Systematic literature review: future skills of teachers

Nor Shamsidar Zainor, Mohd Isa Hamzah, Hafizhah Zulkifli
Faculty of Education, National University of Malaysia, Bangi, Malaysia

Article Info

ABSTRACT

This systematic literature review (SLR) investigates the essential skills future teachers require to succeed in a rapidly evolving educational landscape, influenced by technological advancements and shifting pedagogical paradigms. It highlights the misalignment between the skills possessed by teachers and the demands of 21st-century education, which can result in teaching becoming irrelevant. Employing a qualitative approach in accordance with preferred reporting items for systematic reviews and meta-analyses (PRISMA) standards, this study analyzed two primary databases—Web of Science (WoS) and Scopus—alongside Google Scholar, focusing on empirical journal articles published in either Malay or English from 2019 to 2023. From an initial pool of 55,362 articles, only 14 were selected for analysis. The qualitative findings identified four key themes: i) digital technology skills; ii) communication skills; iii) lifelong learning skills; and iv) socioemotional skills. These insights emphasize the urgent need for teacher training programs to integrate these competencies into their curricula. By addressing these gaps, educational stakeholders can better equip teachers to meet the demands of 21st-century classrooms, ultimately enhancing educational outcomes and fostering student success. Future research should further assess the effectiveness of these training programs on teaching performance and student achievement.

Corresponding Author:

Mohd Isa Hamzah
Faculty of Education, National University of Malaysia
Bangi, Selangor, Malaysia
Email: isa_hamzah@ukm.edu.my

1. INTRODUCTION

The future skills of teachers encompass a set of abilities and knowledge required to thrive in the increasingly complex educational landscape [1]–[3]. Rapid changes in technology and student needs require teachers to possess a diverse range of skills to ensure their teaching remains relevant and effective. The aim of this study is to understand the future skills required by teachers to address the challenges of modern education, as well as to identify the main objective, which is to analyze the necessary skill requirements and propose effective professional development programs. This study identifies the problem of misalignment between the skills possessed by teachers and the demands of 21st-century education, which can result in teaching becoming irrelevant. The impact of the findings from this study is to ensure that teachers are better prepared to face rapid changes and help students achieve success in an increasingly digital and dynamic world [4].

The current issue in 21st-century education is the lack of skills teachers need to align their teaching with technological advancements and contemporary social challenges. Although the role of teachers has become increasingly important as agents of change within the education system, many global education systems face a shortage of up-to-date skills in technology, creativity, critical thinking, and communication

[5]–[7]. The difference in teaching today compared to the past is significant, where teachers are no longer just knowledge transmitters, but also facilitators who integrate technology and social skills into their teaching. The solution proposed by this study is to recommend the development of more comprehensive professional development programs that are relevant to the rapid changes in technology and the evolving needs of today's students. With this approach, teachers will be better prepared to adapt to the increasingly dynamic challenges of global education [8]–[10].

Although some professional development programs have been introduced, most of these programs do not emphasize the digital technology, communication, lifelong learning, and socio-emotional skills needed for future teaching [11]. Therefore, this study aims to assess teachers' understanding of the required skills and identify gaps in existing professional development programs. The contribution of this study lies in its proposal to design a more effective professional development program that not only focuses on technical skills but also includes digital technology skills, communication skills, lifelong learning skills, and comprehensive socio-emotional skills, to ensure that teachers are equipped to meet the demands of future education. This approach will lead to more holistic training, enabling teachers to integrate digital technology, communication, lifelong learning, and socio-emotional skills more effectively into their teaching practices [12], [13].

Although systematic literature review (SLR) is recognized as a crucial step in research, there are several challenges that hinder its frequency and limit its scope. It is undeniable that studies such as [10], [11] address issues related to teacher skills. However, it should be noted that Gusenbauer and Haddaway [14] specifically discuss the formation of vocational skills for sports teachers, and this study does not investigate in-depth the relationship between the skills defined in the article and the demands and challenges related to changes in the educational landscape. Similarly, Soboleva *et al.* [10] touches on the characteristics of team-building skills for teachers, but this study does not thoroughly examine the adaptable learning environment needed to meet the requirements of teachers in acquiring the necessary future skills. The current focus on SLR on future teacher skills is inadequate due to its limitations, such as limited source coverage, lack of systematic methodology, and potential selective labelling. Therefore, SLR is crucial for providing a comprehensive overview of the research landscape [12].

