International Journal of Evaluation and Research in Education (IJERE)
Vol. 12, No. 4, December 2023, pp. 2053~2062
ISSN: 2252-8822, DOI: 10.11591/ijere.v12i4.26087

Integrated teaching in primary schools: A systematic review of current practices, barriers, and future developments

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Article Info

Article history:

Received Nov 28, 2022
Revised Sep 11, 2023
Accepted Sep 27, 2023

Keywords:

Challenges
Integrated teaching
Primary education
Research directions
Trends

ABSTRACT

Recent years have seen a rise in the use of integrated teaching in many nations across the globe due to the vital role it plays in the delivery of primary education programs that focus on the growth of students' abilities. However, a comprehensive review of integrated classroom practices in elementary schools has yet to be conducted, making it difficult for interested readers to make education decisions about entering the sector or for established experts to keep up with the latest developments. To fill this gap, we performed a meta-analysis using the PRISMA procedure and a comprehensive literature search. Following the PRISMA guidelines, the study analyzed 24 publications on integrated teaching in primary school that appeared in Scopus and Google Scholar between 2014 and 2022. The study used text analysis and synthesis to highlight active nations, extracted keywords, drawing obstacles and challenges, and future research opportunities. The result reported 13 types of obstacles and challenges that need to be overcome in the long run. As such, five research directions were compiled based on prior publications, namely as teachers' training program, integrated teaching materials, integrated teaching models, school policies and other interventions, and others. Interested readers, prospective researchers and policymakers could benefit from these findings by tackling existing issues or investigating recommended research directions.

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1. INTRODUCTION

It is acknowledged that we are in the midst of the transition to the fourth industrial revolution, with big data, the internet of things, blockchain, and artificial intelligence gaining popularity in our everyday lives [1]–[3]. The transition from traditional labor-intensive working styles to modern tech-assisted methods has increased the competency requirements for employees [2], [4]–[6]. Consequently, prospective job-seekers must acquire the comprehensive skills as soon as possible in order to adapt and thrive in this competitive global environment [4], [5], particularly during the early development - when there is a growing demand for interdisciplinary instructions that encourage children to apply their knowledge to real-world problems and understand the relationships between subjects and fields [6], [7].

Integrated teaching is one of the approaches that has "re-emerged" lately due to the ever-growing education "reform" to meet the demand for "outcomes" based education [7]–[9]. This strategy presupposes that a problem be seen and examined from a variety of perspectives, and that knowledge is acquired from many disciplines [9], [10]. In this regard, integrated teaching is described as the planning and instruction of several disciplines, fields, and subject areas in order to assist students in getting a better understanding of a

particular topic [8], [11]. Although, there are many different terms that may imply integrated teaching such as interdisciplinary, multidisciplinary, integration, cross-curricular, cross-subject, or comprehension [7], [8]. This study uses the term integrated teaching to narrow down the scope, which focused on teaching perspectives and for consistency throughout the research

With the growing interest in integrated teaching in primary education, researchers have conducted studies on different subjects/topics such as curriculum design [9], [12]–[14], students' performance investigation [15], [16], teachers' perspectives [17]–[19], assessment [11]. For example, Cotič *et al.* [16] performed an empirical study to compare the problem-solving capabilities of children who received interdisciplinary integrated instruction to those who did not. Their results supported the integrated method when there was a considerable performance disparity between the two groups. In another work, Haapaniemi *et al.* [15] reported that a work style geared to foster collaborative thought and a sense of shared focus on the task at hand was valued in addition to more typically "practical" components like as computer proficiency. Participating students indicated that collaborative techniques and the teacher's pedagogical choices in supplying resources and organizing the tasks were the most beneficial.

Much more research has been conducted to demonstrate the advantages of integrated teaching; however, past publications were primarily ascribed to descriptive analysis or qualitative research [8], [20] rather than relying on solid theoretical underpinning [7], [18]. One potential reason for the absence of a pedagogical framework is that instructors were previously assigned to work with single structures and did not get enough assistance for adopting interdisciplinary instruction [13]. To overcome, Mård and Hilli [7] proposed a general didactics framework as a guideline for teachers in planning, executing and reflecting multidisciplinary teaching approach. Table 1 highlights some recent integrated teaching publications classified into six tentative areas.

