

# **Teachers' Experiences of Facilitating Play-based Learning Online for Young Children During the COVID-19 Pandemic in China Through the Lens of the TPACK Framework**

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## **Abstract**

This study investigates the knowledge and experiences of 11 teachers in China, facilitating online learning for young children aged two to six in Early Childhood Education (ECE) during the COVID-19 pandemic. The pandemic caused global school closures, prompting a swift move to online education. The Technological Pedagogical Content Knowledge (TPACK) framework was used as an analytical tool to investigate how ECE teachers incorporated information and communication technology (ICT) to facilitate play-based learning in a virtual environment. A multi-case study approach was employed, collecting qualitative data from five international schools implementing three curricula. The study aimed to uncover the strategies teachers used, identify the challenges they faced in sustaining play-based pedagogy online, and highlight the potential of ICT in fostering engagement and developmental learning for young children. The findings offer insights into the challenges and opportunities of online teaching for young children, offering practical guidance for creating effective online environments that support play-based learning within diverse curricula. This research contributes to a broader understanding of online pedagogy for young learners in crisis contexts.

**Keywords :** *Early Childhood Education, Play-based Learning, ICT, COVID-19*

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## Introduction

The COVID-19 pandemic led to school closures, and the shift to online learning affected over 1.5 billion learners globally (Gupta & Jawanda, 2020; Walters, 2020), significantly affecting children in early 2020 (Espino-Díaz et al., 2020). This transition presented unique challenges as Early Childhood Education (ECE) teachers lacked the infrastructure and resources to support young children's learning online (Dayal & Tiko, 2020), and parents were overwhelmed by the demands of facilitating their children's learning at home (Mader, 2020). Amid the COVID-19 pandemic, China adopted the “Zero COVID Case” policy to minimise the number of COVID-19 cases (VOA News, 2022). China's Ministry of Education rapidly closed schools in February 2020 (Liu et al., 2020) and implemented the ‘Learning Continues’ initiative for online education, resulting in students shifting to education online overnight (Ministry of Education [MoE], 2020). Subsequently, there were intermittent lockdowns and temporary returns to online learning (Huang et al., 2021) until early 2023 (World Health Organisation [WHO], 2023). This study explored how ECE teachers in international schools in China used information and communication technology (ICT) for online learning for young children (aged two to six) during the COVID-19 school closures from 2020 to 2021.

ECE is commonly known to be offered to children from birth until age 8 (UNICEF, 2024). The Chinese international schools involved in this study implemented three different ECE curricula based on the Early years foundation stage statutory framework in England (Department for Education [DfE], 2024), American Common Core Standards (Kamerman & Gatenio-Gabel, 2007; NAEYC, 2015) and International Baccalaureate (IB) Primary Years Programme (PYP) framework (IBO, 2018). These curricula embrace child-centred approaches, recognising the importance of catering to each child's unique needs and interests and guiding teachers’ instructional practices (DfE, 2024; IBO, 2018; National Association for the Education of Young Children [NAEYC], 2015). Pedagogically, they prioritise play, where children actively engage in hands-on experiences to explore and learn and to encourage children to take ownership of their learning (Espino-Díaz et al., 2017). Play-based learning is recognised as the cornerstone of ECE because it fosters exploration, creativity, and holistic development through diverse modes of engagement, cultural responsiveness, and meaningful interactions with educators (Edwards, 2017). The play spectrum (see Figure 1),

ranging from unstructured play to highly structured, adult-directed activities, provides a nuanced understanding of play as a versatile tool for holistic development (Department for Children, Schools and Families [DCSF], 2009). Given that the highly structured approach contains ‘little or no play’ (Figure 1), it is questionable if it should be included in the play continuum. Nevertheless, the other three approaches provide a useful lens for examining play. Teachers in this study referred to focused learning as purposeful play when curriculum learning outcomes informed the design of hands-on playful experiences for children. They referred to child-initiated play as free play when children were free to make decisions about their play experiences.

