

## **Enhancing the Pedagogical Competence of Prospective Arabic Teachers through the MBKM Teaching Assistance Program**

**Zulaikha Nur Khasanah<sup>1</sup>, Muh. Naim Madjid<sup>1</sup>**

<sup>1</sup>Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia

Corresponding author email: [zulaikhanurkhasanah7@gmail.com](mailto:zulaikhanurkhasanah7@gmail.com)

Article History: Received on 11 October 2025, Revised on 25 December 2025,  
Published on 2 February 2026

**Abstract:** The low pedagogical competence of teachers continues to be a significant concern in Indonesian education, particularly in the context of Arabic language instruction. This study explores the role of the MBKM teaching assistance program in fostering pedagogical competence and Pedagogical Content Knowledge (PCK) among prospective Arabic teachers. Using a qualitative systematic literature review, this research examines relevant national and international studies published between 2020 and 2025 to understand how experiential learning in school settings supports teacher development. The results reveal that participation in the MBKM Teaching Assistance program contributes to the enhancement of instructional planning, classroom management, assessment skills, and reflective practices. In addition, the program supports the integration of pedagogical approaches with subject-specific knowledge, which is essential for addressing the structural and linguistic complexities of Arabic. Nevertheless, the success of the program is shaped by factors such as mentoring effectiveness, coordination between institutions, and the initial pedagogical preparedness of participants. This study concludes that the MBKM teaching assistance program offers a promising framework for strengthening pedagogical competence and PCK in Arabic teacher education, particularly when accompanied by systematic mentoring and continuous evaluation.

**Keywords:** Arabic Teacher, MBKM Program, Pedagogic Competence

### **A. Introduction**

Improving the quality of human resources to be superior and competitive is highly dependent on the quality of education in a country. Ki Hajar Dewantara emphasized that a teacher is “ing ngarso sung tulodo, ing madyo mangun karso, tut wuri handayani,” which means that teachers must be role models, inspire, and encourage students to be independent (Kristini et al., 2023). However, the state of education in Indonesia still faces significant problems. In terms of Indonesian students' reading ability, according to the results of the Programme for International Student Assessment (PISA) survey released in Paris in December 2019, Indonesia ranked 72nd out of 77 countries. This position places Indonesia in the bottom six and still behind

several neighbouring countries, such as Brunei Darussalam and Malaysia (Akbar Marsudi, 2021). The Education Index from the Human Development Reports (2017) shows similar results, placing Indonesia seventh in the ASEAN region with a score of 0.622 (Aminudin et al., 2022). These facts illustrate that the quality of education in Indonesia is still not optimal and requires strategic solutions, especially in improving the quality of teachers who play a direct role in the learning process.

The quality of education in Indonesia is still hampered by the low competence of teachers. Indonesian Law no. 14 of 2005 concerning teachers and lecturers stipulates that teachers must have four competencies, namely pedagogical, professional, personal, and social competencies (Presiden Republik Indonesia, 2005). Of these four competencies, pedagogical competence is the main foundation because it is related to teachers' ability to understand the characteristics of students, as well as their skills in designing, implementing, and evaluating the learning process. However, data shows that teacher competence in Indonesia is still low. The results of the Teacher Competency Test for the 2012-2015 period show that 1.3 million out of 1.6 million teachers did not meet the minimum standard score (Revina, 2020). In addition, the number of certified teachers decreased from 1.39 million in 2019 to 1.27 million in 2023 (Kemdikbud, 2024). Therefore, improving the quality of teachers is a top priority in national education policy.

Learning a foreign language is not just about mastering vocabulary, but requires planning, appropriate pursuit strategies, and effective evaluation. Foreign language learning encompasses four main skills, namely listening, speaking, reading, and writing (Wahyuningsih et al., 2024). In the context of Arabic language learning, the challenges are more complex in terms of structure, pronunciation, and communication skills, which are often considered difficult by students due to their difficulty in understanding the material and low self-confidence. This situation is exacerbated by a lack of innovation on the part of teachers, limited learning resources, low student motivation, and a high administrative burden on teachers. Therefore, Arabic teachers are not only required to be proficient in the language, but also to be able to design creative lessons, manage heterogeneous classes, and develop appropriate assessments. Teachers with good pedagogical competence can connect theory and practice, such as training students to use vocabulary in everyday communication, assessing progress objectively, and providing memorable learning experiences. Thus, the success of Arabic language learning depends heavily on the ability of teachers to implement their pedagogical competence to overcome challenges and achieve educational goals.

