offering insights that can guide the implementation of more effective training strategies within teacher education institutions.

Understanding how pre-service training influences PCK development is crucial in ensuring the readiness of future educators. By strengthening the link between theoretical knowledge and classroom application, such programs hold the potential to significantly improve educational outcomes and teacher performance.

2. METHOD

This study employed a one-group pre-test post-test design (see Table 2) to assess the improvement in students' pedagogical content knowledge. In the context of research on PCK through preservice teacher training, this design can indeed be used to see changes that occur after the intervention. However, this design has a number of limitations that are important to be reflectively observed. Without a comparison group, it is difficult to determine whether changes in PCK scores are caused by

the training or by other factors (e.g., additional learning experiences, informal discussions, or personal motivation). This design is easy to implement, especially in resource-constrained training contexts, but it has limitations in terms of inferential power. Although not strong enough to claim causality, this design is useful as an initial step in exploring the effectiveness of PCK training before more rigorous follow-up studies.

The study's population consisted of students enrolled in Islamic Religious Education at Fatmawati Sukarno State Islamic University, Bengkulu, Indonesia. The sample included 45 students from a single experimental class, selected through purposive sampling. This class served as the experimental group, where preservice training was implemented.

Table 2. Design one one-group pretest posttest

Group	Pretest	Treatment	Posttest
Experiment	O ₁	X ₁	O ₂

The preservice training was implemented following the established procedures. The steps taken in this study were: 1) randomly selecting one study group; 2) administering a pre-test (initial test) in both classes; 3) delivering the preservice training intervention in the experimental class; 4) conducting a post-test (final test) after the preservice training was completed over two sessions.

Table 3. Stages of preservice training for prospective teachers

Stages	Activity
Overview and procedure explanation of preservice training.	<ul style="list-style-type: none"> - The lecturer outlines the goals and stages of preservice training. - Students focus on the lecturer's explanation of the activity procedures.
The provision of PCK for future biology teachers encompasses teaching models, assessments, and learning management.	<ul style="list-style-type: none"> - Lecturers assist students in presenting PCK content related to religious studies. - Students are tasked with gathering information from various learning resources.
Reflection	<ul style="list-style-type: none"> - Lecturers offer feedback on the current activities. - Lecturers assign follow-up tasks for the preservice training program.

In this study, the data collection method employed was a test aimed at evaluating the mastery of pedagogical content knowledge (PCK) skills among prospective teachers. The test, consisting of essay-style questions (pre-test and post-test), was used to assess the participants' PCK proficiency before and after instruction. This research instrument has been validated by experts, ensuring its accuracy. Examples of descriptive questions on mastering the PCK concept are: 1) how to manage Islamic religious learning using animated videos, 2) how to provide Islamic religious content material in enrichment programs. To assess its validity, the researcher used the expert agreement index, based on the Aiken index (V). The instrument's reliability was determined using the Cronbach alpha coefficient, which yielded a value of 0.79, indicating high reliability (Taber, 2018). The results of this evaluation are presented in Table 4 below:

Table 4. The results of the Aiken Index Coefficient of Instrument Validity

Instruments	V	Validity
Mastery of PCK	0.84	Valid

The findings of this study were analyzed using descriptive quantitative methods to assess the effectiveness of PCK mastery through pre-service training. A paired sample t-test was employed for the analysis. Prior to conducting the t-test, several assumptions were checked, including the normality test and homogeneity test.

This study was conducted in accordance with ethical research principles, to ensure that the rights, privacy, and well-being of participants were fully protected. Prior to data collection, informed consent was obtained from all participants. Prospective participants were given written and oral explanations of the purpose of the study, the procedures to be followed, potential benefits and risks, and their right to withdraw at any time without consequence. The consent form included a statement that participation was voluntary and that the data collected would be kept confidential.

3. FINDINGS AND DISCUSSION

3.1 Findings

The results of the study indicate that the implementation of pre-service training can enhance the mastery of pedagogical content knowledge (PCK) among prospective teachers. The post-test score, following the treatment with pre-service training, was 81.50, which is higher than the pre-test score of 62.40. The data from the pre-test and post-test results of the pre-service training implementation are shown in Table 5 and Figure 2.

