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COMPARATIVE ANALYSIS OF INDONESIAN AND MALAYSIAN PRESERVICE TEACHERS' UNDERSTANDING OF TPACK AND EDUCATION FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

This study aims to compare preservice teachers' understanding of TPACK and ESD in Indonesia and Malaysia. The research uses comparative research, which compares the understanding of TPACK and ESD of science preservice teachers between Indonesia and Malaysia. The research sample comprised 164 preservice teachers from Indonesia and Malaysia, aged 23-25 years, selected using simple random sampling. A test method was used to measure TPACK understanding, and a questionnaire method was used to measure ESD understanding. The data analysis method used descriptive analysis of TPACK and ESD understanding profiles and comparative tests with Mann-Whitney. The results showed that Indonesian and Malaysian preservice teachers' TPACK and ESD understanding profiles were not much different. Indonesian preservice teachers have a slight advantage in overall TPACK understanding. Meanwhile, Malaysian preservice teachers scored slightly higher in ESD comprehension compared to Indonesia. There is a need for continuous development and professional support to strengthen preservice teachers' understanding of TPACK and ESD in an increasingly digitalized education context, which will ultimately support sustainable development goals more effectively.

Keywords: ESD; Indonesia; Malaysia; TPACK

INTRODUCTION

Education is one of the critical factors in a country's development. Qualified preservice teachers are essential to ensure effective and quality education. One of the critical things for preservice teachers is to have the ability to integrate technology into the learning process (Dinc, 2019). Technology can increase learning effectiveness and help preservice teachers prepare students to become members of society who are ready to face future challenges (Francom et al., 2021). Technology can redefine learning and prepare future teachers to help students develop 21st-century skills, but it is often underutilized in classrooms (Trust, 2017).

One of the frameworks used as a parameter for teachers' ability to use technology in the learning process is Technological Pedagogical Content Knowledge (TPACK) (Shafie et al., 2019). The Technological Pedagogical Content Knowledge (TPACK) framework, developed by Mishra and Koehler in 2006, addresses the need for effective technology integration in teaching (Koehler et al., 2015; Esposito & Moroney, 2020). TPACK emphasizes the interrelation of technological, pedagogical, and content knowledge, extending Shulman's concept of pedagogical content knowledge (Koehler et al., 2015). This framework has gained significant attention

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in educational research, with numerous studies published (Koh et al., 2015). TPACK provides a lens for examining teacher knowledge and preparation, as demonstrated in a study of preservice teachers' development of technological, pedagogical, and content knowledge (Martin et al., 2021). TPACK refers to the teacher's ability to integrate three interrelated aspects: technology, pedagogy, and content (Li et al., 2022).

TPACK consists of three main components: PK (Pedagogical Knowledge), Knowledge of teaching methods and practices; TK (Technological Knowledge), Knowledge of technology and how to use it; and CK (Content Knowledge), Knowledge of the subject matter being taught. The framework also includes a combination of all three components: PCK (Pedagogical Content Knowledge): Integration between pedagogy and content; TCK (Technological Content Knowledge): Integration between technology and content; TPK (Technological Pedagogical Knowledge): Integration between technology and pedagogy, and TPACK: Full integration of technology, pedagogy, and content.

Understanding TPACK is crucial for preservice teachers to effectively integrate technology into their teaching (L. Mercado et al., 2019; Nurhidayah & Suyanto, 2021; Sastria, 2023). Research shows that TPACK-focused courses can improve preservice teachers' technological knowledge and ability to use educational technology tools (Canbazoglu Bilici et al., 2016; Bunterm et al., 2018). However, preservice teachers may struggle to develop new knowledge bases due to limited pedagogical experience. Therefore, teacher education programs should provide opportunities for preservice teachers to develop their TPACK, emphasizing acquiring pedagogical content knowledge before integrating technology (Canbazoglu Bilici et al., 2016). Implementing TPACK-based activities, such as online inquiry projects, can enhance preservice teachers' understanding of the inquiry process, confidence in science concepts, and knowledge of Web 2.0 tools for scientific inquiry (Sheffield et al., 2015). ACK is an essential framework for preparing preservice science teachers to effectively use mobile technology in their teaching practices (Bunterm et al., 2018).