Educational Institutions for Teacher Training (LPTK), with their role as producers of prospective teachers, are required to equip students with strong pedagogical skills (Saepudin, 2021). However, many prospective teachers graduating from LPTK still lack practical experience, resulting in their pedagogical skills not developing optimally. In response to this challenge, the Ministry of Education, Culture, Research,

and Technology established the Freedom to Learn - Independent Campus program which is known as Merdeka Belajar - Kampus Merdeka (MBKM), based on Indonesian regulation ministry number 53, 2023 concerning quality assurance in higher education, which emphasizes that students have the right to participate in learning outside of their study programs. One of the main programs in the MBKM policy is teaching assistance in educational units, which is designed to provide direct experience to education students as prospective teachers in the learning process at partner schools (Raubun, 2022). The aim of this program is to improve the pedagogical competence, communication skills, cooperation skills, and professionalism of prospective teachers. Thus, teaching assistance acts as a bridge between the theory learned on campus and its application in practice in the field.

Previous studies have revealed that teaching practice experience plays an important role in developing the pedagogical competence of prospective teachers. Research conducted by Gaol et al. (2025), and Firdausi & Christanti (2024) shows that student involvement in the MBKM teaching assistance program can improve their pedagogical and professional skills while also benefiting partner schools. Febriani et al. (2023) emphasized that teachers' pedagogical competencies greatly influence learning strategies, classroom management, and student's Arabic learning outcomes. Sauri & Sanusi (2024) showed that Arabic teachers in Indonesia are still weak in the active use of Arabic, so strengthening their pedagogical competencies is very necessary. Yip (2025) mentions that the development of Pedagogical Content Knowledge (PCK) of prospective teachers still faces challenges, especially in student understanding and evaluation, even though practical experience has been proven to strengthen teaching orientation and learning strategies. However, most existing studies still discuss the impact of MBKM in general, without addressing how it supports the subject-specific development of PCK, especially in languages with complex linguistic structures such as Arabic. Therefore, a clear research gap exists regarding the role of MBKM teaching assistance in shaping the PCK of prospective Arabic teachers without further reviewing the characteristics of specific subjects, including Arabic. Based on this gap, this study aims to analyze how the MBKM teaching assistance program contributes to the enhancement of pedagogical competence and Pedagogical Content Knowledge (PCK) among prospective Arabic teachers, focusing on how field-based learning experiences prepare them to meet the demands of 21st-century education.

## **B. Methods**

This study adopted a qualitative Systematic Literature Review (SLR) approach to analyze the role of the MBKM teaching assistance program in enhancing pedagogical competence and pedagogical content knowledge (PCK) among prospective Arabic teachers in Indonesia. This method was employed to provide a systematic and transparent review process while enabling comprehensive qualitative analysis of relevant literature. The literature search was conducted across Google Scholar,

SINTA-indexed journals, international journals, conference proceedings, and official government documents related to the MBKM program. Publications issued between 2020 and 2025 were considered. The search strategy involved combinations of keywords such as MBKM, teaching assistance, pedagogical competence, Pedagogical Content Knowledge, Arabic teacher. The studies were selected based on predefined inclusion criteria: (1) relevance to the MBKM Teaching Assistance program or teaching practice in teacher education; (2) focus on pedagogical competence and PCK; (3) relevance to Arabic language teaching or language teacher education; and (4) publication in English or Indonesian. Irrelevant or duplicate studies were excluded.

Data analysis was conducted through thematic synthesis. The selected literature was organized into key themes, including the development of pedagogical competence, integration of PCK in Arabic language teaching, challenges in program implementation, and supporting factors in field-based learning. Pedagogical Content Knowledge (PCK) was used as the theoretical lens to interpret how pedagogical strategies and subject matter knowledge were developed through participation in the MBKM Teaching Assistance program.