Table 5. Pre-test and post-test results of pre-service training implementation

Data	N	Max Value	Min Value	Average
Pre test	45	62.3	57.4	62.40
Post test	45	81.3	75.5	81.50

Table 5 above presents the results of the descriptive statistical analysis for the preservice training implementation data. It shows that the average pretest score is 62.40, while the average posttest score is 81.50. This indicates an improvement in the prospective teachers' mastery of PCK before and after the training.

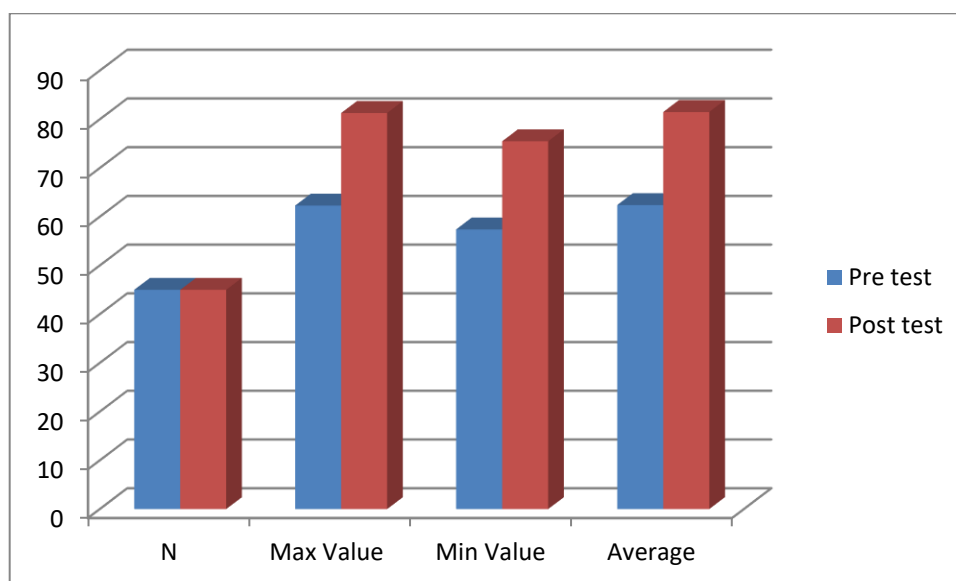


Figure 2. Differences between pretest and posttest results

The normality test, conducted using the Kolmogorov-Smirnov method, showed that the significance values for both the pretest and posttest scores were above 0.05. This suggests that H0 is accepted, meaning the data is normally distributed. For the homogeneity test of the pretest and posttest data, the Levene test was used. The homogeneity test for the pretest yielded a significance value of 0.57 with an F value of 0.074, while the posttest data produced a significance value of 0.35 with an F value of 1.044.

This indicates that the pre-test and post-test data have equal variance (homogeneous). Since all data are normally distributed and homogeneous, hypothesis testing is conducted using parametric statistics, specifically the paired sample t-test in the SPSS program. The results from the paired sample t-test analysis show that the implementation of pre-service training has a positive impact on enhancing the PCK mastery of prospective teachers, as shown in Table 6 below.

Table 6. Paired sample t-test results

Dependent Variable	t-test for Equality of Means			Information
	t	Df	Sig.	
PCK (Pre test)	.65	45	.362	The average PCK of prospective teachers is the same.
PCK (Post test)	15.062	45	.000	The average PCK of prospective teachers differs.

3.2 Discussion

The paired sample t-test results for the pre-test data yielded a significance value of .362. Since this value is greater than .05 (sig. > .05), the null hypothesis (H0) is accepted and the alternative hypothesis (H1) is rejected, indicating that there is no difference in the average score before the pre-service training. In contrast, the post-test data showed a significance value of .000. As this value is less than .05 (sig. < .05), H0 is rejected and H1 is accepted, suggesting that there is a significant difference in the average teacher PCK mastery after the pre-service training. This suggests that the pre-service training is effective in enhancing the PCK mastery of prospective teachers. The training process engages participants more and makes it easier for them to grasp the material, as it systematically presents the steps aligned with the objectives of the pre-service training (Everling et al., 2015). Overall, the

implementation of pre-service training for prospective teachers has a significant impact, as it improves PCK mastery and enhances their professional competence (Suryawati, Firdaus & Yosua, 2014).

