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"استخدام تكنولوجيا المعلومات والاتصالات في الفصول الدراسية في مرحلة الطفولة المبكرة: مراجعة منهجية للأدبيات"

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“The Incidence of Information and Communication Technologies in Early Childhood Classrooms: A Systemic Literature Review”

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Abstract

The significance of ICT (Information and Communication Technologies) in teaching and learning has been widely recognized owing to technological advancements. It has become an essential part of education at all levels including early childhood education. Existing studies elaborated various viewpoints regarding the use of ICT in early childhood education (ECE) and have identified a number of barriers to its use in the classroom context. The overview of these studies does not gravitate towards a single viewpoint or conclusion which creates room for exploration of the topic at a deeper level. This systematic literature review (SLR) aims to contribute to the existing pool of literature regarding the attitude of teachers about the effectiveness of the use of ICT in ECE classrooms. Using PRISMA protocols, 12 studies were identified to carry out this SLR mainly explored the attitude of teachers towards the use of ICT, existing practices and its effectiveness in teaching at the ECE level. The study concludes that generally, the teachers have a positive attitude towards the use of ICT at the ECE level, however, its practice is limited in classrooms due to a number of reasons. It further concludes that half of the teachers consider it effective as a means to teach at the ECE level while the other half opine that the same can be achieved using traditional means. Based on the results, I identified the research gaps and suggested venues that can be addressed in future studies. The results of this study provide valuable insight into ICT integration at the ECE level and suggest areas to improve such as training teachers, and providing ICT resources for effective use in a classroom environment.

Keywords: *Cooperative/collaborative learning, Early years' education, Distributed learning environments, Improving classroom teaching, Teaching/learning strategies.*

ملخص البحث

لقد تم الاعتراف بأهمية تكنولوجيا المعلومات والاتصالات في التدريس والتعلم على نطاق واسع بسبب التقدم التكنولوجي. لقد أصبح جزءًا أساسيًا من التعليم على جميع المستويات بما في ذلك التعليم في مرحلة الطفولة المبكرة. تناولت الدراسات الحالية وجهات نظر مختلفة بشأن استخدام تكنولوجيا المعلومات والاتصالات في التعليم في مرحلة الطفولة المبكرة وحددت عددًا من العوائق التي تحول دون استخدامها في سياق الفصول الدراسية. لا تنجذب النظرة العامة لهذه الدراسات نحو وجهة نظر أو استنتاج واحد مما يخلق مجالًا لاستكشاف الموضوع على مستوى أعمق. تهدف هذه المراجعة المنهجية للأدبيات إلى المساهمة في مجموعة الأدبيات الموجودة فيما يتعلق بموقف المعلمين حول فعالية استخدام تكنولوجيا المعلومات والاتصالات في الفصول الدراسية لتعليم الطفولة المبكرة. باستخدام بروتوكولاتPRISMA ، تم تحديد 12 دراسة لتنفيذ هذه المراجعة المنهجية لاستكشاف موقف المعلمين تجاه استخدام تكنولوجيا المعلومات والاتصالات والممارسات الحالية وفعاليتها في التدريس على مستوى التعليم في مرحلة الطفولة المبكرة. وخلصت الدراسة بشكل عام إلى أن المعلمين لديهم موقف إيجابي تجاه استخدام تكنولوجيا المعلومات والاتصالات على مستوى التعليم في مرحلة الطفولة المبكرة، إلا أن ممارستها محدودة في الفصول الدراسية نتيجة لعدد من الأسباب. ويخلص كذلك إلى أن نصف المعلمين يعتبرونها وسيلة فعالة للتدريس على مستوى التعليم في مرحلة الطفولة المبكرة بينما يرى النصف الآخر أنه يمكن تحقيق الشيء نفسه باستخدام الوسائل التقليدية. وبناءً على النتائج، قمت بتحديد الفجوات البحثية والأماكن المقترحة التي يمكن معالجتها في الدراسات المستقبلية. توفر نتائج هذه الدراسة رؤية قيمة لتكامل تكنولوجيا المعلومات والاتصالات على مستوى تعليم الطفولة المبكرة وتقترح مجالات للتحسين من أجل الاستخدام الفعال.