This SLR was guided by the primary research question: how do future teachers' skills impact their effectiveness in enhancing student engagement in schools? This SLR aimed at examining future teacher skills. It contributes significantly to both practical and academic fields, enabling educators to apply various skills in their teaching practices and researchers to expand the scope of this study to enhance their knowledge.

The uniqueness of this study lies in its approach, which combines digital technology, communication, lifelong learning, and socio-emotional skills into a comprehensive framework. This approach emphasizes the importance of continuous professional development, which needs to be adapted alongside technological advancements and changes in student needs. By integrating social and cognitive skills, this study aims to empower teachers as agents of change capable of adapting to the increasingly complex needs of students. Through this study, it is hoped that more dynamic and effective solutions will be provided to improve the quality of education and develop teacher competencies better suited to the challenges of future education [8]–[10].

2.   METHOD

A qualitative approach following preferred reporting items for systematic reviews and meta-analyses (PRISMA) writing standards, which involves the steps of identification, selection, assessment, and synthesis of relevant studies. Strict selection criteria were established to ensure the quality and relevance of the articles. PRISMA, consisting of 27 items, is a publishing standard used in medicine and public health and remains relevant in social science research. Adhering to the PRISMA guidelines helps reduce bias and synthesize the SLR effectively, thus making a meaningful contribution to research [15]. For our article search, we utilized two main databases: Web of Science (WoS) and Scopus, along with Google Scholar for additional support. Defining the research questions (RQs) is a crucial step in the planning phase and is fundamental to any SLR, as it drives the entire review methodology. Given that our SLR aims to identify and analyze the current state of research, we employed the population, interest, and context (PICo) framework, a mnemonic designed for formulating RQs in qualitative research. PICo, with each component serving a specific purpose in question formulation.

- Population (P): this refers to the group or participants of interest in the study. It specifies who the research is focused on, such as a specific demographic, patient group, or community.
- Interest (I): this represents the main focus or phenomenon of interest in the study. It could be a particular experience, behavior, intervention, or issue that the research aims to explore or understand.

- Context (Co): this defines the setting, environment, or specific context in which the population and interest are situated. It might refer to geographical location, cultural or social settings, or any other relevant backdrop for the research.

Employing the PICo framework aids in organizing RQs in a clear and systematic manner by dissecting the essential elements of the study into three components. This method guarantees a focused research direction and well-defined questions, facilitating the process of locating relevant literature or designing the study. This research has formulated one research question.

2.1. Identification

The SLR begins with the identification of relevant keywords to search for related sources. Three main keywords were established: skill utilization, teaching, and future. To expand the search, synonyms, related words, and variations were sought. An online thesaurus, previous studies, the Scopus database, and expert discussions were used to ensure the keywords used were relevant and comprehensive. The results of this identification process can be referenced in Table 1.

Table 1. Search string formed for the purpose of article search/database reference

Source	Database search string
WoS (*n*=17,485)	TS= (("expertise" OR "competence" OR "proficiency" OR "ingenuity" OR "technique" OR "dexterity" OR "savvy") AND ("learn*" OR "coach*" OR "train*" OR "guidance" OR "tutor*" OR "instruction" OR "teaching") AND ("eventual" OR "forthcoming" OR "imminent" OR "impending" OR "planned" OR "prospective" OR "subsequent"))
Scopus (*n*=37,877)	TS= (("expertise" OR "competence" OR "proficiency" OR "ingenuity" OR "technique" OR "dexterity" OR "savvy") AND ("learn*" OR "coach*" OR "train*" OR "guidance" OR "tutor*" OR "instruction" OR "teaching") AND ("eventual" OR "forthcoming" OR "imminent" OR "impending" OR "planned" OR "prospective" OR "subsequent"))

Based on the selected keywords, the process of searching for articles in the SLR involved two main databases: WoS and Scopus, with Google Scholar as a supplementary resource. Each database has its own justification. WoS is recognized for its quality and accuracy in indexing high-quality journals [16] and provides detailed bibliometric information to assess the impact of studies. Scopus, on the other hand, is popular for its broad coverage [14], [17], and precise bibliometric analysis. Google Scholar offers open access to a wide range of resources, including journals and theses that may not be available in other databases [17]. However, it is important to note that Google Scholar may produce a larger number of less rigorously vetted results [18], necessitating careful screening. Overall, the combination of these three databases provides comprehensive and varied coverage for the SLR.