In addition, one of the goals of education is to create a competent and highly competitive generation to face future challenges (Taufik, 2020). An Education for Sustainable Development (ESD) approach is needed to create a competent and highly competitive generation. ESD is an educational approach that aims to shape sustainable thinking and action in everyday life through a learning process oriented toward sustainability issues (Adomßent et al., 2014). ESD is crucial to creating competent generations to address future challenges (Cebrián et al., 2020; Krishna et al., 2016). ESD aims to develop sustainability competencies by integrating ecological, social, and economic aspects into learning (Krishna et al., 2016; Glavič, 2020). Key issues in ESD include its scope, policy, cooperation, content pillars, teaching methodologies, and organizational aspects (Glavič, 2020).

ESD focuses on classroom learning and involves real experiences outside the classroom, such as visits to sustainability-related places, environmental projects, or cooperation with local communities and related institutions (Rey-Garcia & Mato-Santiso, 2020). Preservice teachers are important in achieving ESD goals. They will be the educators of the future and can play an essential role in creating a competent generation (Stratton et al., 2015). ESD is crucial for achieving the Sustainable Development Goals, with teachers playing a key role in its implementation (Kalsoom & Qureshi, 2021a). Preservice teachers often lack a comprehensive understanding of ESD, focusing primarily on environmental aspects while neglecting economic and social dimensions (Bezeljak et al., 2019). For this reason, teacher education programs are integrating ESD using various strategies and methods across different fields and countries (Raman et al., 2022).

Research related to measuring the TPACK understanding of preservice teachers has been conducted in Indonesia and Malaysia in the form of questionnaires and tests (Dewi et al., 2021, 2022; Habibi et al., 2020; Irwanto et al., 2022; A. Raman, 2014; Yanuarto et al., 2020) The research was conducted to find TPACK in each country, but a comparison of the two countries has not been performed. Comparative analysis needs to be conducted to determine the readiness of prospective teachers in Indonesia and Malaysia to become professional teachers. In addition, the results of this study can also be used by policymakers to assess whether existing policies support the development of technology-based and sustainability-oriented professional teachers. By knowing the strengths and weaknesses of the mastery of TPACK and ESD of preservice teachers, the data can be used to design training programs tailored to the needs of each country and according to national and global professional teacher standards.

Research related to ESD of preservice teachers in Indonesia (Atmaca, 2017; Eliyawati et

al., 2023; Hidayati, 2021; Kalsoom & Qureshi, 2021b; Mardian, 2023; Novidsa et al., 2020) and Malaysia (Liskinasih et al., 2020; Mahat & Idrus, 2016; Pasang & Mohd Najib, 2022; F. I. Raman et al., 2022) has also been done. However, no comparative analysis has been conducted. So, the novelty of this research is that it focuses on comparative analysis to find out how preservice teachers in Indonesia and Malaysia understand TPACK and ESD. The comparative analysis of the understanding of TPACK and ESD between preservice teachers in the two countries is intended to determine the readiness of preservice teachers in Indonesia and Malaysia to become professional teachers.

METHODS

The research method used is comparative, which compares the understanding of TPACK and ESD of prospective science teachers between Indonesia and Malaysia.

The research sample used was Teacher Professional Education Programme students in semester 2 (final). The research samples selected were 164 from Indonesia and 164 from Malaysia, aged 23-25 years. Participants in this timeframe were chosen because the preservice teachers had completed their undergraduate education and were currently taking teacher professional education. The sampling technique used was simple random sampling. Simple random sampling is an approach to randomly select a sample from a population (Aityan, 2022).

