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Teacher Competence in Designing Personalized Learning: A Systematic Literature Review

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ABSTRACT

This study aims to identify and analyze teacher competencies in designing personalized learning in the digital era. Using the Systematic Literature Review (SLR) method based on the PRISMA model, this research reviewed 35 scientific articles published between 2020 and 2025 related to teacher competence, pedagogical design, and personalized learning. Content analysis revealed four major dimensions of teacher competence: pedagogical competence, technological competence, assessment and reflective competence, and socio-emotional and innovative competence. The findings indicate that effective personalized learning requires the integration of understanding students' learning profiles, the use of adaptive and AI-based technologies, formative and reflective assessment practices, and the creation of empathetic and inclusive learning environments. The study implies that educational management plays a strategic role in developing continuous professional development policies to strengthen teachers' digital literacy, reflective capacity, and pedagogical innovation. It is recommended that teacher training programs and performance management systems be optimized to support the effective implementation of personalized learning in schools.

1. Introduction

The demand for innovative learning models in this era of disruption has become a global concern, along with the importance of preparing children for 21st-century competencies (Farisia et al., 2023). Toward the development of education in the 21st century, teachers are required to be able to deliver student-centered learning. The shift in the learning paradigm from conventional and uniform to learning that respects individual differences marks the emergence of the concept of personalized learning. This approach emphasizes the importance of adapting the learning process to the needs, interests, abilities, and learning styles of each student so that their potential can develop optimally (Hughey, 2020; Wahyuni & Haryanti, 2024).

In the context of Indonesian education, the concept of personalized learning aligns with the spirit of the Independent Curriculum, which positions students as active subjects in the learning process. Personalized learning utilizes a student-centered learning approach, emphasizing that students are not merely recipients of information, with teachers acting as facilitators (Bishop et al., 2020). In student-centered classrooms, students achieve core standards using a variety of learning methods and paces tailored to their needs and interests. Through this approach, students learn how to manage their learning process independently according to their unique style (Grant & Basye, 2014). Personalized learning can increase student motivation and learning outcomes through curriculum adjustments and teaching methods tailored to individual needs (Iwan et al., 2026; Yusuf, 2024).

However, implementing personalized learning requires adequate teacher competency, not only in pedagogical aspects, but also in the use of digital technology, authentic assessment, and reflective and innovative skills (Grant & Basye, 2014; Rini & Lestari, 2025; Sitompul, 2022; Wati & Nurhasannah, 2024), and this certainly requires the support and role of the school principal (Azizah et al., 2026; Putra & Raharja, 2025). A competent teacher integrates multiple methods and digital tools to create interactive and pleasurable learning environments (Ayuningtyas & Ritonga, 2025). Teachers must be able to analyze student learning needs, design flexible strategies, and use technology as a tool to support personalized learning (Education Elements, 2018). Several previous studies have shown that teacher competency is a key factor in the successful implementation of personalized learning. Research findings emphasize the importance of teachers' role in optimizing student potential through personalized learning that supports character development and creativity (Jayanti et al., 2022; Wahdah, 2024). However, these research findings are scattered across various contexts, models, and theoretical frameworks. Few studies have systematically reviewed and synthesized research findings related to teacher competency in designing personalized learning, particularly within the last five years. This study is guided by two main research questions:

1. What topics or concepts are most frequently explored, as indicated by author keywords in these publications?
2. What competencies do teachers need to design personalized learning based on previous research?

In response to these questions, this study aims to identify, analyze, and synthesize research findings on teacher competencies in designing personalized learning published between 2020 and 2025. This approach is intended to provide a comprehensive overview of research trends, key thematic areas, and the evolution of relevant concepts within the field. Furthermore, the findings are expected to offer deeper insights into the essential dimensions of teacher competencies, including pedagogical, technological, and adaptive skills. Ultimately, this study seeks to inform the development of teacher professional development programs that are responsive, innovative, and aligned with the growing demand for adaptive and learner-centered educational practices in the digital era.

2. Methodology

This study employed a Systematic Literature Review (SLR) with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) model as the primary method. This approach aims to systematically and transparently review, select, and synthesize previous research findings to obtain a comprehensive overview of the topic under study (Kitchenham & Charters, 2007). The research data sources were scientific articles published in reputable national and international journals between 2020 and 2025. The articles were collected through the Google Scholar online database. The keywords used in the English search process included teacher competence, pedagogical design, and personalized learning. The keywords used in Indonesian were kompetensi guru, rancangan pembelajaran, and pembelajaran terpersonalisasi. The details of the inclusion and exclusion criteria are presented in Table 1 below.

