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Lifelong learning practices of primary school teachers: a systematic literature review

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ABSTRACT

The practice of lifelong learning among teachers involves continuous efforts to enhance their knowledge, skills, and competencies through various activities. Previous studies have explored different practices such as reading, collaboration, participation in courses, culturalizing learning, conducting research, and digital learning. However, there is a lack of systematic reviews of these practices. This an article aims to fill this gap by conducting a systematic review of lifelong learning practices among primary school teachers for 5 years since 2019 until 2023. The study integrates various research designs and follows the ROSES publication standard. Articles were selected from databases including Scopus, Web of Science (WoS), and ERIC. Thematic analysis revealed four key concepts: self-learning, continuous training, knowledge integration, and digital networks. Future research can focus on examining the resilience of teachers from diverse backgrounds in adapting to changes in the education system. This study serves as a valuable reference for teachers to assess their own lifelong learning practices and facilitate transformative growth towards becoming knowledgeable educators.

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1. INTRODUCTION

The role of education evolves with human life and civilization, intrinsically connected to human development, crucial for addressing poverty, promoting health, ensuring sustainable livelihoods, and maintaining a sustainable environment [1]. In the 2013 UNESCO report, its goal is to strengthen the existing policies to establish a lifelong learning system. Yazıcı *et al.* [2] defines lifelong learning is described as involving cognitive, emotional, and behavioral changes throughout one's biological development from birth to death. Teachers must acknowledge lifelong learning as an ongoing process where they acquire knowledge, skills, and understanding to meet their professional requirements. Therefore, lifelong learning is a component that can enhance the development of teacher professionalism in future educational objective.

As a starting point for teachers to prepare themselves to deliver quality teaching, their teaching practices should conform to the current modernization, such as mastering digital technology to diversify their teaching methods. However, several research [3], [4] showed teachers' lack of skills in teaching, such as the different study background with current teaching options, lack of motivation, lack of skills, inability to fulfill student needs, difficulty in writing articles, and a lack of preparatory and in-service training. The research indicates a discrepancy between the current priorities and abilities of teachers regarding their professional development and real-world application [5]. In addition, their learning endeavors are aimed at bridging the dichotomy between theoretical knowledge and practical application, thereby enhancing the efficacy of

pedagogical practices. Additionally, it underscores the paramount significance of continuous practice-oriented learning for educators, ensuring their sustained relevance and efficacy over an extended duration. Derived from this issue, the researcher wants to investigate more broadly the need for lifelong learning practices for teachers so that it can help them improve their skills and be able to deliver their best to the students.

It cannot be denied that there are abundant of studies that discuss teaching practices, such as reading, collaborating and communicating, participation in courses, following learning programs, culturalizing learning, conducting research, and learning digitally [6], [7] as well as many others that touch on learning practices throughout the teachers' life. The proliferation of these numerous studies necessitates a comprehensive systematic literature review (SLR) to facilitate the aggregation and enhanced comprehension of their findings. In addition, although there is a lot of literature on lifelong learning practices of teachers at the moment, but it is very widespread to various levels of education such as high school, college and university. So, efforts to conduct a systematic review of these studies and delineate potential thematic patterns within the subject domain remain constrained, particularly regarding the procedural aspects of the review process, such as the methodologies for study identification, screening, and eligibility criteria establishment, which have yet to receive adequate attention and development.

While acknowledging the necessity for conducting a SLR, it is noteworthy that the volume of research available, as well as the breadth of studies encompassed, may not currently reach an extensive scale. However, it remains imperative to implement SLR despite the current limitations, as traditional literature reviews are susceptible to various issues including transference, author bias, recruitment bias, and publication bias. Many researchers tend to selectively include articles that align with their research objectives, potentially compromising the integrity and comprehensiveness of the review process [8].

This study conducts a SLR to identify gaps in knowledge regarding lifelong learning practices among primary school teachers. The focus on primary education is crucial for fostering comprehensive development and an inquisitive mindset in students. The main goal is to provide a detailed evaluation of existing research, enhancing understanding in this area and offering valuable insights for educators and researchers.

2. METHOD

2.1. Review protocol

To form this systematic literature review, the researcher had referred to the reporting standard for systematic evidence syntheses (ROSES) protocol review. The ROSES protocol review is a very appropriate reference because it helps the researcher develop a comprehensive and organized SLR [9]. Furthermore, Gusenbauer and Haddaway [9] also emphasizes the strength of ROSES based on its flexibility in terms of methodology. This SLR methodology is versatile and applicable to diverse types of analysis, including qualitative, quantitative, and integrative approaches.