The data collection method consists of 2 types: the test method to measure the understanding of TPACK and the questionnaire method to measure the understanding of ESD. The TPACK test consists of 24 multiple-choice questions distributed in six TPACK components: PK, TK, TPK, TCK, PCK, and TPACK, adapted from Dewi et al. (2022). PK was not measured because the sample came from different disciplines. The TPACK understanding score was normalized to a maximum score of 100. The ESD questionnaire consisted of 24 statements based on four ESD indicators: Content Pedagogy, Inquiry, Professional Practice, Assessment and Evaluation, Professional Development, and Attitude, adapted from Eliyawati et al. (2023). The respondents filled out the questionnaire on a scale of 1 to 5. The questionnaire score was then normalized with a maximum score of 100.

Data analysis methods used descriptive analysis of TPACK and ESD understanding profiles and comparative tests with Mann-Whitney. The Mann-Whitney test was used to determine whether there was a significant difference between the scores of TPACK and ESD understanding of preservice teachers in Indonesia and Malaysia.

RESULTS AND DISCUSSION

Profile of TPACK Understanding in Indonesian and Malaysian Preservice Teachers

Based on the TPACK test results, the TPACK understanding score profiles of Indonesian and Malaysian preservice teachers are shown in Figure 1.

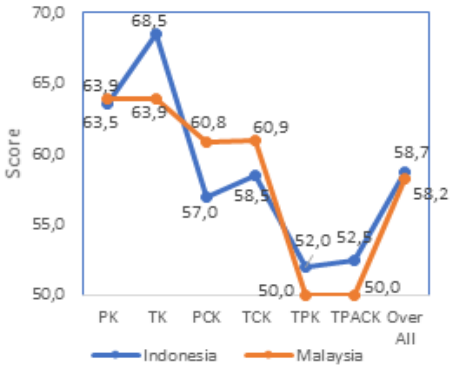

Figure 1. TPACK Understanding Profile of Indonesian and Malaysian Preservice Teachers

Figure 1 shows that the TPACK understanding profiles of Indonesian and Malaysian preservice teachers are not much different. The TPACK understanding profiles of Indonesian and Malaysian preservice teachers show significant similarities influenced by several factors.

1. Similarity of Education System

Indonesia and Malaysia have relatively similar education systems, especially regarding the structure and curriculum of teacher education. Both countries follow an education model influenced by colonial education (Othman, 2016). Amin et al. (2022) and Raya (2023) state that the education curriculum in Malaysia is heavily influenced by Western education, particularly from the UK. It is similar to Indonesia, which also has a colonial history that influences its education system.

Curricula in both countries adopt learning approaches based on global standards, including integrating technology in education, which forms the basis for developing TPACK. ASEAN countries are committed to improving educational technology and teacher education quality. Many member states have invested in ICT infrastructu-

re to bridge the digital divide and enhance ICT accessibility in education (Prajaknate, 2017). Indonesia and Malaysia have integrated ICT into their curricula, with teachers beginning to innovate and develop appropriate technologies for learning situations (Rizal et al., 2019). However, challenges remain, including insufficient teacher training in ICT skills and limited technological access despite investments (Prajaknate, 2017). ASEAN countries focus on improving network capabilities for online learning and implementing policies to strengthen technology equity (Machmud et al., 2021). Additionally, there is growing interest in establishing an international accreditation agency for teacher education institutions to enhance the quality of teaching, learning, and research in the region, although potential challenges include local acceptance and global acknowledgment (Muslim et al., 2023).

2. Use of Technology in Education

Indonesia and Malaysia have tried to integrate technology into their education systems. These efforts include improving technology infrastructure in schools, training teachers in the use of technology, and developing curricula that support the use of technology but face challenges in implementation.