Table 1 A brief summary of integrated-learning-related journal papers published between 2014 and 2022

Research areas	Contributors
Investigation of the design of cohesive instructional resources	[11], [12], [14], [21]
The role of teachers' knowledge, attitude, and skills in interdisciplinary scientific education	[13], [17], [22], [23]
Exploring methods of cross-disciplinary instruction (math, physical education, music, science, language, ethics)	[24]–[29]
Studying methods for incorporating cultural and real-world content into the classroom	[16], [30], [31]
Understanding how to use ICT in the classroom	[5], [32]–[34]
Examining the implementation of science, technology, engineering, art, and mathematics (STEAM) in the classroom	[6], [22], [35]–[37]

Table 1 provides an indication of the heterogeneous integrated teaching themes found in primary schools. While this diversity of subject area may be attractive for academic researchers, it may be challenging for prospective scholars to the field to rapidly acquire proficient in the body of knowledge required to examine trending topics, address urgent issues, and uncover interesting new research avenues. Even though there have been several studies and meta-analyses conducted in higher education settings to address the aforementioned problems, comparable research in elementary schools is hardly found, making our work a novel contribution. Thus, the purpose of this study is to provide a comprehensive review of contemporary integrated teaching publications in primary education with respect to current trends, challenges, and research directions. More specifically, this article attempts to answer the following research questions: i) What are the recent research methods and trending topics of integrated teaching in primary education? (RQ1); ii) To what extent does integrated teaching provide obstacles or problems in elementary school settings? (RQ2); iii) To what extent does integrated teaching need further research in the realm of primary education? (RQ3).

Answering these gaps in the literature is crucial to science, technology, engineering and mathematics (STEM) education, especially in primary schools. First, it enables interested scholars to keep up of the area by scanning the highlights rather of reading every document. Second, it enables new researchers to examine contemporary topics and benefit from earlier experience via the lens of other researchers. Thirdly, it facilitates the selection of future research directions based on suggestions. In addition, it gives indicators for practitioners and policymakers to support their strategies in terms of plan and budget for the "re-emerged" growth of integrated teaching research in primary education.

2. RESEARCH METHOD

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) were utilized for this study, as it incorporates a review of previous articles on integrated teaching [38]. The intention of the Prisma guideline is to aid researchers in the reporting of scientific reviews and meta-analyses. This is a list of

evidence-based characteristics for systems assessment reports that assist reviewers in explaining why the review was conducted and what the authors achieved [38]. It has previously been employed to achieve comparable research objectives [3], [39]–[41].

2.1. Source selection

The document repository was constructed with the input from Scopus, Google Scholar, IEEE Xplore, Wiley Online Library, and ScienceDirect. It includes titles, abstracts, and keyword lists. These databases were regarded as pertinent and reputable resources for study in the realm of the educational sciences [3], [39]–[41].

2.2. Search criteria

To add articles to our database, all two search-related criteria need to be met. The topic search term: at least one term related to "integrated teaching" must appear in the article title, abstract, or author keyword (integrated teaching, STEM). The scope search term: at least one of "primary education" OR "elementary education" OR "basic education" was included in the article's title, abstract, or keyword. Using the criteria, 3,400 articles were identified, including 763 Scopus articles, 1,330 Google Scholar articles, 76 IEEE Xplore items, 581 ScienceDirect articles, and 650 Wiley Online Library papers. The collection was compiled between August 15, 2022, and August 29, 2022.

2.3. Eligibility assessment

To evaluate the admissibility of the obtained papers, we examined their titles and abstracts against the entry requirements. In the corpus, only articles that match the following criteria were kept peer reviewed: Articles in indexed databases that have been peer reviewed. Due to the dependability of peer-reviewed journals and the stringent peer review procedures, only publications from these databases will be evaluated for this research. For the topics, only articles suited for integrated teaching in elementary school were selected. In terms of language, all the chosen papers were written in English with a timeframe of publication between 2014 and 2022. Schematically shown in Figure 1 is the progression of data during a PRISMA-style systematic review. There were 3,400 articles located throughout all databases. Duplicates were weeded out by matching titles. We manually review every paper to filter out irrelevant content. Consequently, 3,033 papers were deemed unsuitable for inclusion. That leaves 367 articles whose entire texts may still be retrieved. It turns out that 12 of the remaining articles are inaccessible. Upon reviewing the eligibility report, the authors decided to exclude 331 studies. Ultimately, both Scopus and Google Scholar were used to compile the 24 publications included in the research.