### **C. Result and Discussion**

The teaching assistance program, as one of the implementations of MBKM, can serve as a concrete solution to the issue of low pedagogical competence among teachers, particularly in classroom planning and management, student understanding, and assessment practices (Umi Hanifah et al., 2024). This program contributes significantly to the development of both soft and hard skills for teachers and prospective teachers. Improvements can be observed in communication, problem-solving, creativity, social interaction, technological proficiency, as well as writing and research abilities. Thus, the MBKM program not only strengthens the pedagogical competence of future teachers but also enhances their professional capacity through 21st-century skills that align with the demands of modern education. This finding indicates that the effectiveness of the MBKM Teaching Assistance program lies in its ability to provide authentic and contextual teaching experiences, allowing prospective teachers to apply pedagogical knowledge directly in real classroom settings rather than merely understanding it at a theoretical level.

### **MBKM Policy and Teaching Assistance Implementation**

A strategic policy was started by the Ministry of Education, Culture, Research, and Technology in an attempt to improve Indonesia's higher education system. The Minister of Education and Culture Regulation number 3 of 2020 concerning National Higher Education Standards, which governs student's rights to engage in learning activities outside of their academic programs, has served as the foundation for the MBKM program from 2020. The goal of this program is to close the gap between classroom theory and real-world application by giving students opportunity to

engage in flexible, contextual learning experiences that are pertinent to the demands of the workplace. Student exchanges, internships, teaching support, research, humanitarian projects, entrepreneurship, independent studies, village development through thematic community service programs, and national defense are the nine categories of MBKM activities. These are shown in the figure below.



**Figure 1. 9 Categories of MBKM Activities**

The teaching support program is one way the MBKM strategy is being implemented. It gives students, particularly those from Teacher Training Institutions (LPTK), the chance to directly engage in educational activities at partner schools. The MBKM Guidebook states that the teaching aid program's objectives are to improve the professional and pedagogical abilities of aspiring educators, improve collaboration between colleges and schools, and close regional disparities in educational quality. With a conversion value of 20 credits, this activity is conducted under the supervision of field lecturers and supervising teachers. Students can hone their communication and classroom management abilities as well as administer learning assessments through this experience.

### **Pedagogical Competence and Arabic Language Teaching**

Pedagogical competence constitutes one of the four teacher competences delineated in Law number 14 of 2005 regarding teachers and lecturers. This competence encompasses teacher's capacity to comprehend student characteristics, devise and execute learning strategies, and perform assessments to facilitate the optimal development of student's potential. Educational competence comprises two essential components, mastery of educational knowledge and reflective skills. The pedagogical knowledge component includes instructor's comprehension of diverse educational theories, learning methodologies, educational psychology, and concepts that facilitate

the teaching and learning process. Reflective skills pertain to educator's capacity to critically assess and evaluate the learning process, enabling them to identify strengths, shortcomings, and requirements that must be addressed in subsequent learning endeavours (Susanto et al., 2020). This ability is dynamic, necessitating that educator adapt to evolving societal, technological, and educational demands.

Pedagogical competence is of paramount importance in the context of Arabic language acquisition, as Arabic is distinguished by its intricate phonological, morphological (*sharf*), and syntactic (*nahwu*) characteristics. Students frequently encounter challenges in comprehending the material, establishing confidence in communication, and sustaining their motivation to learn as a result of this complexity. This argument is further substantiated by the research conducted by Sudargini & Purwanto (2020), which demonstrates that the pedagogical competence of teachers significantly influences the learning outcomes of students. Empirical evidence suggests that the quality of learning is significantly influenced by the pedagogical competence of instructors, as evidenced by the low average achievement in the Arabic UAMBN during the 2012–2016 period, which was only 4.64. A reference in the formulation of learning objectives is Bloom's Taxonomy, which can also be used to analyze pedagogical competence.



**Figure 2. Bloom's Taxonomy**

The application of Bloom's Taxonomy in Arabic language teaching further highlights the importance of pedagogical competence, as effective teachers are expected to guide students from basic cognitive processes toward higher-order thinking skills such as analysis, evaluation, and creation (Darwati, 2022). A teacher who possesses a high level of pedagogical expertise is capable of facilitating learning that enables students to achieve the highest cognitive level.

## **Teaching Assistance and the Development of PCK**

From the perspective of Pedagogical Content Knowledge (PCK), teaching assistance activities enable prospective Arabic teachers to integrate subject matter knowledge with appropriate pedagogical strategies. Through direct classroom engagement, students learn to adapt instructional methods, select relevant learning resources, and respond to diverse student needs. This process reflects the core components of PCK, particularly knowledge of instructional strategies and knowledge of learner characteristics within specific subject domains (Yip, 2025). However, several challenges persist in the implementation of the MBKM Teaching Assistance program. Studies have reported limited pedagogical preparedness among some participants prior to placement, as well as weak coordination between universities and partner schools. These constraints often reduce the effectiveness of mentoring and limit opportunities for reflective practice, which are essential for sustained PCK development.