The search techniques used to find articles or references in WoS and Scopus involved advanced searching using basic functions such as Boolean operators (AND, OR), phrase searching, truncation, wildcard, and field codes (Table 1). Additionally, a manual search was conducted using handpicking methods in Google Scholar and the snowballing technique on the selected articles. A total of 17,485 articles were obtained from Scopus and 37,877 from WoS, and all these articles will undergo the second stage of the systematic search strategy, which is screening.

The handpicking method involves the manual selection of articles from search results, allowing researchers to assess the quality and relevance more carefully. This process begins with a search using keywords in Google Scholar, which displays a variety of sources such as journals and theses. Articles are evaluated by reading the abstracts to determine their suitability for the research topic before reading the full text, while considering factors such as the publisher, publication year, and reference status (peer-reviewed). Relevant and high-quality articles are saved for further analysis. Additionally, the snowballing method is used to find additional sources by examining the references in the selected articles and using the "cited by" function in Google Scholar. Each new article obtained through snowballing is re-evaluated using the handpicking process to ensure its relevance and quality.

2.2. Screening

A total of 55,362 articles obtained through the identification process will be screened in the screening phase. In this stage, each article is analyzed based on inclusion and exclusion criteria to ensure that only relevant and high-quality sources are selected for further research [18]. The first inclusion criterion is the publication year, with only articles from 2019 to 2023 considered, based on the concept of research maturity presented by Kraus *et al.* [19]. The second criterion focuses on journal articles, as these have undergone expert review before publication to ensure their quality and credibility. The third criterion emphasizes the importance of language; only articles in Malay and English are selected to ensure good comprehension.

The fourth inclusion criterion in this SLR is the requirement for empirical data. Only relevant empirical data will be included, while review articles will not be considered. This is because the main focus of the SLR is to identify and analyze the findings of previous studies. The fifth criterion emphasizes that the selected articles must present findings related to future teacher skills. Articles discussing other skills, such as technical skills, arts and creativity, and financial skills, will be excluded. This is important to ensure that all selected articles provide relevant findings for this SLR, as seen in Table 2. In the second phase of the screening process, a total of 54,718 articles were discarded for not meeting the established criteria, leaving 107 articles for the next stage. This step allows the researcher to provide a more in-depth and precise focus in the study. This detailed exclusion process, guided by the expertise of the researcher, is key to a better understanding of the research.

Table 2. Inclusion criteria used

Criterion	Inclusion criteria
Publication year	Five year (2019 to 2023)
Publication type	Journal article
Language type	Malay and English
Type of findings	Empirical in nature
Focus of findings	Data related to future teacher skills

2.3. Eligibility

Eligibility screening is the second process in the screening phase conducted on all articles that passed the initial screening stage in the SLR. The purpose is to assess the relevance of each article against the established research criteria. In this process, the title and abstract of each article are read in full. If the relevance of an article remains unclear after reviewing the title and abstract, the methodology, results, and discussion sections of the article will be examined in greater depth.

During this process, 93 articles were excluded for being irrelevant, leaving 15 relevant articles selected for the next stage of the study. The excluded articles did not focus on teacher skills but rather on engineering skills, project management, and other types such as review papers, proceedings papers, book chapters, editorial materials, meeting abstracts, articles published before 2019, and those written in languages other than English. This meticulous selection process ensures that only articles meeting the research criteria and focusing on teacher skills are continued, providing a solid foundation for further analysis and synthesis in the SLR. The systematic search process using PRISMA can be seen in Figure 1.
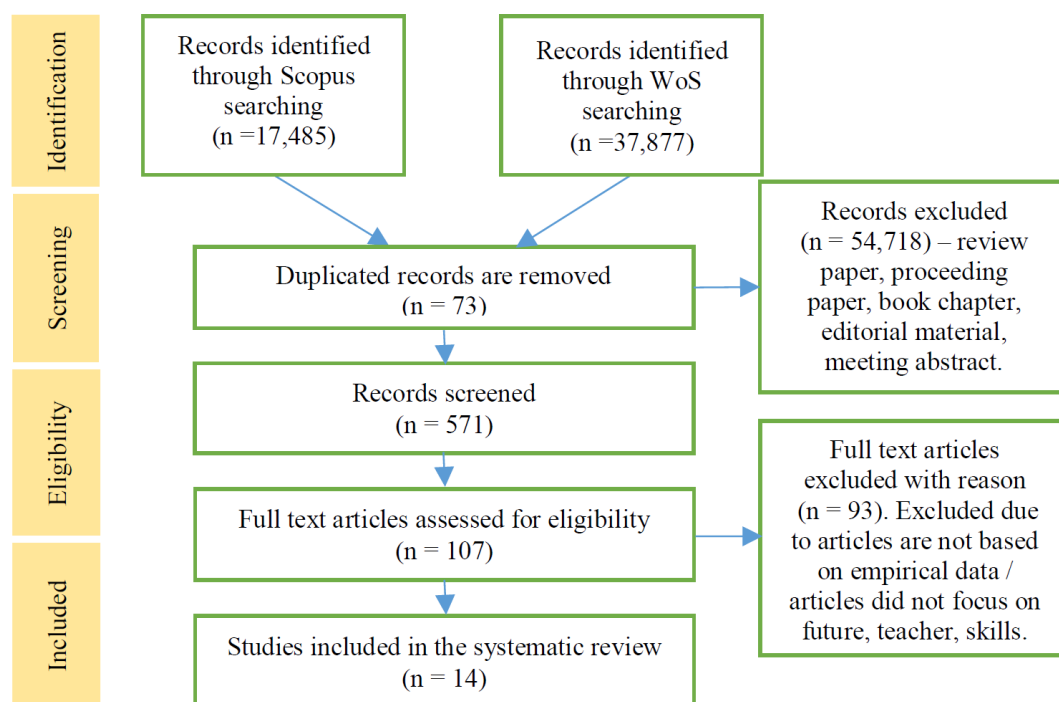