Based on the reflection on the activities, it can be concluded that the benefits of pre-service training for students include a better understanding of the material in line with competency and basic competency standards. This training helps prospective teachers in learning planning and syllabus development, and enables students to apply active, creative, innovative, and engaging teaching methods in line with the learning design concepts. From this, the competencies of prospective teachers after pre-service training can be summarized as follows: they become more competent in pedagogical skills, management, and assessment, and are able to implement strategies, methods, or learning techniques that are both engaging and enjoyable for their students.

The research findings indicate that pre-service training positively impacts the enhancement of PCK understanding. This improvement occurs because prospective teachers develop the awareness and skills needed to apply it in their teaching. This aligns with Ertmer et al. (2012), who emphasize the importance of teachers being aware of the need to continually improve learning through innovative and creative approaches, such as technology-based methods. Additionally, the advantages of technology-based learning can motivate students to stay actively engaged with the material (Howard et al., 2015). Tsai & Chai (2012) also note that teachers who can design learning strategies based on their PCK positively influence students, helping them construct knowledge and have meaningful learning experiences. The increase in post-test scores related to PCK in this study is likely a result of the pre-service training. Mar'atus et al. (2016) suggest that the guidance process in mastering PCK plays a crucial role and significantly affects the ability to create learning tools and other related aspects.

The development of PCK is crucial for designing learning experiences that are tailored to specific teaching methods and content (Koehler et al., 2013). Aquino (2015) further emphasizes that PCK development is essential in mentoring novice teachers to enhance their teaching effectiveness. Teachers must be discerning in selecting teaching strategies and learning models that align with the subject matter content and the technology they wish to integrate. Effective integration of educational technology into science education requires teachers to possess a strong understanding of content, pedagogy, and technology, along with how these elements interact (Srisawasdi, 2014).

PCK refers to the understanding of a specific topic within a particular field, coupled with the use of suitable teaching methods (Hashim et al., 2013). As a result, mastering PCK is crucial for prospective teachers as it significantly contributes to their preparation and development of other essential teaching skills (Mahdum, 2015). The ability of teachers to integrate technology into the learning process, using suitable pedagogical and technological strategies for specific subjects, is vital (Schmidt et al., 2009). Focusing on PCK can transform teachers' professional development experiences by creating learning technologies tailored to their needs.

Strong PCK skills can offer new insights for teacher educators in addressing challenges related to classroom teaching practices and learning processes (Chai et al., 2011). Studies on teacher education suggest that the PCK model can serve as an effective framework for preparing and developing teachers' competencies in school settings. According to Hashim et al. (2013), the use of technology in teaching can impact students' conceptual understanding, so teachers must carefully select teaching methods that align with the subject matter content and the technology they plan to incorporate into their lessons (Koehler et al., 2013).

Teachers with a strong understanding of pedagogy know how to effectively enhance students' knowledge, help them acquire skills, and foster positive attitudes toward learning. Therefore, pedagogical knowledge involves a deep comprehension of cognitive, social, and developmental learning theories and their application in the classroom (Schmidt, 2009). Teachers lacking a solid grasp of the content may misrepresent the material to their students (Mishra & Matthew, 2006).

Content knowledge refers to an understanding of concepts, theories, ideas, frameworks, evidence, and the methods for developing such knowledge (Suryawati et al., 2014). Therefore, teachers must possess both a broad and deep understanding of the materials in their specific field. This

knowledge is crucial as it shapes the distinct approach for each academic discipline (Koehler et al., 2013). As developments progress, academic institutions are under increasing pressure to enhance curricula and align them with contemporary needs. There is a pressing and ongoing demand to incorporate technology into the learning process. Both digital and non-digital technologies can support various learning activities (Harris et al., 2009). Technology can assist students and aspiring teachers in their professional growth, helping them stay informed about the latest trends in education, learning strategies, and scientific advancements within their fields.