الكلمات المفتاحية: *التعليم التعاوني، التعليم في السنوات الأولى، بيئات التعليم الموزعة، تحسين التدريس في الفصول الدراسية، استراتيجيات التدريس/التعلم.*

Introduction

The demand to use Information and Communication Technology (ICT) has tremendously increased in recent times and has become an indispensable part of all educational systems including early childhood education. Essentially, it is to meet the learning demands of different students according to their capacities (Chiroma & Abifarin, 2018). It has been established that using ICT encourages self-efficacy and resourcefulness among young students. It also enhances the skills of teachers and provides opportunities for linking schools and extending learning avenues beyond the boundaries of traditional classrooms (Chiroma & Abifarin, 2018; Liyanawatta et al., 2022) This could also help in enhancing the teaching and learning environment in early childhood education stage for optimal academic performance through the development of psychomotor skills of the learning domain in children (Kerckaert et al., 2015).

In the current era, ICT has predominance in the lives of younger children who are preoccupied with the screen most of the time and are engaged in the use of computers, tablets, smartphones, television, etc. (Matthew et al., 2015). ICT includes a varied pool of high-technological sources and devices that are utilized for communication. They are made to collect, generate, administer and distribute information (Adebanjo & Rasheed, 2021). This pool of ICT can also be extended to include electric devices utilized for information storage and recovery, whose growth is partially influenced by the capability to bring about a complementary connection between high-tech invention and individual components (Matthew et al., 2015) This implies that the people who interact with technology (in case of teaching- teachers) determine how effective the use of it in terms of teaching. The effectiveness of the ICT is determined when it is employed either as a medium of instruction or medium of delivery (Kadir et al., 2014).

For, the instructional processes, ICT provides teachers with the opportunities to conduct learner-centered teaching where the quality of instructions can be enhanced using the latest technologies, information sources, and latest knowledge to enhance the learning environment. Based on the knowledge accessed through ICT, teachers can also improve their educational delivery system by using several ICT tools for a better understanding of students (Soetan et al., 2014). It has been observed that efforts are being made to use ICT in schooling which has generated promising outcomes whereas, at the early childhood education level, its integration is limited with lesser desired outcomes (Soetan et al., 2014). Teachers of this level, have shown lesser interest in the application of ICT for instructional purposes which has generally decreased the infrastructural investment by stakeholders at the early childhood education level in terms of making early schools resourceful with ICT (Kadir et al., 2014). There is a need for early childhood instructors to increase their knowledge and competence about ICT and related tools to get the picture of the essential task that they, as teachers can perform in facilitating technology for young children.

When we talk of ICT application in early childhood education, first there is a need to elaborate on what early childhood education (ECE) refers to. Generally, the type of education received between ages 0 to 5 within the school environment (Adebanjo & Rasheed, 2021) is referred to as ECE. It is sometimes referred to as playgroup or pre-school. ECE is necessary to prepare the child for a smooth transition from home to school. It provides adequate care and supervision when parents are away at work or for business engagements (Soetan et al., 2014). At this level, children are often provided with stimulating materials to learn through play at school as a source of the expression of inner feeling, curiosity, and creativeness that involves exploratory behaviour and problem-solving (Adebanjo & Rasheed, 2021). Pre-schools provide students with a stimulating environment for physical, intellectual, and emotional development. Children are often provided hands-on experience which leads them to acquire learning through manipulation (Kerckaert et al., 2015). It has been posited that learning which involves the multisensory organs is highly qualitative as children can interact using all the five sense organs. It is realistic because children are encouraged to participate actively. The objects or devices include DVD, television, electronics, phones, digital cameras, computers, e-books, multimedia players, streaming media, programmable toys, robotics, and electronic musical instrument (Liu et al., 2014). The games and multimedia resources especially those that combined education with entertainment are well accepted by children (Soetan et al., 2014). It has been suggested that by using these devices, children are more likely to develop psychomotor skills effectively. It is well established in the literature that the application of ICT in teaching facilitates better understanding, enhances better memory retention, and improves learners' achievement (Alkan & Koçak, 2015; Yusuf & Balogun, 2011). If ICT is introduced early, children would have been grounded in it before they get to higher institutions. For example, the tertiary institution examinations are being conducted through computers and many children who are not computer literate or well-groomed in computer skills find the computer-

based examination difficult. The need to integrate ICT in pre-schools is a prerequisite as the children of this age are already exposed to this technology in their homes. They are maturing effortlessly with varieties of ICT gadgets that are fast turning out to be the instruments of culture in schooling, in-home, in the workplace, and in the neighbourhood (Kadir et al., 2014).