Furthermore, its utility extends beyond the current field of study, making it adaptable to various other domains. Following the development of ROSES review protocol, this SLR commenced by formulating research questions tailored to the objectives. Subsequently, a meticulous systematic search strategy was developed to identify relevant literature. The review process involved evaluating the quality of the selected articles [10] and extracting pertinent data for analysis. By adhering to this structured approach, SLR ensures rigor and comprehensiveness in synthesizing existing knowledge.

The quality of each article needed to be determined first before being included in the review process. Finally, the selected articles underwent stages including data extraction and analysis. Data extraction aligned with the research question, while qualitative synthesis involved thematic analysis.

2.2. Formulation of the research question

The first step in developing this SLR involved creating suitable research questions. The research questions were formulated using mnemonics or tools like PICO, PICo, PICOM, PICOT, SPIDER, among others, known collectively as the research questions development tool (RQDT). The SLR's research question was derived from PICo. Mnemonics are used to form SLR research questions based on qualitative synthesis and can be used to obtain important aspects or elements that must be present in SLR research questions.

PICo stands for 'P' means population/problem, 'I' means interest, and 'Co' means context [11]. Drawing from this concept, the researcher focused on three key elements for the review: teachers (as the population), lifelong learning practices (as the area of interest), and the primary school setting (as the context). This approach led to the formulation of the research question: "What are the lifelong learning practices among primary school teachers?". The systematic searching process involves identification, screening, and eligibility [8], as shown in in Figure 1.

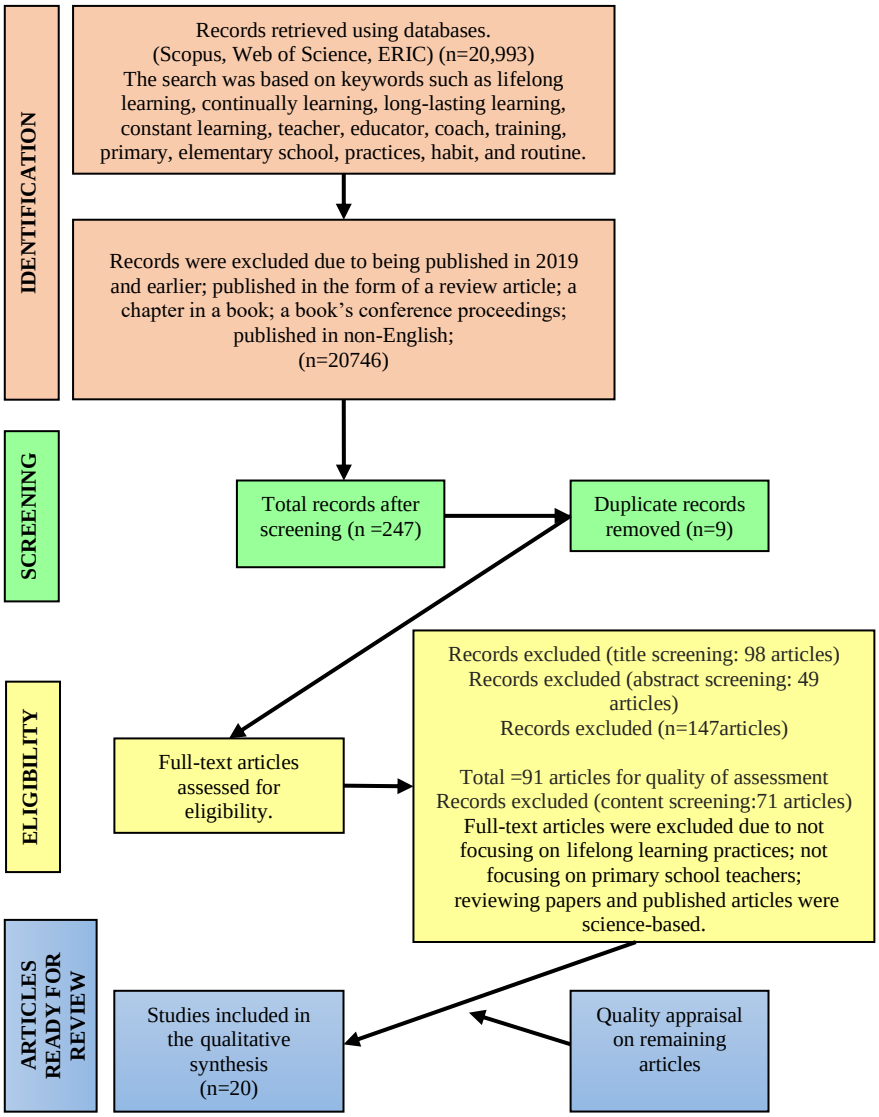

Figure 1. The flow diagram [8]

2.3. Systematic searching strategies

2.3.1. Identification

During the identification phase, researchers expand upon initial keywords, allowing for a broader retrieval of potential articles from databases. Understanding several fundamental concepts is essential before selecting the appropriate keywords [8]. Hence, selecting appropriate keywords for the search process is crucial to enhance the precision of articles referenced in SLR.