## **Teaching Assistance Enhance the Pedagogical Competence of Arabic Teachers**

Implementation of MBKM program through Teaching Assistance activities offers prospective Arabic teachers the chance to employ pedagogical theory in the field. Students acquire the ability to manage their learning by actively engaging in partner institutions. Additionally, they are confronted with real-world scenarios, including a variety of learning approaches, resource constraints, and varying student behaviors. These circumstances necessitate that student develop innovative learning strategies, adapt to the classroom environment, and think critically. Teaching assistance is not merely a field practice activity in these circumstances it also assists emerging Arabic instructors in the acquisition of broader pedagogical competencies, including professional sensitivity, communication skills, and conceptual understanding (Cahyani & Rochayati, 2025). These competencies are of paramount importance to individuals who aspire to become Arabic instructors. Nevertheless, implementation of MBKM program continues to encounter a variety of obstacles in the field. Several studies have demonstrated that certain students are not adequately prepared to navigate the complexities and dynamics of classroom learning, primarily as a result of inadequate pedagogical training prior to their enrollment in school. Conversely, the mentoring process imposes additional responsibilities on mentor teachers and supervising lecturers, resulting in suboptimal coordination between universities and partner institutions. Student's learning experiences are also influenced by the preparedness of educators, technological support, and facilities in each partner school.

This situation is indicative of the general issue of teacher competence. The Teacher Competency Test (UKG) results indicate that approximately 30% of teachers meet the eligibility standards, while the Ministry of Education, Culture, Research, and Technology data indicates that only approximately 25%-33% of Indonesian teachers are considered competent in their field (Putri, 2025). The UKG instrument is not yet

completely capable of exhaustively describing the pedagogical abilities of teachers, as it tends to concentrate on cognitive and memorization aspects, as noted by numerous education observers. Teaching Assistance activities are crucial in the field of Arabic language learning, as they serve as a platform for the development of the competencies of potential instructors. Educators who possess a thorough understanding of the Arabic language, which encompasses phonology, morphology (*sharf*), and syntax (*nahwu*), are required to possess strong pedagogical skills and the ability to adapt to the unique characteristics of their students. Therefore, the development of the pedagogical competencies of prospective Arabic teachers can be significantly enhanced through the implementation of the MBKM program, provided that it is accompanied by an intensive mentoring system, continuous reflection, and effective collaboration between universities and schools.

### **Implications for Policy and Teacher Education Institutions**

The findings of this review underscore the need for policy-level improvements, particularly in the standardization of mentor teacher training to ensure consistent pedagogical guidance across partner schools. For LPTK's the results highlight the importance of strengthening pre-internship pedagogical preparation, especially in instructional design, classroom management, assessment literacy, and reflective teaching practices. Overall, the MBKM teaching assistance program demonstrates significant potential in enhancing the pedagogical competence and PCK of prospective Arabic teachers. Nevertheless, its effectiveness is contingent upon structured mentoring, continuous reflection, and strong collaboration between universities and schools. When these conditions are met, MBKM can function as a strategic model for developing professional Arabic teachers who are capable of responding to the complex demands of contemporary education. Nevertheless, the quality of mentoring and the consistency of coordination between universities and partner institutions continue to significantly influence the efficacy of this program. In order to ensure that this activity is not solely administrative in nature, but rather a genuine method of cultivating professional teachers who are capable of adapting to the requirements of 21st-century education, continuous evaluation is necessary. The MBKM program has the potential to serve as a strategic model for the development of teacher education in Indonesia, particularly in the field of Arabic language learning, which necessitates a high level of pedagogical competence and cultural sensitivity. This can be achieved by enhancing the supervision system, refining performance-based assessment mechanisms, and enhancing pedagogical training prior to placement.

### **D. Conclusion**

This study affirms that the Merdeka Belajar–Kampus Merdeka (MBKM) Teaching Assistance program plays a constructive role in enhancing pedagogical competence and Pedagogical Content Knowledge (PCK) among prospective Arabic teachers.