While technology use influences teachers' morality, it does not directly impact their readiness for Industry 4.0 (Zulnaidi et al., 2024). Teachers in Indonesia generally possess ICT competencies aligned with UNESCO standards but lack access to facilities and training (Machmud et al., 2021). Factors affecting technology integration include teachers' skills, official training needs, and attitudes toward ICT (Champa et al., 2019). Despite positive trends in ICT adoption, challenges persist, such as limited infrastructure, inadequate teacher training, and regional digital divides (Rabani et al., 2023). There is a need for infrastructure development, educator training, transparent policies, and collaboration between the government, educational institutions, and the private sector to improve technology implementation in education (Rabani et al., 2023; Hakim et al., 2023).

3. Teacher Education Policies and Programmes

Education policies in Indonesia and Malaysia recognize the importance of improving teachers' competence in TPACK (Technological Pedagogical Content Knowledge) for 21st-century learning. In Indonesia, TPACK is integrated into professional teacher competencies, aligning with pedagogical, professional, personality, and social competencies (Akhwani, 2020). The Indonesian government supports TPACK implementation through courses and workshops for English language teachers to enhance their skills in technology integration (Rahmi & Ashadi, 2020). Similarly, Malaysia has shown potential for developing TPACK in its educational system (Zainal, 2016). A recent study in Malaysia revealed that teachers have a good understanding of TPACK after training, although there is room for improvement, particularly in keeping up with technological advancements in education (Hariyono et al., 2024).

Both countries also have student and teacher exchange programs and international collaborations focusing on improving TPACK competencies, contributing to their preservice teachers' shared understanding of TPACK. It also emphasizes the need for continuous teacher development programs to meet the demands of 21st-century learning based on TPACK.

4. Influence of Globalization in Education

Research suggests that globalization has influenced education systems in Indonesia and Malaysia, leading to some convergence and maintaining distinct national characteristics. Both countries emphasize divinity as a foundation for education and focus on developing knowledge, skills, and values to prepare competent citizens (Othman, 2016; Othman et al., 2019). Their curricula are designed to be integrated and dynamic, responding to global challenges (Othman, 2016). Assessment methods in both countries have shifted from solely exam-based to include evaluation of the learning process (Othman, 2016; Othman et al., 2019). Malaysia has reformed its higher education sector to increase global competitiveness and attract international students. However, while there is convergence in policy rhetoric and general objectives across countries, significant differences remain in educational structures and processes. It suggests that while globalization has driven some similarities, national education systems maintain their unique features.

5. Cultural and Social Influences

Cultural and social values in Indonesia and Malaysia also share significant similarities, which influence educational approaches and perceptions towards the use of technology in education. Both countries have strong views on the importance of education in national development, as well as collective values that support cooperation and shared learning, which are important elements in the development of TPACK.

Based on this research result, Indonesian preservice teachers' TPACK understanding ranges from 50.0 to 68.5, while Malaysian preservice teachers range from 52.0 to 63.9. In Indone-

sian prospective teachers, the highest score was obtained for the TK aspect, while in Malaysian prospective teachers, the highest aspect was for PK. The profile of understanding TK in Indonesia obtained a high score because the Education policy in Indonesia in the last five years is strengthening technological competence for teachers and preservice teachers (Wang et al., 2023).

Preservice teachers from Indonesia and Malaysia scored quite high and almost the same in the PK aspect, about 63.9 for Malaysia and 63.5 for Indonesia. This score suggests that both preservice teachers understand general teaching strategies and pedagogical approaches. Shulman (1986) emphasizes the importance of Pedagogical Knowledge as the foundation that enables teachers to plan, implement, and evaluate learning effectively.

A significant difference was seen in TK, where Malaysian preservice teachers scored higher (68.5) than Indonesian (63.9). It suggests that Malaysian preservice teachers are more familiar with or better trained in using technology in education than their Indonesian counterparts. Koehler et al. (2015) stated that technological knowledge is essential in modern education, where technology plays a key role in facilitating learning.