Three primary keywords were selected based on the research questions which are; lifelong learning practices, teachers, and primary schools. In order to broaden the range of usable keywords, synonyms, related terms, and variations of the main keywords were explored. This was achieved using an online thesaurus, reviewing keywords from past research, consulting indexing databases like Scopus and Web of Science (WoS), and seeking expert advice. The outcomes of this keyword identification are detailed in Table 1.

Utilizing the chosen keywords, the search for articles was carried out across three principal databases: WoS, Scopus, and ERIC. These databases were chosen for their multiple advantages. Initially, according to the research done by Gusenbauer and Haddaway [9], databases like WoS, Scopus, and ScienceDirect excel in offering extensive searches, more consistent results, and superior search capabilities compared to other databases. The ERIC database is particularly effective for conducting systematic reviews as it fulfills all essential performance criteria required for evidence synthesis. Martín-Martín *et al.* [12] in their study had highlighted the benefits of WoS and Scopus regarding quality control and organized indexing, in contrast to Google Scholar searches.

Table 1. The search string

Database	Search string
WoS	TS= (("lifelong learning" OR "continuing learning" OR "long-lasting learning' OR "enduring learning" OR "constant learning" OR "PSH" OR "LLL") AND ("teacher" OR "educator" OR "schoolteacher") AND ("practice*" OR "habit" OR "routine") AND ("primary school" OR "elementary school"))
Scopus	TITLE-ABS-KEY (("lifelong learning" OR "continuing learning" OR "long-lasting learning" OR "enduring learning" OR "constant learning" OR "PSH" OR "LLL") AND ("teacher" OR "educator" OR "schoolteacher") AND ("practice*" OR "habit" OR "routine") AND ("primary school" OR "elementary school"))
ERIC	(("lifelong learning" OR "continuing learning" OR "long-lasting learning" OR "enduring learning" OR "constant learning" OR "PSH" OR "LLL") AND ("teacher" OR "educator" OR "schoolteacher") AND ("practice*" OR "habit" OR "routine") AND ("primary school" OR "elementary school"))

*Means different forms of a word

The article search in databases like WoS, Scopus, and ERIC utilized advanced techniques, including Boolean operators (AND, OR), phrase searching, truncation, wild cards, and field codes, as outlined in Table 1. Using the specified keywords, databases, and search methods, we obtained 3,257 WoS articles, 1,130 Scopus articles, and 16,606 ERIC articles. These articles then progressed to the screening phase, the second stage of the systematic search strategy.

2.3.2. Screening

A total of 20,993 articles identified underwent a screening process, where criteria for inclusion or exclusion were established to select articles appropriate for the intended SLR [8]. The initial selection criterion for this SLR was the publication year, with only the most recent five-year range (2019 to 2023) considered. The choice of this time frame is grounded on various reasons and aligns with the concept of study maturity, as Kraus *et al*. [13] discusses, during which a significant number of related articles were found, providing a comprehensive review.

To ensure quality, this SLR limited its selection to journal articles, and for clarity in reading and comprehension, only those in English were chosen. Furthermore, the selection focused solely on articles containing relevant empirical data, excluding review articles to align with the SLR's goal of identifying primary findings from previous research, rather than reviewing them. An additional criterion for inclusion was the relevance of the findings. Articles were chosen based on their focus on primary school teachers' lifelong learning practices; irrelevant articles were excluded to ensure the SLR's relevance Table 2. After screening, 20,746 articles were discarded for not meeting criteria, leaving 238 for further review.

Table 2. The inclusion criteria

	Inclusion criteria
Year publication	Within the past 5 years (2019 to 2023)
Type publication	Journal article
Language	English
Types of finding	Empirical finding
Focus of finding	Data related to the practice of lifelong learning in primary school

2.3.3. Eligibility

The next process was to determine the eligibility of the remaining 238 articles selected from the screening process earlier. Eligibility involves a second screening to ensure the chosen articles are precise and pertinent to the intended SLR. This step involved reviewing the article's title and abstract. If clarity was not achieved, further examination of the methodology, results, and discussion sections was conducted. During this phase, 147 articles were excluded for reasons such as focusing on secondary school or vocational teachers, being duplicates, discussing entrepreneurship education, training for teacher candidates, teachers' opinions on science lab use, inaccessibility, or being scoping reviews. Consequently, 91 articles were deemed suitable for the subsequent quality assessment stage as presented in Figure 1.