Through experiential, field-based learning, participants are able to meaningfully combine subject matter knowledge with appropriate pedagogical approaches, particularly in instructional planning, classroom management, learner analysis, and assessment implementation. These results demonstrate that the Teaching Assistance program serves as an effective linkage between theoretical training provided by Teacher Training Institutions (LPTK) and the practical realities of Arabic language instruction. Nevertheless, the program's effectiveness is contingent upon several determining factors, including the quality of mentoring, the strength of coordination between institutions, and the level of pedagogical preparedness of student-teachers prior to school placement. This review is limited by its dependence on secondary sources, which may not comprehensively represent the dynamics of classroom practice and mentoring interactions. Accordingly, future studies are recommended to incorporate empirical approaches, such as classroom observations and in-depth interviews with participating student-teachers, to generate more nuanced and contextualized findings. In conclusion, the MBKM Teaching Assistance program demonstrates considerable potential as a strategic framework for advancing pedagogical competence and PCK in Arabic language teacher education, particularly when reinforced by systematic mentoring, continuous reflective practice, and effective collaboration between universities and partner schools.

### **E. Acknowledgement**

The authors acknowledge Universitas Muhammadiyah Yogyakarta (UMY) for the academic support and facilities provided for this research and extends appreciation to the lecturers for their guidance and constructive input in developing the manuscript.

### **References**

- Akbar Marsudi, R. (2021). *Education Problems in Indonesia*. Kompasiana. [https://www.kompasiana.com/risqi95/6103e7e19f7b9d27a05d5213/permasalahan-pendidikan-di-indonesia?lgn\\_method=google&google\\_btn=onetap](https://www.kompasiana.com/risqi95/6103e7e19f7b9d27a05d5213/permasalahan-pendidikan-di-indonesia?lgn_method=google&google_btn=onetap)
- Aminudin, H., Iskhaq, M., Suyud, R., Syam, E., Agama, K., & Pendidikan, D. (2022). *Assistance in Improving the Quality of Educational Institutions Through Performance Assessment The Head of Madrasah At the Supreme Court Takhassus Al-Qur'an Wonosobo*. 4(4). <https://ejournal.unimman.ac.id/index.php/pengabmas/article/view/146/162>
- Cahyani, H., & Rochayati, N. (2025). Implementation of the Teaching Assistance Program in Improving the Competence of Prospective Educator Students at SMA Negeri 1 Labuapi. *Tambora: Jurnal Pengabdian Kepada Masyarakat*, 2(1), 1-12.
- Darwati, A. (2022). *Strategies to Improve Teacher Competence* (V. 'Alimah (ed.); p. 72). C.V Mega Press Nusantara.
- Febriani, S. R., Rahmawati, R., Amrulloh, M. A., & Bedra, K. G. (2023). Teacher