Numerous researchers have carried out literature reviews for studying the effectiveness of ICT in the ECE context. Historically, it has been argued whether young children may be allowed to use technology at school or not (Alper, 2013; Blackwell et al., 2014; Zomer, 2016). Various authors suggested that the use of ICT is not good for young children (Bolstad, 2004). Today, it is very common to see toddlers use electronic gadgets and watch videos on tablets and explore the internet. It has been elaborated in many studies that digital technologies can help children in engaging meaningful activities. They can provide them opportunities to develop, explore, learn and communicate (KALAŠ et al., 2012). In ECE, the term ICT can be limited to the use of technological tools including digital video cameras, telephone or cell phones, computer games, interactive toys, communication tools, internet, headphones, microphones, television, and video conferencing tools (Olowe & Kutelu, 2014). Literature also speaks that the views of teachers differ regarding the use of ICT in ECE. Although, the effectiveness of ICT has been recognized by teachers, but their computer self-efficacy widely influences their use in class (Gialamas & Nikolopoulou, 2010). A very interesting study on computational thinking and coding skills of pre-schoolers concluded that mobile applications like Scratch Jr aid in affecting positively the computational thinking and coding skills of students (Stamatios, 2022). Two similar studies also explored the use of robotics and another mobile app in teaching pre-schoolers and found them to have positive effects on the students (Kalogiannakis & Papadakis, 2020; Papadakis & Kalogiannakis, 2022).

The studies that have already been conducted, do not present clear conclusions about whether the use of ICT is effective for teaching ECE students or not. Moreover, contradictory findings surfaced when the attitude of ECT teachers toward the use of ICT in the classroom was studied. Some considered it useful and displayed a positive attitude towards its use while others reluctantly acknowledged its significance and considered it a burden for teachers. This leaves room to explore the topic in an international context considering the universal application of the technology. Hence, the SLR was conducted.

Given the studies that have already been conducted on the use of ICT in ECE, I intend to do a review of the existing studies on the use of ICT in ECE classrooms. This study reviewed the research papers that elaborated on the perspective of teachers on the effectiveness of the use of ICT in early childhood education. The aim of this review is not to elaborate on the kind of ICT tools that have been used at the ECE level, rather, it elaborates on how effective their use is in teaching, compared to traditional methods. The main objectives of this research are to explore the attitude and teaching practices of preschool teachers toward the use of ICT in their classrooms and evaluate how they are effective in teaching at this level.

This research is intended to provide the answers to the following research questions:

1. RQ 1: What are the attitudes and practices of preschool teachers toward the use of ICT in classrooms?
2. RQ 2: How effectively ICT is used for teaching pre-schoolers?

The studies that have already been conducted, present various viewpoints regarding the use of ICT in ECE and have identified several barriers to its use in the classroom context. The overview of these studies does not gravitate towards a single viewpoint or conclusion which further creates room for exploration of the topic at a deeper level. This systematic literature review (SLR) aims to contribute to the existing pool of literature regarding the perspective of teachers on the effectiveness of the use of ICT in ECE classrooms.

Limitations

The limitation of this SLR is that only the retrievable studies were included. The factors like barriers to the use of ICT in ECE lay outside the aims of this study. These factors surfaced in many studies that could have explained the negative attitude and limited practice of ICT at this level. I tried to minimize these limitations by including robust results as it is said that the SLR may be seen as a means to get sensible answers to a focused research question (Siddaway, 2014).

Methodology

1. **Study design**

I conducted a systematic literature review (SLR) to study the attitude and practices of preschool teachers towards the use of ICT in the classroom context as well as to evaluate how effective ICT is in teaching preschoolers. Detailed secondary data are used to get the job done in this research. Secondary information can be either "internal" or "external," depending on where it was gathered. Secondary data are currently being gathered and archived by researchers all over the world for research that is growing in popularity.