Figure 1. PRISMA flow diagram for systematic review [20]

2.4. Assessment of article

The article quality assessment process helps to evaluate the rigor of studies by minimizing bias and identifying methodological weaknesses [2], [21]. Three reviewers have been selected from among researchers to conduct this quality assessment. Collaboration efforts among reviewers are crucial to ensuring thorough and consistent evaluations. Given that SLR synthesizes articles from various types of studies (quantitative + qualitative + mixed methods), reviewers utilize the mixed method appraisal tool (MMAT) to assist them in assessing the study quality [22].

Each article or reference will be assessed based on two fundamental criteria and five specific criteria, which will be adapted to the study design of the researcher. The evaluation begins with the two basic criteria: the clarity of the research question and the ability of the data to answer the research question, before being classified according to the study design (qualitative, quantitative, or mixed methods). Evaluators provide a Yes or No answer for each criterion, and if there is any uncertainty, they will respond with cannot tell. Mutual agreement among the three evaluators is required for each assessment, and if consensus is not reached, they will seek a second opinion. Only articles that meet at least three out of five criteria will be considered high-quality and included in the SLR. This ensures that only relevant and high-quality sources are included in the analysis, as seen in Table 3. Therefore, out of the 15 articles assessed, 14 met at least three criteria, indicating high quality and relevance in the context of this study.

Table 3. Quality assessment table

No	Basic criteria/study criteria	[23]	[24]	[25]	[26]	[27]	[28]	[29]	[30]	[31]	[32]	[33]	[34]	[35]
1	Is the research question clearly stated?			N	N									
2	Can the obtained data answer the research question?			Y	Y									
	Qualitative criteria													
1	Is the qualitative approach used appropriate to answer the research question?			Y	Y									
2	Does the methodology of qualitative data collection used suffice to answer the research question?			C	Y									
3	Are the study findings derived from the data sufficient?			Y	Y									
4	Can the interpretation of study findings be supported by the data?			C	Y									
5	Is there continuity between the sources, collection, analysis, and interpretation of qualitative data?			Y	Y									
	Result			A	A									
	Basic criteria/study criteria													
1	Is the research question clearly stated?	N	N				N	Y				N	N	N
2	Can the obtained data answer the stated research question?	Y	Y				Y	Y				Y	Y	Y
	Quantitative criteria													
1	Is the sampling strategy used relevant to answer the research question?	Y	Y				Y	Y				Y	Y	Y
2	Does the selected sample represent the studied population?	Y	Y				Y	Y				Y	Y	Y
3	Are the measurements used appropriate?	Y	Y				Y	Y				Y	Y	Y
4	Is the risk of nonresponse bias low?	Y	Y				Y	Y				Y	Y	Y
5	Is the statistical analysis used appropriate to answer the research question?	Y	Y				Y	Y				Y	Y	Y
	Result	A	A				A	A				A	A	A
	Basic criteria/study criteria													
1	Is the research question clearly defined?					N			N	Y	N			
2	Can the obtained data effectively address the research question?					Y			Y	Y	Y			
	Mixed-methods criteria													
1	Is there a rationale for using mixed methods to address the research question?					Y			N	N	Y			
2	Can different study components be effectively integrated to address the research question?					Y			Y	Y	Y			
3	Are the combined qualitative and quantitative findings interpreted accurately?					Y			N	Y	N			
4	Are inconsistencies between qualitative and quantitative results adequately addressed?					Y			C	Y	Y			
5	Do the different study components adhere to quality criteria for each research design involved?					Y			C	Y	Y			
	Result					A			R	A	A			