2.3.4. Article quality assessment

Assessing the chosen articles for quality is crucial to reduce bias and identify potential methodological flaws [14]. Two evaluators were selected as evaluators for this assessment. Given the SLR's inclusion of diverse research designs (quantitative, qualitative, and mixed methods), they used the mixed methods appraisal tool (MMAT) for guidance during the evaluation [10]. Every article underwent evaluation using two basic criteria and five additional criteria tailored to the article's specific study design. The first step in this process was to evaluate the quality of the article based on two basic criteria, namely: i) Is the stated research question clear?; ii) Is the data obtained able to answer stated research questions? Articles meeting both criteria proceeded to

the next phase, where they were categorized by study design (qualitative, quantitative, or mixed methods) for further assessment based on five specific criteria. Evaluators had three response options for each criterion: "Yes", "No", or "Can't Tell" if the evaluation outcome was uncertain or unclear.

To assess the articles, consensus between the two evaluators was required, with a second opinion sought if they disagreed. Articles that satisfied a minimum of three out five criteria were considered high-quality and included in the SLR as shown in Table 3. Of the 91 articles assessed, 20 met this standard and were selected for the SLR, while the remaining 71 were excluded for not meeting the necessary criteria. This determination was based on a comprehensive review of each article's methodology, results, and discussion, noting discrepancies between the titles and abstracts and the actual content.

2.3.5. Data extraction and analysis

Data extraction from each selected article was performed by two researchers, focusing primarily on the abstract, study results, and discussion, to review findings on lifelong learning practices. Despite this focus, each article was fully read to understand the overall topic. Extracted data were organized into a table to aid analysis. Following extraction, the next phase involved data analysis, employing various methods suitable for qualitative synthesis.

Flemming *et al.* [15] stated that thematic analysis aims to uncover patterns in prior research by identifying similarities or connections among the findings extracted. In order to identify relevant themes, each extracted finding is individually reviewed to detect similarities or links [16], it will be placed in a data group. These groups are then assigned to an appropriate theme. The developed themes are connected to the original data and represent the whole dataset [16].

During the early stages of this process, three themes were developed and 13 sub-themes were identified. Next, all themes were re-examined with experts. After discussions, four main themes were developed, and one sub-theme was removed as it was less relevant to the research question. Then, for each theme identified, the researcher repeated the process, identifying 12 sub-themes in the process.

The thematic analysis of 22 chosen articles yielded four primary themes; self-learning, continuous training, integration of knowledge, and digital networks. For the self-learning theme, the identified sub-themes are action research, reading, personal learning, and access to information. For the continuous training theme, the identified sub-themes are training, short/long term courses, workshops, and seminars/forums/conferences.

Next, for the theme of knowledge integration, the sub-themes formed are collaboration and mentoring. The last theme is digital network, the sub-themes formed are digital learning and social media. The themes were validated by two experts, one in SLR and the other in teaching and learning. The experts concurred that the established main categories and themes align well with the research question as presented in Table 3.

Table 3. Classification of study design, categories, and themes

Research/ author	Design/ themes/ sub-themes	Self-learning				Continuous training				Integration of knowledge		Digital network	
		Action research	Reading	Personal learning	Access to information	Trai-ning	Courses	Work-shops	Seminar/forum /conferences	Collabo-ration	Mentoring	Digital learning	Social media
[17]	MX	/	/	/			/	/					
[18]	QL					/	/						
[19]	QL			/				/		/			
[20]	QL		/	/	/	/	/	/	/	/		/	
[21]	QL									/		/	/
[22]	MX									/		/	
[23]	QL	/		/			/	/	/	/	/		/
[24]	MX		/								/		
[25]	MX					/						/	/
[26]	QL	/					/			/	/		
[27]	MX											/	
[5]	QN						/						
[28]	QL	/		/						/			
[29]	QL									/			
[30]	QL									/			
[31]	QN											/	
[32]	QN	/							/				
[33]	MX									/			
[34]	MX					/							
[35]	QN				/			/	/	/		/	

QN=quantitative; QL=qualitative; MX=mixed methods

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Article background

Prior to delving into the subsequent section, this segment will delineate the background of selected articles included in the SLR. Among the 20 articles chosen, there were three publications in 2022, eight in 2021, three in 2020, and six in 2019. In terms of publication outlets, 16 articles appeared in journals indexed by WoS, three in Scopus-indexed journals, and one in the ERIC journal. The outcomes of the review revealed four primary thematic areas: self-directed learning, continuous professional development (CPD), knowledge integration, and digital networking, complemented by 12 sub-themes aimed at addressing the overarching research inquiry of the SLR: "What characterizes lifelong learning practices among primary school teachers?".