2. **Study Instrument**

Secondary data collection involves the utilization of both published and unpublished sources of data. For the search of the papers, it is suggested that the most common scientific literature databases and platforms may be used (Siddaway, 2014), hence, I used the most common and accessible databases including Web of Science, Scopus, Google Scholar, and Google Search Engine. I also consulted the bibliography and reference section of shortlisted papers to find more related articles. A spreadsheet was created to enlist and record the search and for reference management, software Mendeley was used to store bibliographical information.

3. **Data analysis**

In this regard, the PRISMA protocols and guidelines for systematic literature review by Siddaway (Liberati et al., 2009; Siddaway, 2014) were used. Based on my research questions, main search terms were identified to conduct the electronic search. These terms included: ICT; attitudes and practices; use of ICT classrooms; preschool teachers; effectiveness etc. To collect specific studies, alternative search terms by finding their synonyms were also searched. For instance, the alternative term for “ICT” was “IT”. Similarly, “early childhood education” was rephrased as “preschool education”. Besides alternative terms, broader or narrower terms (e.g., “attitude” or “behaviour”) were also used. An overview of the search terms used in the systematic literature search is provided in Table 1. The final search terms were determined after combining both the main and alternative terms.

During the preliminary search, 1197 papers were identified using the above-mentioned databases. After removing duplication, dropping papers against other reasons, and inclusion of 26 papers retrieved using bibliography, 59 papers were shortlisted for the screening stage of PRISMA protocol. The screening of articles included the following steps: I read the abstract of all the publications whose titles indicated the key terms linked to the use of ICT in early childhood education and recorded the entry if the abstract addressed my research question, or eliminated the publication otherwise. After the systematic search, the studies from the bibliographies were also screened. During the screening phase, 24 papers were dropped owing to the reason that ICT integration and early childhood education were not treated as central aspects. The remaining 35 papers were sought retrieval while 14 papers were denied retrieval owing to multiple reasons. The remaining 21 papers were screened against the eligibility criteria and 9 papers were further excluded against it. A total of 12 papers were included finally. Figure 1 elaborates on the PRISMA Protocols regarding the search, screening, reading, and inclusion of the related publications.

The identified studies were classified according to five given criteria points:

a) The studies may range from the period 2012 to 2022
b) The participant may include pre-service and in-service preschool teachers
c) The Use of ICT Practices in the ECE context covered
d) The attitude of pre-school teachers towards the use of ICT is focused
e) Effectiveness of ICT whether it is useful or not
f) All these aspects are elaborated on in the result section below.

Results

The use of ICT practices at the ECE level was studied in all the identified publications. All the listed studies have the use of ICT in focus as a direct or indirect objective. The selected studies comprise preschools of different geographical locations in the world. Kerckaert et al. (2015) focused on the preschools of Belgium; The views of Chinese ECE teachers were also included (Dong & Newman, 2016). Table 3 describes the contextual broadness of the study in terms of ECE preschools and the point of focus.

1. **The Use of ICT Practices in ECE**

The use of ICT practices at the ECE level was studied in all the identified publications. All the listed studies have the use of ICT in focus as a direct or indirect objective. The selected studies comprise preschools of different geographical locations in the world. Kerckaert et al. (2015) focused on the preschools of Belgium; The views of Chinese ECE teachers were also included (Dong & Newman, 2016). Table 3 describes the contextual broadness of the study in terms of ECE preschools and the point of focus.