Y: Yes; N: No; C: cannot tell; A: Accept; R: Reject

2.5. Data extraction and analysis

The next stage involves extracting data from the articles that have been evaluated for quality by two researchers. This SLR aims to explore prior research on the future skills required by teachers. As such, the data extraction will focus on three primary sections: the abstract, research outcomes, and discussion. If needed, other relevant sections will also be considered. The extracted data will then be structured into a table to aid

analysis. Since this SLR is an integrative study encompassing various research designs (quantitative, qualitative, and mixed methods), qualitative analysis is deemed the most suitable approach [2]. Different types of analysis can be applied in qualitative synthesis, and according to Noyes *et al.* [36], thematic analysis is one of the most effective methods for interpreting findings from diverse research designs. The aim of thematic analysis is to detect patterns based on similarities or connections found in the extracted study results.

To identify the specific themes, each finding is thoroughly analyzed. Findings exhibiting similarities or relationships are grouped together into datasets and assigned corresponding themes [37]. This process led to the identification of four main themes: i) digital technology skills; ii) communication skills; iii) lifelong learning skills; and iv) socio-emotional skills. Further examination of the findings within each theme resulted in the creation of subthemes, totaling sixteen subthemes. All the themes and subthemes are reviewed, leading to four main themes with four subthemes for each. Following this, a validation process is conducted by two experts: one specializing in SLR and the other in education.

Both experts confirm that the identified themes and subthemes are relevant and appropriate to the RQs, as shown in Table 4. Of the 14 articles analyzed, it was found that the previous studies utilized a variety of research methods concerning the future skills of teachers: 4 articles employed qualitative methods, 7 used quantitative methods [38], and 3 utilized mixed methods. This highlights the diverse approaches taken in studying teachers' future skills, underlining the importance of using multiple methodologies to gain a thorough understanding. By deeply examining these themes and subthemes, we can better understand the requirements and opportunities for enhancing teachers' skills in the context of future education, while also recognizing any limitations that may have existed in earlier studies.

Table 4. Classification of study design, categories, and themes

Study	Design Subtheme (if an)	Digital technology skill's				Communication skills			Research planning
		Knowledge	Attitude	Self-efficacy	Motivation	Knowledge	Attitude	Awareness	
1	QN	√	√	√	√	√	√	√	
2	QN	√	√						
3	QL	√							√
4	MX								
5	MX								

Study		Metacognitive awareness	Lifelong learning skills			Socio-emotional skills			
			Curiosity	Perseverance	Motivation	Optimism	Prosocial	Emotion	Empathy
1	QN								
2	QN	√	√	√	√				
3	QL								
4	MX					√	√	√	√
5	MX					√		√	

QN: quantitative; QL: qualitative; MIX: mix method

The selected articles for this systematic review revolve around the future skills of teachers. Supporting studies are shown in Table 3. Based on Table 5 [23]–[34], [39], [40] (see Appendix), 14 articles have been chosen from the Scopus and WoS databases. These databases were selected based on the quality of the articles, particularly in the field of education. The purpose of this study relates to the skills required by teachers to face challenges in future teaching.

3. RESULTS AND DISCUSSION

This section discusses the background of 14 selected articles/references in the SLR, with two published in 2023, four in 2022, four in 2021, three in 2020, and one in 2019. The selected articles/ references were published in various journals: Pegem Journal of Education and Instruction (2), Education Sciences (2), International Journal of Instruction (1), Australian Journal of Teacher Education (1), Technology, Knowledge, and Learning (1), International Journal of Higher Education (1), Educational Research in Information Technologies, Empirical Research in Vocational Education and Training (1), International Electronic Journal of Elementary Education (1), Learning, Culture, and Social Interaction (1), British Journal of Educational Technology (1), and Contemporary Educational Technology (1).