3.1.2. Major systematic literature review findings

a. Self-learning

The primary focus of this study revolves around self-learning, which entails teachers independently taking charge of their own professional development. Within this theme, action research emerges as a key sub-theme, demonstrating its efficacy in enhancing educational practices by addressing complex challenges. Action research empowers teachers to proactively tackle issues, encouraging them to experiment with teaching strategies and refine their expertise through hands-on exploration and testing.

Action research cannot be separated from teaching, and it gives it a higher level of quality [32]. In addition, action research studies run partially in tandem with other continuing education courses, such as science [26]. Through action research, teachers can develop alternative perspectives on their own practice [28]. Writing one's own practice is not only focused on specific content or subjects but also involves the inquiry process itself. According to Zajić *et al*. [32], in order to successfully implement action research, teachers must first master methodological knowledge.

The second sub-theme is related to reading activities. Efforts are being undertaken to enhance reading practices among educators within school settings, as evidenced by the discovery of collaborative endeavors in crafting guidance strategies aimed at fostering teachers' engagement with reading materials. These strategies involve suggesting pertinent professional resources, facilitating annotation and reflection processes, stimulating connections between theoretical frameworks and practical applications, and advocating for pedagogical experimentation [24]. In another study, it was found that teachers read books and articles to enhance skills and knowledge [20]. Furthermore, Sawatzki *et al*. [24] stated that this tendency resonates with most teachers' prevailing sentiment, indicating that they perceive reading as a valuable professional endeavor, thereby serving as a motivating factor for their sustained engagement in reading activities.

The third sub-theme is teachers' personal learning practices. The study showed that teachers take the initiative and study on their own to gain knowledge and competence by pursuing advanced degree programs [17], [29] and degree [19], [23]. However, according to Hallinger *et al*. [23], although teachers are motivated to learn on their own, learning at this level is time-consuming and expensive, causing many senior teachers and others to lose interest and neglect their desires.

In the meantime, this personal learning also opens up the opportunity to choose a new career in the future. Next, the study by Estévez *et al*. [20] showed that progressive teachers tend to choose personal learning that is less institutionalized and non-formal to meet their needs and interests. This phenomenon is underscored by the efficacy of the learning program, wherein educators fortify their collaborative skills and foster dialogues with peers, thereby enhancing their awareness of its benefits and assuming the role of critical allies not only to one another but also to their wider professional community [28].

The fourth sub-theme is access to information. Teachers take advantage of open-source materials [35]. Estévez *et al*. [20] findings showed that teachers also make efforts by doing web searches and referring to blogs related to education to get teaching materials. In addition, as well as to deepen their knowledge. Although there are many teachers who prefer formal activities, the data collected showed that self-learning and informal activities cannot be ruled out [27].

b. Continuous training

This section explores the theme of continuous training for teachers, which encompasses four sub-themes: training, long-term courses/short-term courses, workshops, and seminars/forums/conferences. Continuous training is essential throughout teachers' careers to enhance their knowledge and adaptability, especially considering that initial training often lacks depth for specific teaching contexts. The first sub-theme underscores the importance of ongoing training, which teachers prioritize to improve their skills and stay abreast of developments in education.

For example, deductive and practical methodology training, training in information and communication technology (ICT), cultural training, and training in educational psychology are important areas for teachers to participate in [18]. The findings presented by Estévez *et al*. [20] showed that teachers participate in various

trainings based on their needs and interests to vary teaching innovation, adapt to changes in the classroom, and be able to provide appropriate and comprehensive education to their students. Furthermore, educators expressed high satisfaction levels regarding both the training sessions and educational materials provided, affirming their intention to endorse online training programs like physical education teacher collaborative network (PETCoN), to their peers without hesitation [25].

Moreover, from a quantitative perspective, training has been demonstrated to elevate the overall effectiveness of teachers. Results indicate that community-based teacher training programs effectively empower educators with high competency scores to support their colleagues with lower scores [34]. Training initiatives can serve as a catalyst for motivating educators to actively engage in ongoing learning endeavors by fostering robust networking connections among peers and promoting collaborative work with colleagues [34].

The second sub-theme is related to the course. The study by Parra-Nieto *et al.* [18] found that continuous training was the most frequently chosen category among teachers, with additional participation in training focusing on didactic and practical methodology, ICT, cultural training, and educational psychology, albeit to a lesser extent. Essential training needs include ICT, practical methodology, cultural training, and educational psychology. Continuing education courses in the field of science and technology (a total of 20 weeks over three semesters) [5], [26], CPD effectively enhances teachers' self-efficacy in teaching nature of science (NOS) and their beliefs in the renewed approach.