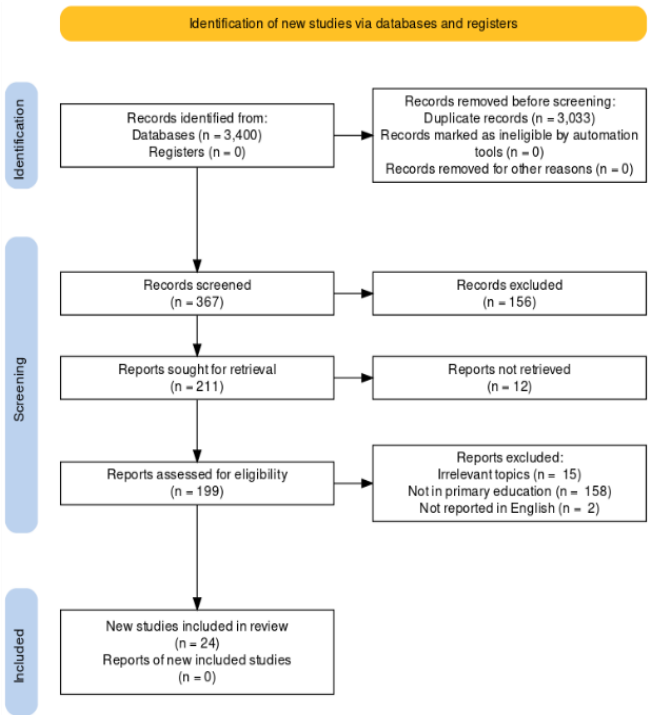

Figure 1. Research flowcharts that depict the progression of data gathering at each stage

2.4. Data coding and analysis

MAXQDA software was utilized to extract and coding data [42]. This application was known for its ability to gather, categorize, and analyze qualitative or unstructured data such as interviews, reviews, articles, material from social media platforms, and online information [43]. Articles on integrated education are assigned codes that comprise the year of publication, the nation of the author, the title, keywords, scientific methods, challenges, and research directions.

3. RESULTS AND DISCUSSION

3.1. What are the recent research methods and trending topics of integrated teaching in primary education? (RQ1)

Figure 2 depicts the number of papers associated with integrated teaching in primary school published between 2014 and 2022, as shown by the timeline. In general, the number of articles tends to rise, with 2021 being the peak year. From 2014 through 2017, just one paper per year was published, demonstrating that this matter received little attention in the period. During the time span of 2018-2022, however, the number of articles climbed dramatically, with a peak in 2019 (there were 5 articles), a decline in 2020, and a rapid rise in 2021 (9 articles). In the most recent two-year period (2021-2022), 12 papers were published, representing fifty percent of the total of 24 articles. There was a precipitous drop in the total number of articles published in the year 2020. This reduction may have been caused by the emergence of the COVID-19 epidemic, which occurred at a time when schools were closed, and teachers were preoccupied with figuring out how to resume regular instruction early.

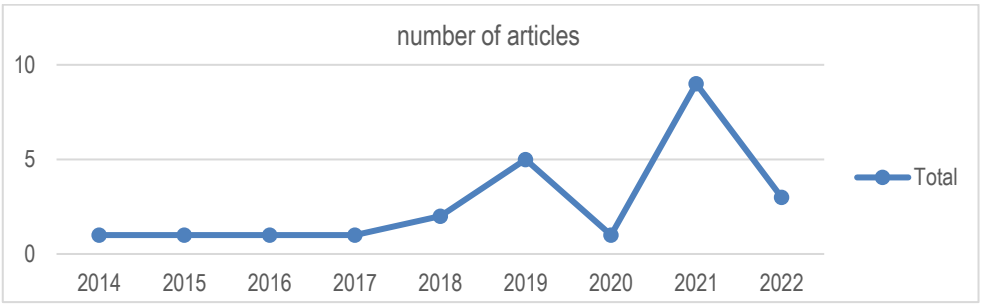

Figure 2. The trend of integrated teaching in primary education from 2014 to 2022