On the PCK aspect, Indonesian preservice teachers had a slightly higher score (60.8) than Malaysia (57.0). It indicates that Indonesian preservice teachers can better integrate pedagogical knowledge with the content of their teaching subjects. Shulman (1986) introduced the concept of PCK as Knowledge that enables teachers to transform subject matter into a form students can understand. This higher score indicates that Indonesian preservice teachers are more effective in combining pedagogical knowledge with content.

On TCK, Malaysian preservice teachers excelled with a score of 60.9 compared to Indonesian preservice teachers, who only achieved a score of 58.5. It shows that Malaysian preservice teachers better integrate technology with the taught content. TCK is important to understand how technology can be used to present and reinforce subject matter. The most significant difference was TCK, where Malaysian preservice teachers only scored 50.0, while Indonesia had a slightly higher score of 52.0.

It indicates challenges in integrating technology and pedagogy in both countries, with Malaysia showing more difficulty in this aspect. Koehler et al. (2015) emphasized the importance of continuous training for teachers to develop these skills. On the overall aspect of TPACK, which is the full integration of all components, it shows a relatively low score for both countries, with Indonesia's score slightly higher. Although preservice teachers know the individual components, incorporating them into teaching practice is a significant challenge. TPACK is a complex skill that requires deep understanding and sufficient practical experience to be applied effectively.

Overall, the score achieved by Indonesian preservice teachers was 58.7, slightly higher than Malaysia's score of 58.2. Although the difference is slight, it could indicate that Indonesian preservice teachers have a slight edge in overall TPACK understanding. Both countries must focus on developing the lacking competencies, particularly in integrating technology and pedagogy (TPK) and fully integrating the three TPACK components.

Comparative Analysis of TPACK Understanding in Indonesian and Malaysian Preservice Teachers

Based on the Mann-Whitney test, the comparative results of TPACK understanding of Indonesian and Malaysian preservice teachers are shown in Table 1.

Table 1. Mann Whitney Test Results of TPACK Understanding

ESD Aspects	Indonesia	Malaysia	P value
PK	63,5	63,9	0,012
TK	68,5	63,9	0,073
PCK	57,0	57,0	0,009
TCK	58,5	58,5	0,007
TPK	52,0	50,0	0,039
TPACK	52,5	50,0	0,036
Overall	58,7	58,2	0,023

A p-value of less than 0.05 indicates a significant difference between the 2 sample groups. However, in TK, the p-value of 0.073 is more significant than 0.05, indicating that this difference is not statistically significant. Although there is a difference in technological Knowledge between the two groups, the difference is not large enough to be considered significant. Both countries have received support from international organizations such as UNESCO, the World Bank, and ASEAN to strengthen technological capacity in education. This support includes technical assistance, training, and the development of policies that encourage the use of technology in education. UNESCO points out that internationally supported programs often contribute to uniformity in technology literacy levels across developing countries.

This support helps ensure that preservice teachers in Indonesia and Malaysia have equal access to technology and training, contributing to similar outcomes in the TK component.

Profile of ESD Understanding in Indonesian and Malaysian Prospective Teachers

Based on the ESD questionnaire results, the ESD comprehension score profiles of Indonesian and Malaysian preservice teachers are shown in Figure 2.

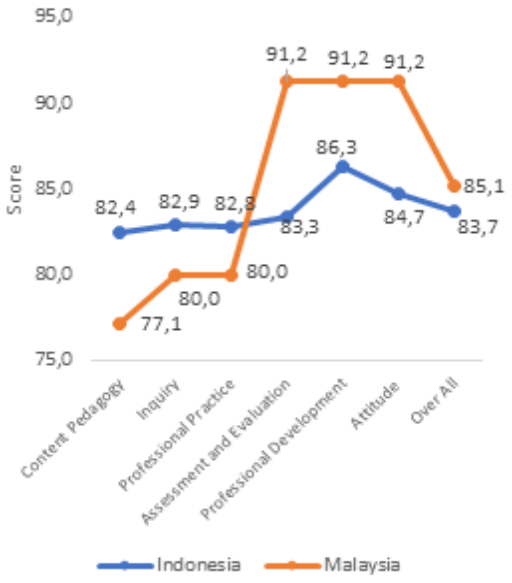

Figure 2. Profile of ESD Understanding of Indonesian and Malaysian Preservice Teachers