On average, the school provides annual courses for teachers to attend, and they are optional because these take place during the teachers' working hours. Findings from Hallinger *et al*. [23] showed that variety of short-term courses are offered by the school or education department related to curriculum areas for teachers to add credit points for the confirmation of their continuing training certificate. Participation in training courses may be voluntary or mandated by school administrators or educational authorities, but administrators often find these courses inadequately address teachers' practical needs, leading to abstract and impractical knowledge. However, integrating new knowledge gained from continuing education courses with action research projects enables teachers to apply insights directly in their teaching practice, leading to observable improvements in student learning outcomes [26].

The third sub-theme is related to teachers' participation in workshops. The study conducted by Al-Mutawah *et al.* [35] showed that the workshops focus on learning new technology, which is a necessary component in teaching and learning. A refresher workshop is organized to fully utilize existing equipment that was less used during the pre-pandemic period. Additional workshops are conducted with specific emphasis on trauma-informed practices, the provision of socio-emotional support, strategies for promoting gross motor activities across various age groups, culturally responsive teaching methods, behavioral interventions including self-regulation techniques, and general pedagogical guidance for effective online teaching platforms. Several studies [20], [23] showed that teachers engage in continuous training workshops and the findings by Sepulveda-Escobar [17] showed that participation in workshops is the most engaging way for teachers to enhance quality their profession. The findings by Nolan and Molla [19] showed that teachers are free to find workshops to cover their lack of knowledge and that they are fully supported by administrators.

The fourth sub-theme is teachers' participation in seminars, conferences, and forums. Findings by several studies [20], [23] showed that teachers are participating in forums, seminars, and conferences. To ensure mastery of good pedagogical knowledge, Zajić *et al*. [32] suggested attending a seminar on pedagogical research methodology should be mandatory for teachers. This effort is proven by Zajić *et al*. [32] that attendance at seminars correlates positively with respondents' attitudes towards the importance of methodological knowledge. Proficiency in methodology is unequivocally essential for undertaking action research. Furthermore, professional development events such as seminars, workshops, and conferences enhance teachers' subject matter expertise and facilitate their understanding of contemporary pedagogical advancements in mathematics and science education [35].

c. Integration of knowledge theme

Within the third theme, centered on knowledge integration, the sub-theme of collaborative work encompasses the sharing of knowledge and practices to enhance outcomes. School coaches highlighted positive experiences with instructional coaching conducted during research projects, spanning both in-person and online settings [22]. The first sub-theme involves collaborative activities where teachers focus on enhancing student learning, their own knowledge, and continuous development of teaching practices within a professional learning community (PLC), facilitated by factors such as project relevance, connections to continuing education courses, university mentors, planning tools, and dedicated collaboration time.

The findings demonstrate that partnerships between schools and universities bolster teachers' collective cognitive engagement through the adoption of a collaborative model integrating both practical and theoretical elements within teacher teams [26]. Teachers express a desire for collaborative learning; however, teachers prefer formal channels (such as the same center where they teach or the department of education)

rather than self-learning mechanisms or non-formal and informal training [27]. Moreover, engaging in dialogue with peers and instructors regarding literature strengthens the perceived value of this experience among professionals, fostering collaborative understanding within their school environments [28].

In Australia, the average teacher age is 43.4 years. Teachers collaboratively engage in lesson observations, with all, including the observer, actively involved in coding, analyzing, and discussing. This collective intellectual engagement fosters a unified dedication to teaching [29]. The study found that participation in critical friends' groups (CFGs) enhances teachers' readiness to persevere in their profession by facilitating collaborative problem-solving related to classroom challenges, focusing on specific academic content, and strengthening professional relationships [30].

According to Zaalouk *et al*. [33], teachers have improved their technology skills, facilitating digital communication among themselves and with students. A significant portion of teachers communicate with collaborative group members frequently, fostering knowledge development. Enhanced knowledge boosts teachers' confidence and reduces anxiety, aiding in addressing challenges. Collaborative training encourages ongoing teacher learning through the development of robust networks and teamwork.

Collaboratively developing materials, experimenting with new teaching strategies, and observing peer classrooms enhance educator learning [35]. In the meantime, Estévez *et al*. [20] claimed that teachers also participate in organizations and associations, in addition to collaborating in organized innovation and research programs. Furthermore, teachers engage in joint reflection with peers, discussing and evaluating ideas for practice improvement and change [19] and sharing reflections with colleagues. The majority of teachers regard collaboration as the optimal approach.