Table 1. Inclusion Exclusion Criteria

Criteria	Inclusion	Exclusion
Year of publication	Articles from January 2020 – October 2025	Articles before 2020
Publication type	Article	Conference articles, books, reviews, etc.
Source type	Journal	Conference proceedings, book series, books, etc.
Language	English and Indonesian	Besides English and Indonesian
Content	Studies related to teacher competency in designing personalized learning	Unrelated studies

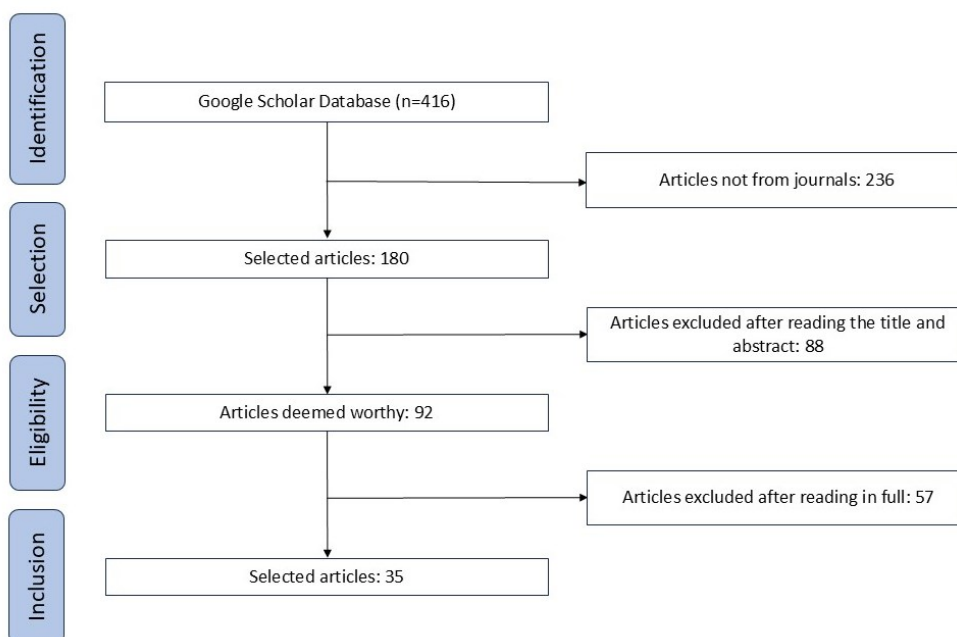


Figure 1. Research Design Flow

Based on figure 1, the article selection procedure involved four main stages: identification, initial screening, feasibility assessment, and final inclusion. In the identification stage, researchers collected articles from various sources based on predetermined keywords. The screening stage eliminated duplicate and non-journal articles, and selected relevant titles and abstracts. Furthermore, in the feasibility assessment stage, researchers thoroughly read the articles to ensure their relevance to the research focus. Articles that met all criteria were then selected as the final sources for analysis. Data analysis was conducted through content analysis. In this stage, researchers coded the articles' content to identify key themes related to teacher competency in designing personalized learning. Next, the categorization results were synthesized to identify general patterns and relationships between themes, thus obtaining a conceptual overview of the competencies required of teachers in the context of personalized learning.

To maintain the credibility and validity of the study results, the researchers re-examined the findings by comparing them with several similar articles and discussing them with education experts. The analysis results were also compared with the teacher competency framework formulated by UNESCO (2021) and the Directorate General of Teachers and Education Personnel, Ministry of Education, Culture, Research, and Technology (Kemendikbud, 2023). With this approach, this research is expected to produce a valid scientific synthesis that is beneficial for teacher professional development in the era of adaptive and personalized learning.

3. Results and Discussion

An article search was conducted in Google Scholar using a combination of keywords: ("*teacher competence*" or "*kompetensi guru*"), ("*pedagogical design*" or "*rancangan pembelajaran*"), and ("*personalized learning*" or "*pembelajaran terpersonalisasi*") for the years 2020–2025. The initial search yielded 416 articles, and after removing articles other than journals, the final result was 180. Further selection was based on title/abstract, leaving 92 articles. After full-text eligibility, 35 articles remained.