This SLR identifies four essential skills for future teachers: digital technology, communication, lifelong learning, and socio-emotional. These skills are crucial for quality and relevance in a dynamic educational environment. Researchers analyzed various sources and databases to identify emerging trends in teacher skills research. These skills are essential for a successful teaching career.

3.1. Digital technology skills

The study focuses on the importance of digital technological skills in the fourth industrial revolution [41], [42]. It highlights four subthemes: knowledge, attitude and discipline, self-efficacy, and motivation. Knowledge refers to the understanding of digital technologies [38]. Attitude reflects commitment to continuous learning and development [28], [32], while discipline refers to the ability to effectively manage technology use in teaching and learning [32]. High levels of self-efficacy encourage teachers to continue learning and grow as professionals, and help them overcome obstacles in digital learning [32]. Finally, motivation, as highly motivated teachers are more likely to continue honing their digital technology skills [28], [32], [43].

The study revealed that many teachers are not proficient in using digital technology for teaching and learning [28], [33], [44]. This is a trend that has been a burden for some teachers who prefer traditional methods, particularly older and more experienced teachers [32]. Many barriers hinder teachers from enhancing the use of digital technology, including support, time, and technology-related facilities [27], [38]. Therefore, the lack of digital technology skills among teachers can impede educational progress and limit student development [39], [44], [45]. The lack of proficiency in technology in teaching is causing a gap between traditional methods and students' needs in a digital society. Addressing this requires ongoing training and support for teachers to master new technologies and effectively use them in the teaching process.

3.2. Communication skills

Communication skills are essential for teachers and students to understand lessons [46], [47]. It highlights four subthemes: knowledge, attitude, awareness, and careful planning. First, knowledge of cultural diversity, languages, and students' backgrounds helps teachers use inclusive approaches [24]. Second, a courageous attitude helps overcome fear of failure, especially when conveying new ideas [24], [36]. Third, high self-awareness and environmental awareness prevent misunderstandings and conflicts, making teachers more effective communicators [24]. Lastly, careful planning is crucial for teachers to be better prepared for teaching, enhancing communication efficiency and skills, and fostering meaningful learning for students [25].

Ineffective communication skills among teachers hinder educational goals [24], as they struggle to adapt to job demands, understand students' psychology [25], recognize non-verbal cues, and manage interactions with cultural sensitivity. This leads to a lack of understanding of students' needs and backgrounds, particularly for those from diverse cultural contexts [32], which can be further complicated by physical exhaustion and difficulty in understanding students' psychology. Improving communication skills is crucial for creating an inclusive and supportive learning environment. It allows teachers to better understand students' needs and build stronger relationships in the classroom, thus preventing negative interactions and potentially undermining the learning process.

3.3. Lifelong learning skills

Lifelong learning is essential for teachers to adapt to societal and global changes [48]. There are four subthemes identified: metacognitive awareness, curiosity, perseverance, and motivation. These subthemes ensure that teachers remain relevant and adaptable to societal and global changes. The first subtheme, metacognitive awareness, helps teachers manage the learning process effectively, such as self-assessment and time management [35]. Second, curiosity drives teachers to seek information on educational and curriculum developments, helping to develop relevant curricula [32]. Third, perseverance fosters a habit of regular and consistent learning [2], allowing teachers to develop their skills gradually. Finally, motivation is crucial, as clear personal development goals guide teachers to continue learning and improving their skills [32].

Previous studies have shown that many teachers, particularly those teaching non-elective subjects, possess limited knowledge and low skills [35], [40]. High workloads, including administrative tasks, managing multiple classrooms, and meeting routine teaching demands, leave teachers with insufficient time and energy to engage in training and professional development [49]. Teachers often experience stress, loss of enthusiasm, and lack of motivation to improve their teaching quality due to administrative routines. The challenges of lifelong learning suggest that many teachers are trapped in administrative routines, hindering professional growth. Educational institutions should focus on professional development and support for teachers to continuously improve their skills and knowledge, thereby enhancing the overall quality of education.

3.4. Socioemotional skills

Socioemotional skills are essential for teachers' personal and professional well-being, focusing on building positive relationships with students [17], [50], [51]. There are four subthemes: optimism, prosocial behavior, emotions, and empathy. These skills are crucial for teachers to maintain a positive and inclusive learning environment. First, optimistic teachers approach challenges with a positive attitude, creating an

inclusive classroom environment [25], [35], [52]. Second, prosocial behavior strengthens teacher-student relationships [23], creating positive learning experiences and promoting collaboration. Third, emotional management enables teachers to respond effectively to students' feelings and cope with stress, maintaining calmness during teaching processes [23], [35]. Finally, empathy deepens teachers' understanding of students' needs and feelings, enhancing emotional relationships and teaching effectiveness [23].