Fostering trust and respect among colleagues is crucial for enabling idea and knowledge exchange [19]. The experience gained in the training session can stimulate discussions that enrich the entire team of teachers. In the other study, Gore and Rickards [29] found that collaboration between young and senior teachers is an effective way to bring colleagues together for mutual benefit and inspiration. Furthermore, the study revealed improved well-being among teachers in this group and are more involved in their work while continuing their profession.

Group work offers teachers the opportunity to work in a collaborative environment, allowing them to focus on overcoming dilemmas experienced in the classroom and on learning and teaching specific academic content. It has helped create strong professional bonds between teachers. The second sub-theme is mentoring. The results of the investigation revealed that educators are involved in mentoring [23]. It was found that teachers who receive mentoring can increase their ability to encourage reading and experimentation [24] and some schools even partner with universities [26].

d. Digital network

For digital network theme, the first sub-theme is related to teachers' digital learning practices. The findings indicate that students in primary education displayed better digital skills, likely reflecting their age and educational stage rather than teacher proficiency. These outcomes underscore the importance of enhancing teacher training programs to diversify and improve the use of digital tools in teaching [31]. In addition, teachers also use technology to build a blended learning environment. Al-Mutawah *et al.* [35] found that teachers use various platforms and technology tools for teaching. Furthermore, findings by Gorozidis *et al*. [25] showed that online community of practice (CoP) programs show great potential in enhancing teacher learning and practical knowledge.

However, the digital aspect of teachers' professional development is still emerging [27]. The second sub-theme concerns social media usage. According to Estévez *et al*. [20], teachers also gain knowledge through unplanned conversations on social networks. The study revealed that primary school teachers possess high digital competence, as evidenced by their frequent use of social networks like Twitter, ClassDojo, and Moodle [31]. In fact, Goodyear *et al*. [21] noted that social media is a form of contemporary professional development that can address clear challenges related to enhance teacher learning to improve teaching quality and student outcomes. Evidence suggests social networks like Facebook enhance teacher education and professional development [25].

3.2. Discussion

In the industrial revolution 4.0 era, teachers' roles extend beyond knowledge provision to include lifelong learning, leadership, resource instruction, network building, and communication facilitation, driven by rapid changes in all fields. This SLR reveals that many teachers proactively engage in self-learning to enhance their teaching effectiveness. The steps to carry out research continuously, plan, and take into account the target need to be implemented comprehensively to ensure effectiveness. Moreover, the complexity of teaching motivates some teachers to read in pursuit of professional growth, problem-solving, and innovation [24].

Personal learning customizes instruction, pacing, and content to meet each learner's unique needs, abilities, and interests. According to Hallinger *et al*. [23], in Vietnamese primary schools, teachers' engagement in activities varies by gender, age, experience, intellect, and family circumstances. Senior teachers favor in-school professional meetings over certification upgrades, citing time constraints for external professional development, unlike their male counterparts. Alternatively, they might focus on leading seminars, mentoring, research, and self-study, showcasing a mature and effective strategy for adult professional learning [36], [37].

Although formal training often fails to meet their expectations, the study's findings indicated that teachers regularly attend various courses organized by the education authorities [20]. These training activities are free and they are compatible with the teachers' working hours. Teachers supplement formal learning with non-formal activities (e.g., workshops, seminars, conferences, and collaborations) and informal interactions (e.g., spontaneous discussions with colleagues). Thus, comprehensive technology training is recommended for future educators to adeptly apply their knowledge across diverse educational contexts.

The need for continuous training and development comes from the idea that the initial training they received at university is not sufficient for them to be able to teach properly nowadays [20]. This has already been confirmed by various previous studies [38], [39]. This change means that one must accept that there is learning that is sometimes not seen, informal, invisible, and silent, but it allows teachers to acquire basic teaching skills [40]. Micro learning is an approach to learning that allows each individual to gain knowledge and use current technology and the internet according to need, appropriate time, and desired place.

In point of fact, teachers can decide their ideas and discuss some important issues through blogs and forums; create post lists, essays, and stories through wikis and portfolios. All these assignments are submitted in such a way as to form all the required skills [7]. This finding underscores the importance of teachers and students alike actively engaging in the conscious skill development in learning, potentially enhancing students' receptivity to new ideas and strategies [41]. However, the short-term workshop failed to enable teachers to link theoretical knowledge with classroom practice [30].

For the integration of knowledge, this study found that collaborative learning is a desired initiative but does not exist. This supports findings from previous studies [17], [42], this study highlights the need to understand the diverse learning requirements of teachers across disciplines to align educational initiatives with their professional needs. Local training enables teachers to develop professionally alongside peers, minimizing travel and fostering collaborative learning partnerships.