In terms of geographic distribution of research, Finland, Vietnam, and Turkey are the three nations with the most interest in integrated teaching studies (out of a total of 17 countries). To be more specific, researchers from Finland, Vietnam, and Turkey have each written at least two articles on integrated teaching in primary school, accounting for a quarter of the total 24 publications. The remaining 14 nations are represented by a single document pertaining to integrated teaching in elementary education as shown in Figure 3.

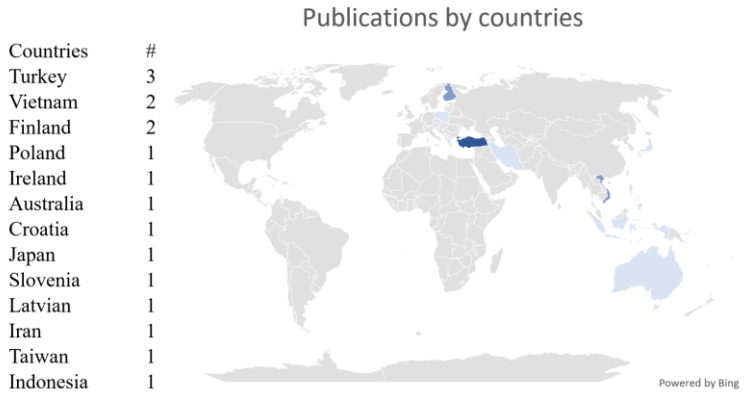

Figure 3. Number of integrated teaching publications by country from 2014 to 2022 (n=24)

In order to investigate which topic is gaining popularity, we can see how often certain keywords appear; the bigger the word, the more times it appears in the publication through the use of a "wordcloud" [44]. A total of 94 relevant terms are summarized in Figure 4. Data from the figure highlighted that integration, integrated teaching, teaching, education, learning, mathematics, curriculum were some of the most often occurring terms in the articles, followed by "teachers", "curriculum", "students", mathematics", "ICT", "competence". As such, these topics can be tentatively classified into four main areas including teachers' perception, student interest, curriculum design and environment factor. In addition to the aforementioned keywords, prior studies also used other indexing keywords including scientists, social media, STEM, STEAM, general didactics, environmental education, and culture integration, implying a potential research topic for prospective researchers. Compared with important topics related to other review articles in the field of education [45]–[47], our study showed some overlaps in the themes of ICT, mathematic, student, integration, indicating that integration of ICT for mathematics is a growing research area recently.