2. **The Attitude of Pre-school Teachers towards the Use of ICT**

Most of the studies indicated that the teachers use ICT in terms of video clips, radio, sound clips, and for administrative use including preparation of worksheets and planning the lesson. Kerckaert et al. (2015) elaborated that although teachers have positive attitudes towards the use of ICT and they consider it effective for the teaching of ECE students but the barriers like lack of resources and competency of teachers prevent them from using it extensively. They concluded that in terms of practice, teachers have limited usage of ICT at the ECE level. Dong and Newman's (2016) in their study concluded that Chinese preschool teachers had an incipient comprehension of the use of ICT in early childhood education (ECE). They had the recognition of the value of ICT for young children and themselves in a restricted way. Though they have a constructive attitude regarding the use of ICT and its usefulness in ECE in terms of practice, teachers use it in a limited way. Palomino (2017) explored the perspective of pre-service ECE teachers towards the use of ICT in ECE and more surprisingly concluded that compared to in-service primary teachers, the pre-service teachers consider it a more effective tool for teaching. In the Jordanian context, it has been found that the preschool teachers did not have a certain understanding of the benefits and advantages of young children's computer use in particular and ICT in general. Hence, they have limited practice of it in ECE (Alkhawaldeh et al., 2017). Similar findings have been identified in a study conducted in the Croatian context where the majority of the teachers expressed a neutral stance toward the benefits of ICT (Preradović et al., 2017). Another study conducted in the Taiwanese context concluded with the limited application of ICT at the ECE level owing to the perception of teachers that it might have side effects on the health of students and eyesight (Chen et al., 2018). Other studies also identified a lesser positive attitude of preschool teachers toward the use of ICT (Gjelaj et al., 2020) and its limited practice in teaching (Dong & Mertala, 2021; Konca & Erden, 2021; Lee, 2021; Romero Tena et al., 2020). One study stood out in terms of the positive attitude of teachers and willingness to adopt it on a broader scale but the practice is limited due to a lack of resources (Adebanjo & Rasheed, 2021).

3. **Effectiveness of ICT at ECE**

This study also aimed at exploring the effectiveness of ICT in teaching at the ECE level. In this regard, I explored the view of ECE teachers on whether they consider it useful or not. Table 4 explains the view of teachers in this regard. The given table suggests that the practice of ICT at the ECE level is limited as listed in 11 studies. According to 6 studies, the use of ICT is effective in teaching as students learn better with it while 5 studies considered it ineffective. The stance of teachers remained neutral in only 1 study.

Discussion

The first research question of this systematic literature review aimed at finding the attitude and practices of preschool teachers towards the use of ICT in classrooms. In terms of attitude, the majority of the studies concluded that teachers have a positive attitude towards the use of ICT in ECE classrooms (Chen et al., 2018; Kerckaert et al., 2015; Konca & Erden, 2021; Lee, 2021; Palomino, 2017). They are aware of its significance in teaching concepts and planning their activities (Chen et al., 2018; Dong & Newman, 2016; Lee, 2021; Romero Tena et al., 2020). These findings align

with several other findings that have also concluded that the majority of the teachers have a positive attitude towards the use of ICT at the ECE level (Chiroma & Abifarin, 2018; Liyanawatta et al., 2022; Soetan et al., 2014). However, in terms of practice, 11 studies out of 12 identify limited practice due to several reasons. The teachers practice the ICT in ECE in a limited way due to a lack of competency (Alkhawaldeh et al., 2017; Kerckaert et al., 2015), lack of resources (Adebanjo & Rasheed, 2021), and potential side effects like weak eyesight (Chen et al., 2018). Similar conclusions are drawn in a few other studies that also concluded that the practice of ICT in ECE is limited to administrative work (Alper, 2013; Blackwell et al., 2014; Zomer, 2016). The study also identified that majority of ICT practice is done in terms of administrative work like planning lessons, and making resources to aid the teacher-centered approach (Chen et al., 2018; Dong & Newman, 2016; Romero Tena et al., 2020). This finding aligns with another study that also came up with similar conclusions (Zomer, 2016).

The second research question aimed at exploring how effective the use of ICT is, for teaching pre-schoolers. Out of 12 studies, 6 concluded it was effective (Adebanjo & Rasheed, 2021; Chen et al., 2018; Kerckaert et al., 2015; Konca & Erden, 2021; Palomino, 2017). These findings endorse the findings of several other studies that concluded with the same results (Bolstad, 2004; Gialamas & Nikolopoulou, 2010; Olowe & Kutelu, 2014). The results of 5 studies in this systematic literature review concluded that ICT is ineffective in ECE classrooms and the same learning can be achieved using traditional means of teaching (Alkhawaldeh et al., 2017; Dong & Mertala, 2021; Dong & Newman, 2016; Gjelaj et al., 2020; Romero Tena et al., 2020). These findings are not in line with the majority of the studies included in the SLR and several other studies that are not included in it. The reason for such conclusions may be explained with the help of another study that explains teachers' ICT engagement predicts their attitude towards technology and self-confidence for teaching with technology. The teachers' lack of knowledge and competency in handling ICT may contribute to such an attitude that prevents them from using it and hence, they consider it ineffective (Varol, 2013