Keyword Co-occurrence Analysis

Bibliometric analysis using VOSviewer yielded six main clusters representing research focuses related to teacher competency in designing personalized learning. Each cluster reflects the theme and research direction trends over the past five years (2020–2025). This is illustrated in Figure 2 and Figure 3.

Cluster 1: Adaptive and Digital Pedagogy (6 items)

Key keywords in this cluster include adaptive learning, digital literacy, digital technology, gamification, students, and training. The red cluster indicates a focus on mastering digital literacy and implementing adaptive technology in teacher training. Research in this cluster emphasizes how teachers need to develop digital pedagogy and adapt to individual student needs through data-driven learning technologies and gamified learning environments.

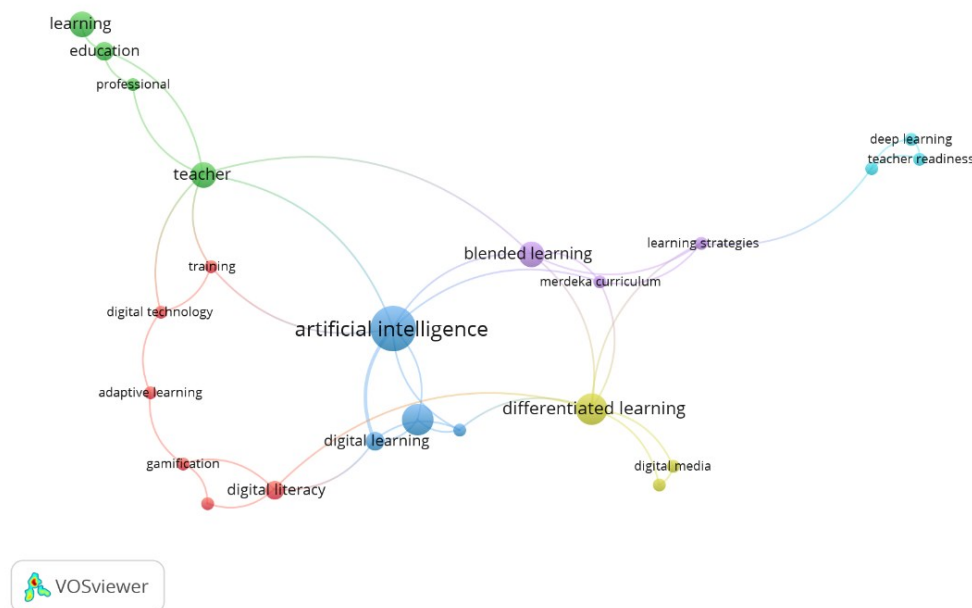


Figure 2. Keyword Network

Cluster 2: Teacher Professional Learning (4 items)

This green cluster consists of the keywords education, learning, professional, and teacher. Its main theme is teacher professional development through continuous learning. Research included in this cluster discusses strategies for improving teachers' pedagogical and professional competencies through professional learning communities and reflective practice approaches to support personalized classroom learning.

Cluster 3: Technology-Enhanced Learning and AI Integration (4 items)

The keywords appearing in this dark blue cluster are artificial intelligence, digital learning, educational technology, and learning effectiveness. This cluster illustrates a paradigm shift toward artificial intelligence (AI)-based learning. The focus is on utilizing intelligent technology to improve learning effectiveness and support teachers in analyzing individual student learning needs. The research findings in this cluster reinforce the importance of AI integration in developing teacher competencies in the digital age.

Cluster 4: Differentiated Learning and Teacher Competence (3 items)

Keywords in this cluster include differentiated learning, digital media, and teacher competence. The yellow cluster highlights teachers' ability to design differentiated learning strategies by utilizing digital media to tailor content, processes, and learning products to student characteristics. This theme is highly relevant to the concept of personalized learning because it demands flexible and innovative pedagogical competence.

Cluster 5: Blended Learning and Curriculum Innovation (3 items)

This purple cluster consists of blended learning, learning strategies, and the Merdeka curriculum. These results indicate a growing emphasis on implementing blended learning models within the context of the Merdeka curriculum in Indonesia. This approach is considered effective in increasing learning flexibility and allowing for personalization in the teaching and learning process.