In an increasingly complex and diverse educational landscape, teachers' socio-emotional skills are essential but often overlooked and deemed irrelevant. Teachers often lack adequate training in socio-emotional skills, which can lead to challenges in classroom management and student interactions [53], [54]. These skills can cause feelings of insecurity and collaboration difficulties [30], [31], [40]. Therefore, prioritizing socio-emotional skills in teacher training curricula is crucial to improving classroom management and positively interacting with students [55]. This will not only enhance students' learning experiences but also prepare teachers to face greater challenges in today's educational world. The study suggests that educational institutions should reconsider teacher preparation methods, emphasizing communication, technology, lifelong learning, and socioemotional abilities. This will equip teachers to handle contemporary education demands and create competitive students. Teachers and educational leaders should collaborate to identify challenges and provide effective solutions. Improving teacher abilities will benefit the overall education standard and create future-ready students.

4. CONCLUSION

The implications of these findings suggest that educational institutions need to change their teacher training approaches, focusing on four key skills: digital technology skills, communication skills, lifelong learning skills, and socio-emotional skills. The integration of digital skills into the curriculum is crucial for teachers to adapt to changes in education and meet the needs of students in a digital world, thereby preparing them to effectively use digital tools and improve student communication. Previous studies indicate that teachers with digital technology skills enhance student engagement, while socio-emotional skills improve teacher-student relationships and learning outcomes. Encouraging continuous training and professional development can help teachers overcome challenges and enhance their student relationships. The study suggests that enhancing socio-emotional skills in teachers can improve classroom management foster a positive learning environment, and enhance education quality. It also suggests further research into training programs' effectiveness and their impact on teacher-student relationships, thereby preparing teachers for future educational challenges and enhancing their competitiveness.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Nor Shamsidar Zainor	✓	✓	✓	✓	✓	✓		✓	✓	✓			✓	
Mohd Isa Hamzah		✓				✓		✓	✓	✓	✓	✓		
Hafizhah Zulkifli	✓		✓	✓			✓		✓		✓		✓	✓

C : **C**onceptualization	I : **I**nvestigation	Vi : **Vi**sualization
M : **M**ethodology	R : **R**esources	Su : **Su**pervision
So : **So**ftware	D : **D**ata Curation	P : **P**roject administration
Va : **Va**lidation	O : Writing - **O**riginal Draft	Fu : **Fu**nding acquisition
Fo : **Fo**rmal analysis	E : Writing - Review & **E**diting	

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest associated with this publication.

INFORMED CONSENT

All individuals who participated in this study provided their informed consent prior to inclusion.

ETHICAL APPROVAL

The study involving human participants was conducted in full compliance with applicable national regulations and institutional guidelines, adhering to the principles outlined in the Helsinki Declaration, and received approval from the institutional review board or an equivalent ethics committee of the authors.

DATA AVAILABILITY

The authors confirm that the data supporting the findings of this study are available within the article [and/or its supplementary materials].