Conclusions and Outlook

Common literature platforms were searched for this study and 12 studies were finally identified to explore the use of ICT at the ECE level. This study aimed at exploring the attitude of ECE teachers toward the integration and use of ICT in the teaching process. It also identified the practices of ICT and the general perception of teachers on whether they consider it effective for imparting knowledge at this level. The study concludes that though the majority of the teachers have a positive attitude toward the use of ICT as a tool for teaching at the ECE level, nearly all of them have limited practice of it in the classroom. This limited practice is the result of a number of reasons including lack of competency, lack of resources, potential health risk and lack of personal engagement in handling ICT gadgets. Half of the studies included in this SLR deemed the use of ICT as effective in terms of teaching while the other half gravitated towards the opposite view as they opined that the same learning can be achieved using traditional means at this level. This leaves further room for future studies that can possibly look for find the reasons for this conclusion. Future studies can also explore the barrier to the use of ICT in teaching at the ECE level to further elaborate on the reason for its limited practice of it at this level.

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Appendices

Table 1. Main and alternative search terms for the structured literature search.

Main Terms	Alternative Terms
Information and Communication Technology	ICT, information technology, IT, Digital Technology, DT, Computer Technology
Attitude	Behaviour, perspective, opinion, viewpoint
Practices	Strategies, teaching practices, methods
Effectiveness	Effective use; usefulness

Table 2. The use of ICT practices in ECE context, the attitude of pre-school teachers, effectiveness of ICT whether it is useful and the methodological approach of the Selected Publications

Study	Publication date	Participants	Context	Focus	Effectiveness	Methodological Approach
(Kerckaert et al., 2015)	2015	In-service Preschool Teachers	Flanders (Belgium) Preschools	how ICT use in Flemish preschools.	Despite teachers have positive attitudes toward the use of ICT, but barriers (Lack of resources and Competency) inhibit the use	**Online Survey Quantitative Approach**
(Dong & Newman, 2016)	2016	In-service Preschool Teachers	Chinese Preschools	Chinese ECE teachers' views on the use of ICT in preschools.	This study shows that Chinese preschool teachers had an emergent understanding of ICT usage in early childhood education (ECE). Limited recognition.	**Mixed-method** **Interviews, Observation**
(Palomino, 2017)	2017	Prospective Early Childhood & Primary Teachers	University (Teacher Education) & Primary School Teachers in Spain	The perceptions of prospective Early Childhood and primary teachers about using ICT	According to ECE teachers, it is effective and useful.	**Descriptive Survey, Quantitative Approach**
(Alkhawaldeh et al., 2017)	2017	In-service Early years Teachers	Jordanian Preschools	Early years teachers' perspectives regarding the role of computer technology in supporting children's learning	The preschool teachers did not have a certain understanding of the benefits of computer use for children.	**Semi-structured Interviews Qualitative Approach**
(Preradović et al., 2017)	2017	In-service Early years Teachers	Croatian Kindergarten Schools	The role and attitudes of kindergarten educators in the early ICT education.	More than one-third of kindergarten educators in Croatia have neutral attitude towards the issue of early ICT education.	**Descriptive Survey, Quantitative Approach**
(Chen et al., 2018)	2018	In-service Preschool Teachers	Preschools in Taiwan	Perception of the application of information communication technology	The teachers have favourable attitudes toward ICT applications in teaching and administration. Fear of side effects	**Interpretive Phenomenology** **Qualitative Approach**
(Gjelaj et al., 2020)	2020	In-service Preschool Teachers & Parents of Preschoolers	Preschools in Kosovo	Teachers' and parents' attitudes and practices about the role of digital technology supplies in young children's development.	Only one of the eight preschool teachers reported a positive attitude regarding the impact of digital technology on children's development.	**Mixed-method Approach** **(in-depth Interviews & online survey)**