Cluster 6: Teacher Readiness and Deep Learning (3 items)

Keywords included in this cluster are deep learning, teacher readiness, and technology. This light blue cluster emphasizes the importance of teacher readiness for technology integration and deep learning approaches. The focus is on teachers' mental, pedagogical, and technological readiness to implement deep and meaningful technology-based learning. The visual map (Figure 2) shows that artificial intelligence acts as a central node connecting several other clusters, such as digital literacy, blended learning, and teacher competence. This demonstrates that AI serves as a bridge between the technological, pedagogical, and professional dimensions of teachers in designing personalized learning. The interconnectedness between clusters reflects that personalized learning requires not only technical aspects but also ethical, curricular, and professional preparedness of teachers.

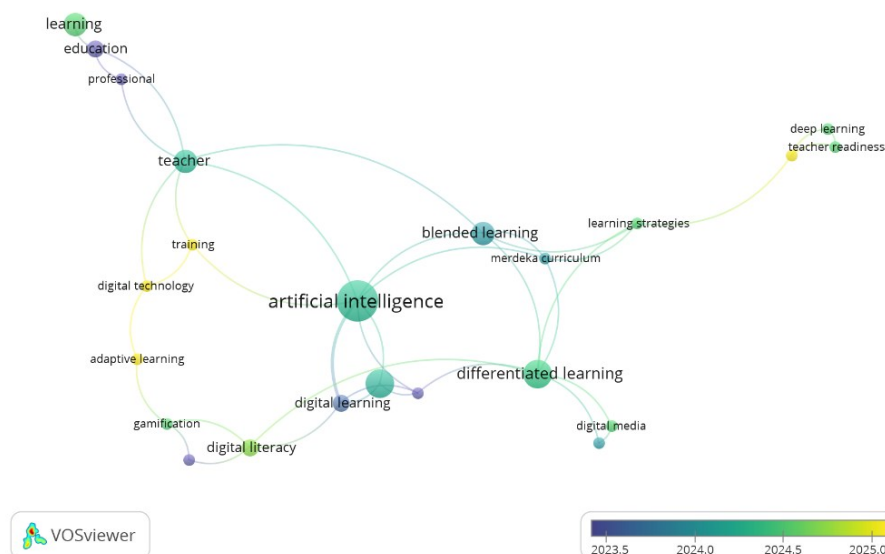


Figure 3. Keyword Network by Publication Year

As illustrated in Figure 3, the results of the overlay visualization analysis show the development of research on teacher competency in designing personalized learning from 2020 to 2025. In the initial period (around 2020–2023), the most widely studied themes focused on digital transformation and improving teachers' technological literacy, with keywords such as digital literacy, adaptive learning, and digital technology. Research issues in this phase emphasized the importance of teacher training and adaptive skills in the use of digital learning technology. Entering the 2023–2024 period, the research focus began to shift to the integration

of artificial intelligence (AI) and differentiated learning, demonstrating efforts to connect teachers' pedagogical competencies with the use of smart technology. Meanwhile, in the current period (2024–2025), the most prominent themes were teacher readiness, deep learning, blended learning, and the independent curriculum. This illustrates the direction of research that increasingly emphasizes teacher readiness in facing AI integration, the implementation of the Independent Curriculum, and adaptive learning designs that support personalized student learning processes. Thus, the current trend shows a shift in issues from mere digital literacy to strengthening teachers' capacity as designers of reflective and intelligent technology-based learning.

Content Analysis

Based on the results of an article search from Google Scholar, 35 articles were found related to the keywords "teacher competence, learning design, personalized learning." The teacher competence in designing personalized learning, which is arranged based on the main themes from the literature review, is as follows.

Table 3. Teacher Competency Analysis

Teacher Competency	Description	Source
Pedagogical Competence in Personalized Learning	Teachers' ability to understand students' learning profiles, differentiation of learning objectives and strategies	(Amelia et al., 2025; Aprilia, 2024; Arifin & Novita, 2025; Chifla-Villón et al., 2025; Fadya et al., 2025; Jamilah et al., 2025; Keristanti et al., 2025; Pratama Ningsih et al., 2025; Rahayu & Ilda, 2025; Rohana et al., 2024; Saidah et al., 2025; Tulak et al., 2024; Wahdah, 2024; Wahyuni & Haryanti, 2024; Wati & Nurhasannah, 2024)
Technological Competence	Ability in digital literacy and utilizing adaptive digital platforms, LMS, and AI to support personalization	(Arifin & Novita, 2025; Chifla-Villón et al., 2025; Harahap, 2025; Ilahi et al., 2025; Jakaria et al., 2025; Jamilah et al., 2025; Mana et al., 2025; Saleh et al., 2025; U, 2025; Wahyuni & Haryanti, 2024)
Assessment and Reflection Competencies	Ability to conduct diagnostic, formative, summative assessments and provide individual feedback	(Hutapea, 2024; Karepesina & Tinenti, 2025; Sari et al., 2025; Tullaily & Viktoria, 2025)
Social-Emotional and Innovative Competence	Empathy, flexibility, and the ability to design inclusive learning environments	(Afiqah et al., 2025; Ali & Baloch, 2025; Ansori et al., 2025; Farisia et al., 2023; Ikhlas & Murniati, 2025; Ilyas, 2022; Oktianah et al., 2025; Sharipova et al., 2025; Wahdah, 2024; Zakri et al., 2025)