4. CONCLUSION

The study's findings suggest that preservice training plays a crucial role in enhancing students' comprehension of Pedagogical and Content Knowledge (PCK). Developing PCK is essential for creating learning experiences that align with both particular pedagogies and specific content. The study recommends that teaching contexts differ in terms of technology, pedagogy, and content, enabling instructors to make decisions that reflect advancements in all three areas. In education, it is essential to use appropriate technology in teaching and learning activities, taking into account the aspects of technology, pedagogy, and content, as well as their interconnections. The findings of this study imply that instructors should integrate technology into learning through an approach that enhances Technological Knowledge (TK), thereby improving the technological literacy of future teachers in educational development. This study recommends that policy makers of educational institutions conduct technical guidance on the implementation of pre-service training on PCK through learning technology design. For future researchers, it is necessary to develop an integrated TPACK learning model in various other fields of study. This research suggests the development of training modules or digital integration in the context of improving PCK through preservice training.

REFERENCES

- Amin, A., Indrawati, M., & Hartati, C. S. (2021) Strategi Peningkatan Mutu Pendidikan Melalui Standarisasi Tenaga Pendidik. *Jurnal Santiaji Pendidikan*, 11(3), 180-187.
- Akerson, V.L, Pongsanon, K. Rogers, M.A.P. Carter, I., & Galindo, I (2017). Exploring the Use of Lesson Study to Develop Elementary Preservice Teachers' Pedagogical Content Knowledge for Teaching Nature of Science. *Int J of Sci and Math Educ*, 15:293-312
- Angga Kutiba Alhuda (2020). Pengaruh Inservice Training And Upgrading Terhadap Kinerja Guru Pendidikan Agama Islam (Studi Kasus Di Smp Negeri 5 Sentajo Raya). *Jom Ftk Uniks*, 1,(2) .1-15
- Arwildayanto.(2021). Pengembangan Preservice dan In-Service Education Untuk Peningkatan Profesionalisme Melalui Kepemimpinan. Laporan Penelitian Kementerian Pendidikan Kebudayaan Riset Teknologi Universitas Negeri Gorontalo.
- Aquino, A. B. (2015). Self-efficacy on technological, pedagogical and content knowledge (tpack) of biological science pre-service teachers. *Asia Pasific Journal of Multidiciplinary Research*. 3(4).150-157.
- Aziz, F., & Akhtar. (2016). Impact of training on teachers competencies at higher education level in Pakistan. ProQuest
- Chai, C.S., Koh, J.H.L., & Tsai, C.C. (2013) A review of technological pedagogical content knowledge. *Educational Technology and Society*. 16(2). 31-51.
- Ertmer, P. A., Ottenbreit-Leftwich, A. T., Sadik, O., Sendurer, E., & Sendurer, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. *Computers & Education*, 59(2), 423-435.
- Everling et al. (2015).The Impact of Field Experiences on Pre-service Teachers' Decisions Regarding Special Education Certification. *Journal of Education and Human Development*, 4(1).