Preservice teachers in Indonesia scored slightly higher in the Content Pedagogy aspect than Malaysian teachers. Content Pedagogy includes the ability to integrate ESD content into effective pedagogy. A strong understanding of content is an important foundation for sustainability education, as it influences how teachers integrate sustainability issues into the curriculum. Higher scores in Indonesia suggest that preservice teachers are more successful in integrating ESD content into their pedagogical practice. Although sustainable education has not been explicitly included in Indonesia's primary and secondary education curriculum (Khoirunnisa & Firmansyah, 2024), Curriculum 2013 has attempted to integrate learning with learners' realities through a scientific approach (Pagga, 2020). Teacher competence is crucial in developing and implementing Education for Sustainable Development (ESD) (Nugroho et al., 2022; Pagga, 2020; Purwianingsih et al., 2022).

Indonesia also scored higher on Inquiry. Inquiry-based learning is an approach that encourages students to explore and discover Knowledge through a process of research and critical reflection. Inquiry-based learning has been identified as a practical approach to teaching science and developing an understanding of sustainability among preservice teachers in Indonesia. Multiple studies highlight its benefits in enhancing science concept knowledge, process skills, and scientific attitudes (Hikmawati, 2018; Jannah, 2020).

In terms of Professional Practice, Indonesia is slightly ahead of Malaysia. Professionalism in teaching practice that includes the application of ESD is key to producing education relevant to global challenges. Good professional practice in ESD requires teachers to not only master the theory but also apply it in complex and dynamic classroom situations. Darling-Hammond (2017) showed that teachers who have a strong professional understanding of ESD tend to be more effective in inspiring students to act in favor of sustainability.

Professional teachers must have four competencies: pedagogic, personality, professional, and attitudinal. In Education for Sustainable Development (ESD), teachers must develop specific competencies, including professional ESD, intrapersonal-ESD, and specific sustainability competencies (Md Zain & Aiyub, 2021). Teacher professionalism is crucial for improving educational quality and national development (Iroegbu & Ogbodo, 2019). It encompasses professional ethics, behavior, and accountability, essential for enhancing education systems and student success. Investing in teacher professional development is key to addressing educational challenges and meeting global needs (Purwantiningsih & Suharso, 2019). Countries like Japan have demonstrated the importance of professional teachers in solving national problems and advancing education. In Indonesia, improving teacher professionalism includes training programs such as Teacher Professional Education (Program Profesi Guru/PPG); this program aims to improve teachers' competencies and qualifications to become qualified professional teachers. Additionally, improving teacher welfare supports efforts to boost professionalism and educational quality.

In the assessment and evaluation, Malaysia scored much higher than Indonesia. This aspect covers the ability to design and implement assessments that assess students' understanding and skills in ESD. Assessment in ESD as a tool to monitor and evaluate the effectiveness of sustainability learning. Assessment is crucial in education, particularly Education for Sustainable Development (ESD). It bridges teaching and learning, providing essential feedback to impro-

ve instructional decisions and student outcomes. Effective assessment in ESD should align with its pedagogical approach, values, and principles (Gajparia et al., 2021). Teachers should employ various assessment strategies to measure competencies, including formative assessments and portfolios, while considering different levels of thinking in test design (Stăncescu, 2017). The assessment process affects teachers and students, emphasizing the importance of key principles such as authenticity, practicality, reliability, validity, and washback in foreign language teaching and learning (Tosuncuoglu, 2018). By integrating assessment throughout the educational process, teachers can classify and grade students, provide feedback, and adapt their teaching methods, ultimately enhancing scientific literacy and promoting reflection-oriented teaching (Stăncescu, 2017; Tosuncuoglu, 2018). The high score in Malaysia indicates that preservice teachers there are more skilled in using assessment to measure ESD learning outcomes.