- Pedagogic Competence in Improving Arabic Language Learning Outcomes Based on Curriculum Integration. *Tarbiyah Wa Ta'lim: Jurnal Penelitian Pendidikan Dan Pembelajaran*, 10(2), 70–79. <https://doi.org/10.21093/twt.v10i2.5964>
- Firdausi, N., & Christanti, A. (2024). Teaching Assistance for Independent Learning Independent Campus: Case Study of Madrasah Aliyah Bilingual Muslimat Nahdlatul Ulama Sidoarjo. *Merdeka Belajar Kampus Merdeka*, 1(1), 1–7. <https://doi.org/10.55732/mbkm.v1i1.1149>
- Gaol, R. L., Simarmata, E. J., Situmeang, E. S., Agustina, D., Girsang, S. V., Zai, A. V. C., & Habeahan, J. (2025). Improving the Competence of Prospective Teacher Students Through Teaching Assistance Activities at SDN 104219 Tanjung Anom. *JGEN: Jurnal Pengabdian Kepada Masyarakat*, 3(3), 419–423. <https://doi.org/10.60126/jgen.v3i3.1012>
- Kemdikbud. (2024). *Press Release 183 - Transformation of Professional Education of In-Office Teachers Encourages the Fulfillment of Certified Educator Teachers*. Direktorat Kepala Sekolah, Pengawas Sekolah, Dan Tenaga Kependidikan. <https://kspstendik.dikdasmen.go.id/berita/detail/siaran-pers-183-transformasi-pendidikan-profesi-guru-dalam-jabatan-dorong-pemenuhan-guru-bersertifikat-pendidik>
- Kristini, A., Sri Purnami, A., & Mulyono, R. (2023). School Principal's Leadership Innovation Based on the Leadership Trilogy of Ki Hajar Dewantara in an Effort to Improve Teacher Competence in Cluster 2 Nanggulan. *Didaktik : Jurnal Ilmiah PGSD STKIP Subang*, 9(1), 189–197. <https://doi.org/10.36989/didaktik.v9i1.693>
- Presiden Republik Indonesia. (2005). Law Number 14 of 2005 concerning Teachers and Lecturers. *Sekretariat Negara*, 14, 2. [https://piaud.uin-suka.ac.id/media/dokumen\\_akademik/43\\_20210506\\_Undang-Undang\\_Nomor\\_14\\_Tahun\\_2005\\_tentang\\_Guru\\_dan\\_Dosen.pdf](https://piaud.uin-suka.ac.id/media/dokumen_akademik/43_20210506_Undang-Undang_Nomor_14_Tahun_2005_tentang_Guru_dan_Dosen.pdf)
- Putri, I. M. (2025). *Teacher Competency Crisis in Indonesia: Only a Third Are Eligible to Teach?* <https://blitarkawentar.jawapos.com/pendidikan/2276295203/krisis-kompetensi-guru-di-indonesia-hanya-sepertiga-yang-layak-mengajar>
- Raubun, U. F. (2022). Student Perception of the Implementation of Teaching Assistance for the MBKM Program in the Biology Education Study Program, Universitas Pendidikan Muhammadiyah (Unimuda) Sorong. In *Skripsi* (Vol. 5, Issue 8.5.2017). <https://eprints.unimudasorong.ac.id/id/eprint/557/1/UmiFitriaRaubun-14820518071.pdf>
- Revina, S. (2020). *Why is the Quality of Teachers in Indonesia Still Low?* Magdalene. <https://magdalene.co/story/mengapa-kualitas-guru-di-indonesia-masih-rendah>
- Saepudin, J. (2021). Educator Training Institution Readiness in Developing Future Professional Teacher in Iain Raden Intan Lampung. *EDUKASI: Jurnal Penelitian Pendidikan Agama Dan Keagamaan*, 19(2)(2), 220–235.

<http://jurnaledukasikemenag.org>

- Sauri, S., & Sanusi, A. (2024). Assessing of Pedagogical Competency of Prospective Teachers in Teaching Arabic in Schools: Suitable or Not Suitable? *Journal of Ecohumanism*, 3(7), 2509–2518. <https://doi.org/10.62754/joe.v3i7.4653>
- Sudargini, Y., & Purwanto, A. (2020). the Effect of Teachers Pedagogic Competency on the Learning Outcomes of Students. *Journal of Industrial Engineering & Management Research ( Jiemar)*, 1(4), 2722–8878. <https://doi.org/10.7777/jiemar>
- Susanto, R., Rozali, Y. A., & Agustina, N. (2020). *Pedagogic Competence Development Model: Pedagogic Knowledge and Reflective Ability*. 422(Icope 2019), 19–23. <https://doi.org/10.2991/assehr.k.200323.082>
- Umi Hanifah, Syafi'i, & Binti Adam, Z. (2024). Developing Pre-Service Arabic Teachers' Competence in Implementing Kurikulum Merdeka through Curriculum Development Course. *LISANIA: Journal of Arabic Education and Literature*, 8(1), 1–19. <https://doi.org/10.18326/lisania.v8i1.1-19>
- Wahyuningsih, S., Zuhriyah, N., Fatimatuzzuhra, N., & Madjid, M. N. (2024). UPaya Arabic Language Teacher in the Development of Maharoh Qiro'Ah Students of Class Xi Religion Man 1 Bima City. *Al-Af'idah Jurnal Pendidikan Dan Pengajaran Bahasa Arab*, 8(1), 408–419. <https://doi.org/10.52266/al-afidah.v8i1.3181>
- Yip, S. Y. (2025). Transition into teaching: examining the pedagogical content knowledge (PCK) development of pre-service STEM career-change teachers. *Journal of Education for Teaching*, 51(3), 525–540. <https://doi.org/10.1080/02607476.2025.2471901>