- Fraser, S.P. (2016). Pedagogical Content Knowledge (PCK): Exploring its Usefulness for Science Lecturers in Higher Education. *Res Sci Educ*, 46:141–161
- Ferreira, C, Baptista, M & Arroio, A. (2013). teachers' pedagogical strategies for integrating multimedia tools in science Teaching. *Journal of Baltic Science Education*, 12(4) 509-524
- Grossman, P. L. (1990). *The making of a teacher: Teacher knowledge and teacher education*. Teachers College Press.
- Harris, J., Punya M., & Matthew K. (2009). Teachers' technological pedagogical content knowledge and learning activity types: curriculum-based technology integration reframed. *Journal of Research on Technology in Education*. 41(4). 393-416.
- Hashim, Zulkefli., & Fatin, A. P. (2013). Amalan pengetahuan teknologi pedagogi kandungan guru fizik tingkatan enam. *2nd Internasional Seminar on Quality and Affordable Education (ISQAE)*.
- Henze, I., Van Driel, J & Verloop, N. (2008). Development of Experienced Science Teachers' Pedagogical Content Knowledge of Models of the Solar System and the Universe. *International Journal of Science Education*, 30 (10): 1321–1342.
- Howard, S. K., Chan, A., & Caputi, P. (2015). More than beliefs: Subject areas and teachers' integration of laptops in secondary teaching. *British Journal of Educational Technology*, 46 (2), 360–369.
- Jahangir, S. F., Saheen, N., Kazmi, S. F. (2012). Inservice training: a contributory factor influencing teachers' performance. *International Journal of Academic Research in Progressive Education and Development*, 1(1).
- Jimoyiannis, A. (2010). Developing a technological pedagogical content knowledge framework for science education: implications of a teacher trainers' preparation program. *Proceedings of Information Science & IT Education Conference (InSITE)*. 597-607.
- Kim, M.K. (2018). Reflective Practice in Pre-service Teacher Education through Journal Writing in a Writing Course. *Modern English Education*, 19, (2).
- Kirschner, S. Borowski, A. & Fischer, H.E (2016). University Duisburg-Essen Physics Teachers' Content Knowledge and Pedagogical Content Knowledge: Developing Test Scales and Measuring the Relation, StandAlone Paper. Presented at NARST 2016
- Koehler, M. J., Mishra, P., Akcaoglu, M., & Rosenberg, J.M. (2013). The technological pedagogical content knowledge framework for teachers and teacher educators. *ICT integrated teacher education models* (pp. 1-8). New Delhi, India: Commonwealth Educational Media Center For Asia
- Lee, E., & Luft. J.A., (2008). Experienced Secondary Science Teachers' Representation of Pedagogical Content Knowledge. *International Journal of Science Education*, 30 (10):1343–1363
- Mahdum. (2015). Technological Pedagogical and Content Knowledge (TPACK) of English Teacher in Pekanbaru, Riau, Indonesia. *Mediterranean Journal of Social Sciences*. 6 (5).
- Mar'atus, S., Lia, Y., & Wartono. (2016). Peranan tpack terhadap kemampuan menyusun perangkat pembelajaran calon guru fisika dalam pembelajaran post-pack. *Jurnal Pendidikan*. 1(2) 144 – 153.
- Meenakshi. (2013). Importance of ict in education. *Journal of Research & Method in Education (IOSR-JRME)*. 1 (4) 2320-73788.
- Nilsson, P. (2008). Teaching for understanding: The complex nature of pedagogical content knowledge in preservice education. *International Journal of Science Education*, 30(10), 1281–1299
- Resbiantoro, G. (2016). Analisis pedagogical Content knowledge (PCK) Terhadap Buku Guru SD Kurikulum 2013. *Jurnal Ilmu Pendidikan*, 6, 153–162.
- Schmidt, D. A., Evrim B., Ann D., Punya M, Matthew J. K., & Tae S. Shin. (2009). Technological pedagogical content knowledge (tpack): the development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*. 42(2) 123-149.
- Sholeh Ridho, (2014), Strategi Peningkatan Profesionalisme Guru Melalui Inservice Training Education, *At-Turas*, Vol 1 No. 1 Maret 2014 pp 95-110
- Shulman, L. S. (1987). *Knowledge and teaching: Foundations of the new reform*. Harvard Educational Review, 57(1), 1–22

- Srisawasdi, N. (2014). Developing technological pedagogical content knowledge in using computerized science laboratory environment: an arrangement for science teacher educational program. *Research and Practice in Technological Enhanced Learning*. 9(1) 123-143.
- Suryawati, E., Firdaus L.N., & Yosua H. (2014). Analisis keterampilan technologica pedagogical content knowledge (tpck) guru biologi sma negeri kota pekanbaru. *Jurnal Biogenesis*. 11(1). 67-72.
- Suyanto., & Asep, J. (2013). *Menjadi Guru Profesional; Strategi Meningkatkan Kualifikasi dan Kualitas Guru di Era Global*. Jakarta: Erlangga
- Taber, K. S. (2018). The Use of Cronbach's alpha When Developing and Reporting Research Instruments in Science Education, *Research in Science Education*, 1-24. <http://doi.10.1007/s11165-016-9602-2>.
- Takahindangen,R, Arwildayanto, & Arifin, (2023). Pengaruh Preservice Dan Inservice Training Terhadap Peningkatan Kompetensi Guru Sekolah Dasar, *Jurnal Pendidikan Glasser*,7(1).23-35