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APPENDIX

Table 5. Summary of findings for the 14 selected SLR articles

Ref.	Methodology/sample	Results
[23]	The survey was conducted with 155 early childhood education students at two public universities in Germany.	The study revealed significant disparities in the anticipated integration of ICT between the two pre-service teachers, despite no significant correlations being found between their profiles, age, type of teaching program, or gender.
[24]	The survey was conducted among 399 English language teacher trainees at Atatürk University, Gazi University, and Pamukkale University.	The inventory, with a score of .925, consisted of 34 items and identified four key factors: attitudes, expertise, awareness, and competencies, based on exploratory factor analysis.
[25]	The study involved 74 international relations students from Kazan Federal University, observing course implementation, analyzing books, and reflecting on experiences through practical activities such as role-playing games and simulations.	The study reveals that incorporating simulation or role-play in learning significantly enhances students' communication abilities and academic achievements, shaping their teaching competencies and communication styles. It recommends structured and coordinated training for foreign language teachers, highlighting the importance of these findings for university instructors.
[39]	A survey was used to systematically examine and compare the opinions and perceptions of preschool teachers and prospective teachers regarding critical thinking skills.	The findings revealed that both current teachers and teacher trainees had similar perceptions of computational thinking (CT), emphasizing logical reasoning, problem-solving, algorithm use, coding/programming, mathematics, integrating technology in teaching, and computer usage. However, teachers placed greater emphasis on logical thinking, algorithm use, and coding/programming compared to prospective teachers. Moreover, teachers demonstrated higher confidence in applying CT concepts effectively.
[26]	The study involved interviews with dental assistants (DAs) and surveys from 51 participants across three different vocational school classes.	The paper evaluates the effectiveness of cognitive apprenticeship using video clips and pilot study findings, suggesting adjustments to meet the target audience's needs through a pretest-posttest-follow-up experimental design.
[27]	An analysis of documentary materials on novice teacher training and digital education in the context of historical and cultural heritage.	The study explores classroom practices and innovative research initiatives in Spain's social sciences didactics, focusing on the preservation of historical and cultural heritage in Primary Education educators' training, providing an overview and assessment.
[28]	A survey was conducted with 420 high school teachers in Malang Regency, Indonesia.	The study reveals that e-leadership significantly influences teachers' attitudes towards virtual learning platforms, positively affecting technology acceptance and self-efficacy, indicating the need for future research.
[29]	A survey was conducted with 154 teachers working in primary and secondary schools in Poland.	The study highlights the importance of teacher training and professional development programs in improving self-efficacy, digital competence, and peer support in predicting SEERT.
[30]	Mixed methods: observation, audio and video recordings, semi-structured interview transcripts, and surveys involving 350 students and 30 teachers in an urban school.	The study suggests that teachers' use of a non-judgmental, self-evaluative protocol can enhance their affective-reflective skills and teaching confidence. It also suggests reframing teacher professional learning from curriculum content to include emotional experiences and analysis, thereby boosting teacher confidence.
[31]	Mixed methods: validated instruments and descriptive statistical analysis, along with correlations, interviews, or content analysis.	Socio-emotional competence and self-efficacy in future secondary school teachers.
[32]	Ten reflective discussions were recorded through video, field notes, photos, and documentation from workshops and follow-up meetings with teachers. The study sample involved five researchers and nine teachers from two primary schools in the Swedish community.	Teachers' collaborative reflective discussions on technology-mediated teaching: envisioned and enacted transformative agency

Table 5. Summary of findings for the 14 selected SLR articles (*continued*)

Ref.	Methodology/sample	Results
[40]	A survey was conducted with 1,194 active teachers from Andalusia, Spain.	Teachers' digital competence to assist students with functional diversity: identification of factors through logistic regression methods
[33]	A survey was conducted with 238 prospective teachers studying at the faculty of education at a state university in Turkey.	The study found that prospective teachers embraced progressivism and reconstructionism, demonstrating competence in lifelong learning and teaching-learning processes, with gender influencing essentialism but not teaching-learning process competencies.
[34]	A survey was conducted with 834 prospective teachers from a public university in Turkey.	Structural equation modeling (SEM) indicates that self-directed learning abilities, metacognitive awareness, and 21st-century skills positively predict prospective teachers' preparedness for online learning.

BIOGRAPHIES OF AUTHORS

Nor Shamsidar Zainor 🆔 📇 SC ● is currently a Ph.D. candidate at the Faculty of Education, National University of Malaysia, Bangi, Selangor. In addition to her studies, she teaches at Secondary Religious School Bandar Baru Salak Tinggi in Sepang. She obtained a Diploma in Islamic Education in 2013 and a bachelor's degree in Al-Quran and Al-Sunnah with Communication in 2018 from the Selangor Islamic University (UIS). Her research interests include Islamic education and the Al-Quran. She can be contacted at email: p119732@siswa.ukm.edu.my.

Mohd Isa Hamzah 🆔 📇 SC ● is currently a lecturer at the Centre for Diversity Education Studies at the National University of Malaysia (UKM). He completed his master's degree at the University of Birmingham in 1995 and earned his Doctor of Philosophy in Education from the University of Warwick in 2008. His research interests include arts, applied arts, and Islamic education. He can be contacted at email: isa_hamzah@ukm.edu.my.

Hafizhah Zulkifli 🆔 📇 SC ● is a lecturer at the Centre for Community Education and Well-Being Studies at the National University of Malaysia (UKM). She earned her master's degree from UKM in 2011 and completed her Ph.D. at the International Islamic University Malaysia (IIUM) in 2019. Her research interests include Arts, applied arts, and education, specifically in Islamic education, philosophy of education, and measurement and evaluation. She can be contacted at email: hafizhah_zulkifli@ukm.edu.my.