The study results show that teacher competence in designing personalized learning requires the integration of interrelated pedagogical, technological, assessment, and socio-emotional aspects. First, pedagogical competence is the main foundation in implementing personalized learning. Teachers are required to be able to understand students' learning profiles, differentiate objectives, and adapt learning strategies to suit individual needs (Amelia et al., 2025; Arifin & Novita, 2025; Wahyuni & Haryanti, 2024). This is in line with the text by Education Elements (2018) that personalized learning can only be realized if teachers have a deep understanding of student characteristics and are able to adapt learning designs based on these differences. Thus, reflective and analytical abilities in understanding learning needs are key indicators of relevant pedagogical competence in the era of adaptive education.

Second, technological competence emerges as a key supporting pillar in the implementation of personalized learning. Teachers need strong digital literacy and the ability to utilize various adaptive learning platforms such as LMS, AI-based systems, and learning analytics tools to support personalization (Chifla-Villón et al., 2025; Harahap, 2025; Mana et al., 2025). This finding confirms the views of Mishra and Koehler (2006) within the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the importance of teachers' ability to synergistically integrate technology with pedagogical and content dimensions. In this context, technological competence is not merely the skill of using digital media, but also the ability to select and adapt relevant technology to individual students' needs.

Furthermore, assessment and reflection competencies are crucial elements in the personalized learning process. Teachers need to master diagnostic and formative assessments to identify the initial abilities, learning styles, and needs of each student (Hutapea, 2024; Sari et al., 2025). The individual feedback generated from these assessments forms the basis for adjusting subsequent learning activities. As Black and Wiliam (2009) state, formative assessments serve not only to measure achievement but also as a tool to facilitate continuous learning. Teachers' reflective abilities in interpreting assessment results also determine the effectiveness of the personalized strategies implemented.

Finally, socio-emotional and innovative competencies are also important dimensions that emphasize the role of teachers as empathetic, flexible, and well-being-oriented learning facilitators (Afiqah et al., 2025; Ilyas, 2022; Zakri et al., 2025). Teachers with these competencies are able to create a safe, inclusive, and diversity-supportive learning environment. Furthermore, an innovative attitude is needed to develop creative and responsive learning designs that address the dynamics of student needs. These findings align with Fullan and Langworthy's (2014) view that empathy-based and collaborative pedagogical innovation is key to building meaningful learning in the 21st century.

Overall, the results of this analysis indicate that teacher competency in personalized learning is multidimensional and intersecting. 21st-century teachers need to integrate pedagogical, technological, assessment, and socio-emotional aspects to

create truly adaptive and learner-centered learning. This underscores the need for teacher professional development programs aimed at enhancing reflective, digital, and socio-emotional capacities as prerequisites for effective personalized learning practices.

4. Conclusion

The results of this systematic review confirm that teacher competency in designing personalized learning is multidimensional and integrated. The four dimensions identified are pedagogy, technology, assessment and reflection, and socio-emotional and innovative. These competencies demonstrate that the success of personalized learning depends heavily on teachers' abilities to understand individual learning needs, adapt learning technology, and apply reflective assessment and an empathetic approach in teaching practice. Thus, 21st-century teachers are required not only to master conventional teaching skills but also to become adaptive learning designers who facilitate student diversity through a balanced integration of pedagogy and technology. From an educational management perspective, the findings of this study provide strategic implications for the management of human resources in education, particularly in teacher professional development. Educational institutions need to implement policies that support a continuous professional development system based on reflection and innovation, and strengthen teacher performance management through training mechanisms, academic supervision, and competency-based evaluation. The research recommendations emphasize the importance of collaboration between schools, the government, and training institutions in developing an adaptive, inclusive, and sustainable learning ecosystem, so that personalized learning can be optimally realized at various levels of education.

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