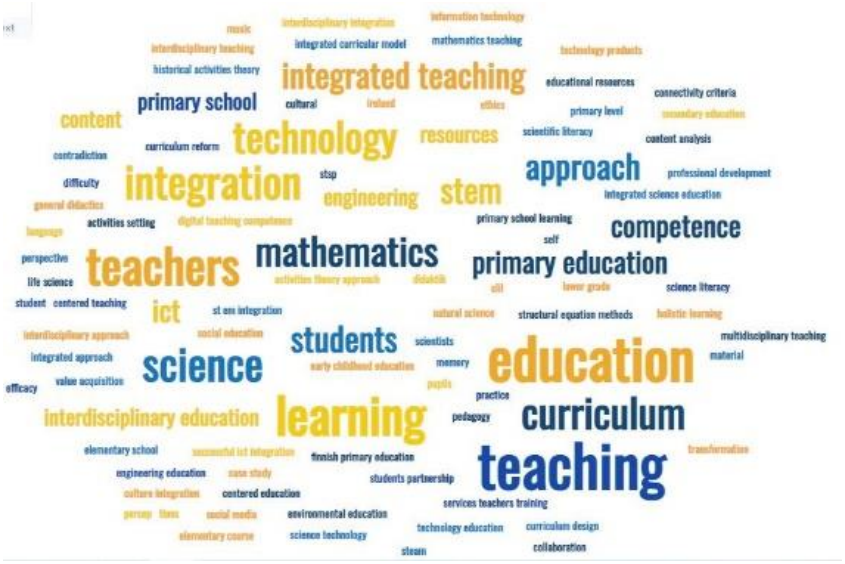

Figure 4. Highlighted keywords extracted from 24 articles

Figure 5 illustrates that 12 papers (50%) of the total, employed a combination of research methods in their examinations of integrated teaching in primary schools. Quantitative methods with four articles are utilized by 17% of researchers, while qualitative methods with the same number of articles are used by 17% of researchers. There were 12% of the papers used the empirical strategy. With just one article representing 4% of all article methods, development research is far and by the least popular.

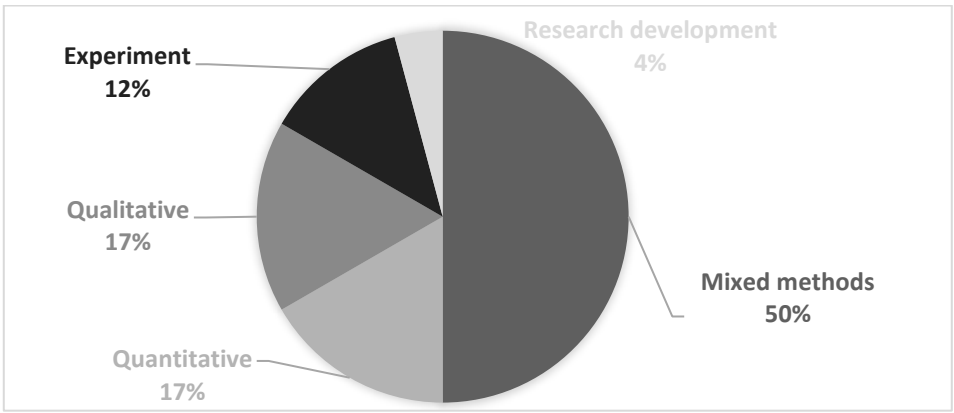

Figure 5. Proportion of research methods employed in 24 articles

3.2. To what extent does integrated teaching encounter obstacles or problems in elementary school settings? (RQ2)

The frequency with which demanding challenges were addressed by authors in the publications gathered was detailed in Table 2. Many of the researchers confess that they have relied on primary-level, country/state-specific, and region-specific samples. As a result, they cannot guarantee high reliability and generalizability on an international scale due to inadequate empirical sampling [7], [21], [31], [33].

Table 2. Obstacles or problems in elementary school settings

No	Category	References
1	Lack of teachers' competence in integrated learning in the classroom (15)	[5], [7], [12], [16], [22], [23], [25]–[27], [30]–[33], [37], [48]
2	Inadequate availability of integrated teaching materials (10)	[7], [12], [21], [22], [24]–[26], [30], [31], [33]
3	Scarce empirical evidence (4)	[7], [21], [31], [33]
4	Lack of understanding of integrated curriculum among teachers (3)	[22], [23], [33]
5	Not having enough support from educators and peers (3)	[5], [28], [34]
6	Less effort put on making interconnections between scientific ideas (3)	[29], [31], [37]
7	Putting less emphasis on preparing students to be lifelong learners (3)	[12], [16], [32]
8	Uncertainty over the implementation of integrated education (2)	[22], [23]
9	Lack of capacity to create a positive, inclusive classroom (2)	[5], [25]
10	Inadequate needs assessment and identification amongst students (2)	[27], [32]
11	Poor quality because of insufficient resources (2)	[22], [24]
12	Lack of consensus over inter-disciplinary techniques	[23], [26]
13	Others (3)	[21], [31], [32]