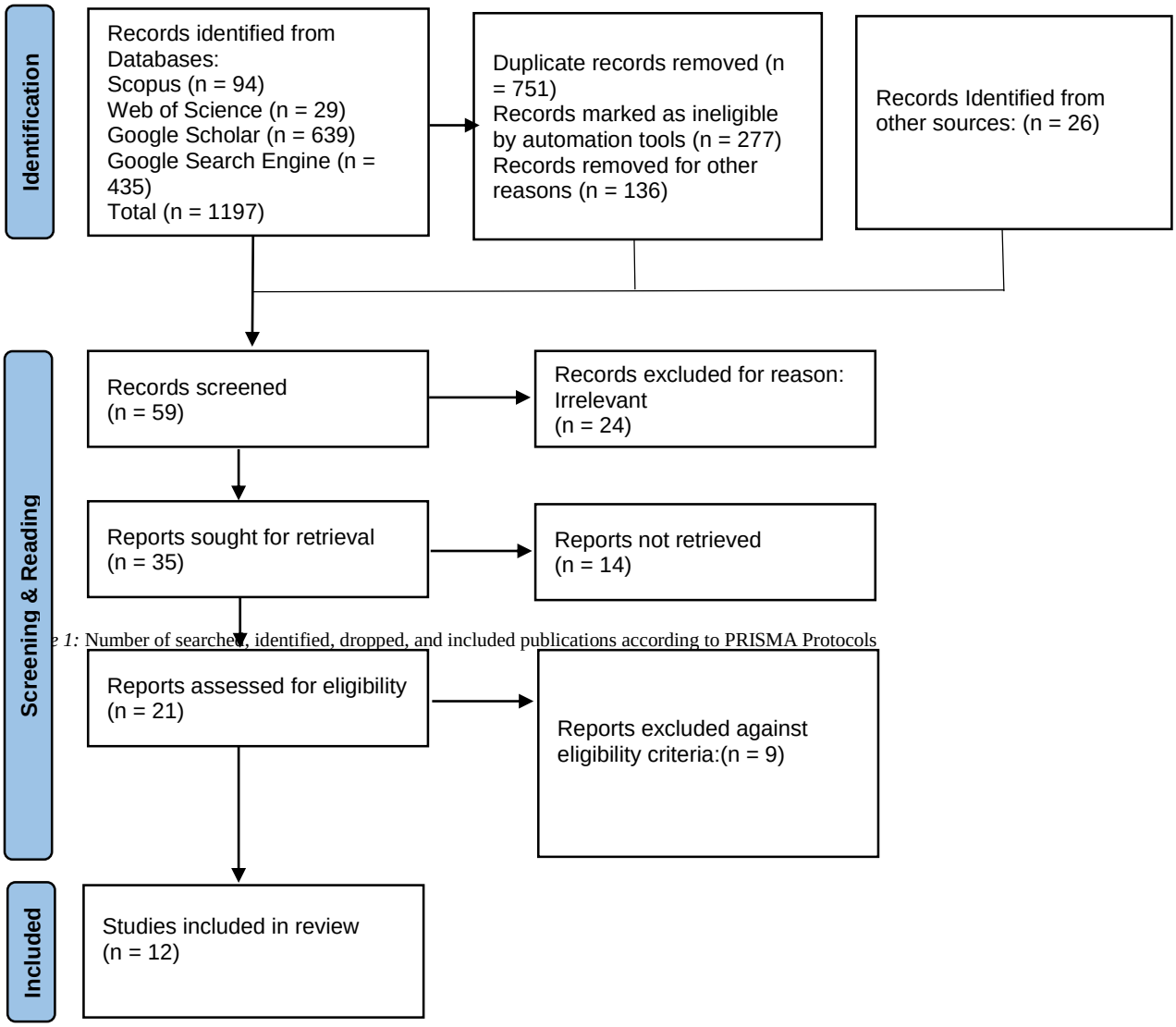
(Romero Tena et al., 2020)	2020	In-service Preschool Teachers	Preschools in Spain	How ECE teachers make use of ICT and its frequency	These technologies were not openly and consistently used. Mostly administrative and bureaucratic tasks were performed.	**Descriptive Survey, Quantitative Approach** **(Component analysis, descriptive analysis and multivariate analysis)**
(Dong & Mertala, 2021)	2021	Pre-service Preschool Teachers	University (Teacher Education) in Finland	Teachers' perceptions of ICT	ICT used as a new tool to carry out traditional teacher-centred and teacher-initiated practices in a more efficient manner.	**A broader Mixed-method approach**
(Konca & Erden, 2021)	2021	In-service Preschool Teachers	Preschool in Turkey	Teachers' usage of digital technologies (DT) in early childhood education.	Positive attitude but their DT usage was limited to a few types of activities.	**Cross-sectional Survey**
(Adebanjo & Rasheed, 2021)	2021	In-service Preschool Teachers	All registered private nursery schools of Ogun State, Nigeria.	The use of ICT in Early Childhood Education (ECE) in Ijebu North Local Government of Ogun State, Nigeria.	The attitude is positive however, teachers do not engage in activities that promote the usage of ICT devices in ECE classrooms due to limited resources.	**Expost-facto research design**
(Lee, 2021)	2021	In-service Preschool Teachers	Malaysian Preschools	Relationship between preschool teachers' teaching experience and their usage of (ICT) and Internet in (ECE).	The ICT beliefs are: perceived usefulness and perceived ease of use. It influenced attitudes towards using ICT in the classroom practice. The difference in belief and practices of ICT was observed.	**Correlation** **Quantitative Approach**