Teacher empowerment through local training is effective in countries with geographically dispersed educators, including those on isolated islands, as it facilitates organization and benefits teachers, students, parents, and schools alike [1]. The results indicate that school-university collaborations bolster teachers' collective identity by merging practical and theoretical models for team collaboration [26]. For the digital network aspect, there are several sub-competencies that are targeted by UNESCO in developing teacher competence, among them: i) aspects of understanding ICT in education; ii) ICT aspects for curriculum and assessment; iii) ICT aspects for pedagogical practice in schools; iv) ICT aspects for learning; v) ICT aspects for organizations; and vi) ICT aspects for teachers' self-development (UNESCO, 2011). The pandemic since 2020 has challenged teachers' digital competence [43].

The unforeseen global event has presented widespread challenges, including significant disruptions to the education sector. Notably, the epidemic led to the cessation of in-person learning in Spanish schools, necessitating a shift to online education. Consequently, there has been a pressing need for the development and implementation of effective strategies to enhance the teaching and learning process [44] and this entails the adaptation of ICT to provide educational guidance. Consequently, it is imperative for educational institutions to enhance teacher training and resource utilization to ensure effective teaching and diversify the educational tools employed. In addition, teacher growth can be achieved through dynamic and innovative courses and programs, such as through websites and social media [45].

The teachers' efforts are shown in the previous research [46], [47] that teachers at pre-school and primary school levels are actively involved with online tutorial teaching and extensive use of WhatsApp for teaching purposes. Besides, Guillén-Gámez *et al.* [48] demonstrated that professionals in this area possess advanced digital skills. These results reinforce the findings that all tutors offer assistance, including online, to facilitate the teaching and learning process across various educational levels [49]. It reinforces the concept that tutorial activities are structured and deliberate in their execution, as found by Chafiq and Talbi [50]. Similarly, mathematics educators are encouraged to foster and enhance a favorable outlook towards utilizing technology in both teaching and learning [51].

Teachers mentioned that they use technology to allow them to meet with students individually. There are also teachers who state that they use digital tools to track student progress and engage students. Undoubtedly, there are teachers filling their knowledge gaps by engaging with professional development and technology [33]. However, this result contradicts the findings by Yunus *et al*. [47] that it has been observed that primary school teachers show minimal engagement with social networks. The discussion emphasizes the

crucial role of lifelong learning for teachers, especially in the context of rapid changes in education due to factors like the fourth industrial revolution and COVID-19 pandemic. This implies a need for CPD programs that focus on enhancing teachers' digital competencies, pedagogical practices, and adaptability to changes in the education landscape.

In the future, the study of lifelong learning among teachers can be further expanded by looking at the teachers' resilience from various backgrounds in dealing with changes in the country's education system. Studies can also be done across various themes, such as the factors that encourage lifelong learning for teachers at school. In addition, future studies can look at the challenges and issues faced by teachers in an effort to make lifelong learning a routine in teachers' lives. This is because a study like this can be used as a guide by teachers in this era of globalization in finding references as well as guidance to improve their professionalism and the quality of their teaching. Besides, there is a need for research to investigate how initiatives for continuous education the teaching quality and student learning achievements. This could involve longitudinal studies or experimental research designs to assess the effectiveness of different professional development interventions in enhancing teaching practices and improving student achievement.

4. CONCLUSION

The implications of the findings suggest a multifaceted approach to enhancing teacher professional development, with a focus on self-directed learning, continuous training, integration of knowledge, and digital networking. Firstly, acknowledging the significance of self-learning practices, particularly through action research, reading activities, personal learning initiatives, and access to information, can empower teachers to proactively improve their pedagogical skills and adapt to evolving educational landscapes. Secondly, emphasizing the importance of continuous training, including long-term courses, workshops, seminars, and conferences, highlights the necessity for ongoing professional development to address evolving educational challenges and enhance teaching effectiveness. Additionally, fostering collaborative practices among teachers, both within schools and through external networks, can facilitate knowledge sharing, reflective dialogue, and instructional innovation, ultimately fostering a supportive professional community conducive to continuous growth and improvement. These findings also open up avenues for further research. Future studies could explore the effectiveness of specific self-learning strategies, such as action research or reading activities, in enhancing teaching practices and student outcomes. Investigating the impact of various forms of continuous training, including online courses, mentoring programs, and workshop participation, on teacher efficacy and student learning could provide valuable insights for designing targeted professional development interventions. Moreover, examining the dynamics of collaborative learning communities, both online and offline, and their influence on teacher motivation, instructional quality, and student engagement, could offer valuable guidance for fostering collaborative cultures within educational settings. Additionally, investigating digital networking tool integration, like social media platform and online communities of practice, in teacher professional development initiatives could shed light on innovative approaches to enhancing teacher learning and promoting educational innovation in the digital age.

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