If we omit the articles that did not identify any restrictions, we find that 21 publications (87.7%) specified obstacles that were being tackled. The teaching competence of instructors was regarded as the most important criterion for the effective implementation of integrated education in 16 studies (66.7%). The majority of primary teachers agree that they require professional development in order to acquire the knowledge and abilities necessary to implement integrated lesson plans [5], [28], [34], [37]. In addition, 10 (41.67%) publications of the total, suggested that references to integrated teaching should be developed in order to assist teachers. Prior publications reported that it was vital to modify the content of curriculum by switching from an approach that was thematically focused to an approach that was integrated, which would contribute to improving the primary education system. In addition, the awareness of instructors and students, support from the school, resources, and the teaching environment are some of the difficulties that the previous study attempted to provide strategies for overcoming. Regardless of how thoroughly teachers comprehend the integrated approach, implementation will be challenging if they do not receive support from the school and colleagues [28]. This was the primary and most pressing concern that was voiced by the teachers who took part in the survey. Gailīte [24] stated that despite this, there was still a lack of resources to offer for integrated education such as material, financial, time, curriculum, and people.

In contrast, which only listed the issues that were described in the publications, this research quantified these challenges and categorized them in descending order. Because of this, researchers who are interested in the topic may rely on it to cover more area. This summary will aid academics in acquiring a comprehensive understanding of the critical factors influencing integrated education.

3.3. To what extent does integrated teaching need further research in the realm of primary education? (RQ3)

Table 3 highlights the importance of advanced education support for teachers in education institutions, courses, and foreign representative agencies [24] when making proposals for the development of primary teacher training programs [23]. Further research clarifies possible models for incorporating integrated education into teacher training; developing a teacher training program requires stimulating teacher collaboration through hands-on exercises in integrated teaching [33]. Therefore, research is focused on developing teachers' competencies to implement integrated teaching strategies from the very beginning of their tenure at pedagogical institutions, which is the first step toward integrated education's effectiveness.

Regarding the opportunities of developing materials to guide teachers in implementing integrated teaching in primary schools, supporting the development of teachers' skills and knowledge, several authors, reported that developing integrated teaching materials helps teachers integrate the content of subjects into teaching tools, such as lesson planning, selection and use of media, making teaching materials, and designing instructional activities for students [12], [22], [31], [32]. It was discovered that studies advocate for the need of developing integrated teaching models in a wide variety of disciplines and topics [29], [35]. It is necessary to conduct empirical research on the models in a variety of educational settings [7]. This would imply that the

acknowledgement of the advantages of integrated education has made many new research avenues, new trends in methodology, teaching strategies, and initiatives feasible [24], [37].

Table 3 Future research opportunities suggested by prior publications

Themes	Future research directions	References
Teacher training program	Investigation of potential frameworks for incorporating integrated curriculum into practicum education systems.	[23]
	Creating effective teacher-training programs requires fostering teacher cooperation via ICT-integrated teaching materials practice.	[33]
	Help for teachers to enroll in graduate programs, take courses, join international organizations.	[24]
Integrated teaching materials	Need to provide documentation for teachers to use integrated methods.	[12]
	Interdisciplinary teaching best practices should be specified in teacher handbooks.	[26]
	Invest in the professional growth of teachers by helping them gain STEM-related expertise.	[22]
	Make lessons more engaging by incorporating cultural elements into their content.	[31]
	Design advanced technology course instructions.	[32]
Integrated teaching models	Design effective frameworks for incorporating multidisciplinary education into the classroom.	[29], [49]
	Extensive field testing of the model in a variety of instructional settings.	[7]
	Explore how science teachers are bringing STEAM concepts into the classroom.	[37]
	Similar research may be conducted using cross-disciplinary teaching paradigms.	[35]
School policies and other interventions	Investigation on the impact of present school structures, cultures, and policies on teachers' expertise.	[28]
	Evaluation of students' perceptions of their learning under an integrated strategy.	[25]
	Consideration of a proposal for a global STEAM education regime.	[6]
	Introduction of technological gadgets as early as the primary school level.	[36]
	Study emerging methods, pedagogical tools, and course initiatives.	[36]
Others	More studies should be conducted with the goal of improving the existing findings' consistency and applicability.	[21]
	Evaluation of the scale of existing applications in other domains.	[7]

In addition, the researchers stated that in order to further develop integrated teaching, it is vital to focus study on the existing policy of the school, conduct out student evaluation, and offer an integrated education regime that adheres to international standards [6], [25], [28]. As a consequence of this, more study ought to be carried out to improve the dependability and generalizability of the findings, as well as to strengthen empirical investigations in order to assess the extent to which they may be implemented across a variety of scientific domains [21]. The similarity in research approaches in several papers in the subject of education [45], [46], [50] indicates the necessity for more research in such areas in the context of ICT. This is an essential direction in keeping with the changing educational framework.