Table 3.The Use of ICT Practices in different Preschool Contexts

Geographical Location Context	Study	Point of Focus
Belgium	(Kerckaert, Vanderlinde, and van Braak 2015)	ICT uses in Flemish preschools.
China	(Dong and Newman 2016)	Teachers' views on the use of ICT in preschools.
Spain	(Palomino 2017; Romero Tena, López Lozano, and Puig Gutiérrez 2020)	• The perceptions of prospective Early Childhood and Primary teachers about using ICT • How ECE teachers make use of ICT and its frequency.
Kosovo	(Gjelaj et al. 2020)	Teachers' and parents' attitudes and practices about the role of digital technology supplies in young children's development.
Croatia	(Preradović, Lešin, and Boras 2017)	The role and attitudes of kindergarten educators in the early ICT education.
Malaysia	(Lee 2021)	Relationship between preschool teachers' teaching experience and their usage of (ICT) and Internet in (ECE).
Jordan	(Alkhawaldeh et al. 2017)	Early years teachers' perspectives regarding the role of computer technology in supporting children's learning
Taiwan	(Chen et al. 2018)	Perception of the application of information communication technology
Nigeria	(Adebanjo and Rasheed 2021)	The use of ICT in Early Childhood Education (ECE) in Ijebu North Local Government of Ogun State, Nigeria.
Finland	(Dong and Mertala 2021)	Teachers' perceptions of ICT
Turkey	(Konca and Erden 2021)	Teachers' usage of digital technologies (DT) in early childhood education.

Table 4. Effectiveness of ICT in Teaching at ECE Level

Study	Participants	Practice	Effectiveness
(Kerckaert, Vanderlinde, and van Braak 2015)	In-service Preschool Teachers	Limited	Effective
(Dong and Newman 2016)	In-service Preschool Teachers	Limited	Ineffective
(Palomino 2017)	Prospective Early Childhood & Primary Teachers	Extensive	Effective
(Alkhawaldeh et al. 2017)	In-service Early years Teachers	Limited	Ineffective
(Preradović, Lešin, and Boras 2017)	In-service Early years Teachers	Limited	Neutral
(Chen et al. 2018)	In-service Preschool Teachers	Limited	Effective
(Gjelaj et al. 2020)	In-service Preschool Teachers & Parents of Preschoolers	Limited	Ineffective
(Romero Tena, López Lozano, and Puig Gutiérrez 2020)	In-service Preschool Teachers	Limited	Ineffective
(Dong and Mertala 2021)	Pre-service Preschool Teachers	Limited	Ineffective
(Konca and Erden 2021)	In-service Preschool Teachers	Limited	Effective
(Adebanjo and Rasheed 2021)	In-service Preschool Teachers	Limited	Effective
(Lee 2021)	In-service Preschool Teachers	Limited	Effective



e 1: Number of searched, identified, dropped, and included publications according to PRISMA Protocols