In the professional development aspect, Malaysia again excelled. Malaysian preservice teachers have better access or more opportunities for ESD-focused professional development. Malaysia has placed significant emphasis on teacher professional development to improve the quality of education. The Ministry of Education actively encourages teachers to join important programs by offering incentives and potential promotions. High-performing schools in Malaysia have implemented effective teacher professional development programs, focusing on objectives, content, delivery methods, and evaluation (Ghani et al., 2016). These programs have been rated highly satisfactory by teachers in both high and low-performing schools (Ghani & Adnan, 2015). Implementing these programs has implications for enhancing teacher competencies and creating a professional learning culture (Ghani & Adnan, 2015). Continuous improvement of teacher competence is crucial, and schools should provide opportunities for teachers to attend professional development programs (Ghani et al., 2016; Ghani & Adnan, 2015).

Regarding Attitude, Malaysia scored higher, indicating that preservice teachers in Malaysia have a more positive attitude or commitment to ESD principles. Research on preservice teachers in Malaysia indicates generally positive attitudes towards environmental and inclusive education principles. Preservice teachers demonstrated positive attitudes toward teaching Environmental Education (EE) during practicum and integrating Information and Communication Technologies (ICT) in ESL classrooms. They also showed readiness to integrate Education for Sustainable Development (ESD) in biology teaching. Malaysia showed higher scores, indicating a more proactive attitude and greater acceptance of sustainability principles.

Figure 2 concluded that both countries have their strengths and weaknesses in ESD understanding. Indonesia excels in aspects related to pedagogy and inquiry, suggesting that preservice teachers there are more successful in integrating ESD principles into their teaching methods. Malaysia excelled in assessment, professional development, and attitude, suggesting that the Preservice teachers there are more skilled in evaluating ESD learning and have a more substantial commitment to sustainability principles.

Comparative Analysis of ESD Understanding in Indonesian and Malaysian Teacher Candidates

Based on the Mann-Whitney test, the comparative results of the understanding of ESD in Indonesian and Malaysian Preservice teachers are presented in Table 2.

Table 2. Mann Whitney Test Results of ESD Understanding

ESD Aspects	Indonesia	Malaysia	P value
Content Pedagogy	82,4	77,1	0,072
Inquiry	82,9	80,0	0,043
Professional Practice	82,8	80,0	0,039
Assessment and Evaluation	83,3	91,2	0,106
Professional Development	86,3	91,2	0,070
Attitude	84,7	91,2	0,082
Overall	83,7	85,1	0,037

A p-value of less than 0.05 indicates a significant difference between the two sample groups. The test results showed significant differences in some aspects, such as Inquiry and Professional Practice, where Indonesia excelled, while the differences in Assessment, Evaluation, and Attitude in Malaysia were insignificant, although Malaysia showed high scores. Comparative studies show similar levels of historical thinking skills among preservice teachers in both countries, suggesting a need for intensive training (Awang et al., 2016). Research on teacher efficacy indicates no significant overall differences between Indonesian and Malaysian teachers, except in student engagement (Wangid et al., 2020).

These findings underscore the importance of preparing preservice teachers for global competition and sustainable development through curriculum design and international experiences.

CONCLUSION

Indonesian preservice teachers have a slight edge in overall TPACK understanding. Although the difference is relatively small, it shows superiority in some aspects, such as PCK and TPACK. Meanwhile, Malaysian preservice teachers scored slightly higher in ESD comprehension than in Indonesia. This result suggests that, although there are advantages in some aspects of both countries, Malaysian preservice teachers have a stronger and more holistic understanding of ESD. These results suggest the need for continuous development and professional support to strengthen preservice teachers' TPACK and ESD understanding in an increasingly digitalized education context, which will ultimately support sustainable development goals more effectively.

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