In brief, this article examines the study orientations that affect the key features influencing integrated education in elementary schools. As indicated in the findings from the first research question, integrated education has become more widely applied recently, and ICT has been developing as an essential component of this pedagogical strategy. Given the direction that digital transformation is taking place in education generally [51]–[53] it is not surprising that our findings align with this trend. What that means is that prospective researchers and teachers in elementary education should be aware of the importance of ICT and digital transformation in general. Many studies have demonstrated that digital transformation, when implemented correctly, may be a strong paradigm to promote education and learning [54], [55]. However, if teachers do not adapt themselves to the digital transformation, it might lead to job losses and other negative outcomes (disruptive technology) [56]–[58].

In addition, our findings revealed an imbalance in the research methodologies utilized in previous publications, with a greater emphasis on mixed research and a lesser focus on experimentation and research development. This suggests that future researchers might replicate the study in their own academic setting and validate their results to those of other studies using the same mixed-method approach. Alternatively, when earlier findings are considered insufficient, interested researchers may initiate experiments or research development to enrich the corpus of knowledge. Moreover, our findings were consistent with those of the recently published publication review [59], [60], whose authors observed a similar pattern in the methodologies used in the research. One plausible reason for this disproportion was attributed to the time required for teachers to design and adapt teaching/learning materials for a new pedagogical method rather than focusing on other issues. Interestingly, this explanation was partially uncovered in our findings (Table 2) where a lack of teaching and learning resources was recognized as a barrier in 10 previous studies. This suggests that prospective researchers could continue to develop curricula to alleviate the shortage of modern curriculum. Alternatively, interested scholars may benefit from information in Table 2 as a springboard for further investigation. For instance, addressing the problematic issue of enhancing teachers' competencies, since this criterion was the most frequently highlighted.

The disparate findings led to the categorization of future research directions into five distinct groups: integrated teaching materials, which focused on developing and unifying resources; integrated teaching models, which brought concepts into practical settings; teacher training programs, which focused on improving teachers' competencies; integrated teaching models, which brought concepts into practical settings; school policies and other interventions, which investigated external factors that could have contributed to the disparate findings; and others – which focused on the need to re-conduct the experiment in different settings. The implication from this categorization is that it allows researchers to examine integrated teaching from a management viewpoint at a more general level of abstraction. As such, strategies and policies can be justified based on these broad categories rather than investigating individual items.

4. CONCLUSION

Based on the analysis of 24 articles, our results reported an increase in integrated teaching research in primary education in recent years. Among the 17 countries included in our corpus, Turkey was the most prolific in terms of publications on this research subject, followed by Vietnam and Finland. The Wordcloud revealed that the most often used terms associated with this study are curriculum, students, mathematics, ICT and competence, suggesting that they are the most important concepts in this research topic. Mixed research approaches were employed frequently in prior publications while experiments and research development were lesser emphasis, implying that prospective researchers are encouraged to validate existing findings or explore new knowledge in their educational context. We examined the challenges and demonstrated that teachers' integrated teaching competencies and contextual factors affect the efficacy of the teaching process.

The results support the need for focusing on primary school teaching programs; shifting the teaching model in the direction of integration; and effectively converting traditional teaching techniques into integrated teaching to build teacher capacity. In addition, social environmental factors have a significant impact on teachers and students and this study suggests that we can improve the teaching environment and management mechanisms in schools, with professional training and expert guidance, in order to assist teachers in enhancing their teaching capacity and students in adapting to this learning method in a safe and enjoyable environment. The establishment of five unique study areas allows future scholars to examine integrated education from a management viewpoint at a high degree of abstraction. Consequently, plans and policies may be justified based on these broad categories as opposed to researching individual elements.

ACKNOWLEDGEMENTS

This research was supported by a grant from the Ministry of Education and Training, Vietnam B2022-TDV-03.

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