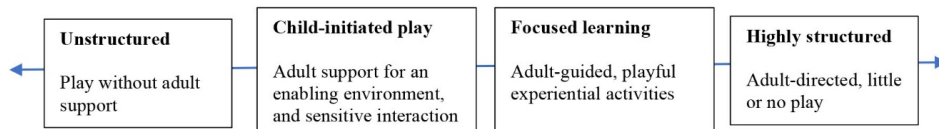


Figure 1. a continuum of approaches (DCSF, 2009, p.5)

ICT in ECE has become increasingly prominent in research, teaching and learning (Dong & Newman, 2016, 2018; Havu-Nuutinen et al., 2017) and teacher professional development (Yang & Hong, 2022). However, the term ICT has been used interchangeably with digital technologies (Luo et al., 2022), digital media (Park & Hargis, 2018), or interactive technology (Miller, 2018). The Chinese Ministry of Education acknowledges using technological products (such as television) in ECE without specific terminology references or guidelines (MoE, 2012). Nevertheless, the term “ICT” is commonly used in the context of ECE research in China (Dong & Newman, 2016, 2018; Yang & Hong, 2022). The reference to ICT in this study refers to a range of digital devices used in an educational setting to facilitate participant interaction and sharing of ideas and resources, including desktop computers, iPads, software programs, applications, and online activities.

### Theoretical and Analytical Framework

Mishra and Koehler (2006) introduced the TPACK framework comprising Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK). These

intersect to form Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and Technological Pedagogical Knowledge (TPK). Integrating these domains constitutes Technological Pedagogical Content Knowledge (TPACK), which refers to teachers' knowledge of how technology can enhance teaching and support student learning more deeply and effectively. The TPACK framework helps teachers consider how their knowledge domains intersect to teach and engage students with technology effectively. Studies employing TPACK found that iPads and their applications positively impact early numeracy learning (Disney et al., 2019; Miller, 2018), underscoring the importance of purposeful technology integration aligned with effective teaching practices. Luo et al. (2022) found that TK, TPK, and PK all positively impacted TPACK, with PK exerting a comparatively smaller influence on ECE in Chinese schools. These findings shed light on the framework's role in examining technology integration to enhance teaching and the need for ECE teachers to prioritise pedagogic approaches that seamlessly integrate technology into teaching instruction (Luo et al., 2022).

Mishra (2019) added Contextual Knowledge" (XK) to the revised framework (Figure 2), incorporating teachers' awareness of available technologies, policies at various levels, and organisational constraints, highlighting the need for teachers to develop XK alongside TPACK to enhance technology integration and sustain effective teaching practices. For example, a study by Blackwell et al. (2016) showed that contextual factors (XK) can

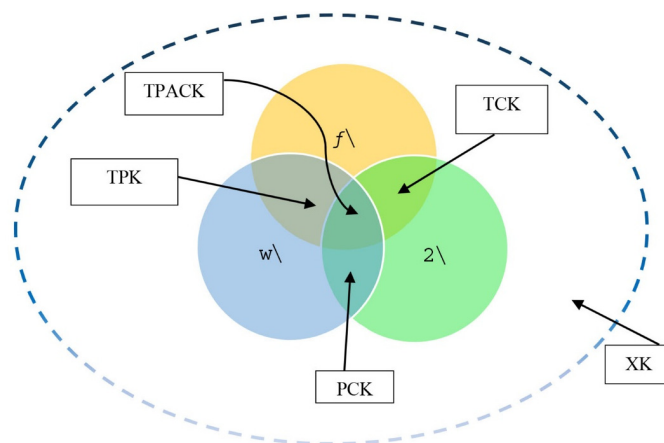


Figure 2. Revised version of the TPACK Framework (Mishra, 2019, p.77)

influence iPad integration.

This study utilised Mishra's (2019) framework to explore teachers' experiences with online teaching of young children in five international schools in China and identified contextual influences (XK) on their decision-making. It contributes insights into leveraging ICT to enhance curricular implementation and play-based learning experiences online. The overarching research question, informed by the literature and the TPACK framework, is: How did ECE teachers integrate ICT to enhance young children's play-based learning online during COVID-19 school closures, and how did XK influence their approaches?

## Methods

This study used a multi-case study approach (Yin, 2018) to examine ten international school teachers' experiences facilitating young children's learning online in China between 2020 and 2021. Qualitative analysis methods were used to investigate *how* teachers facilitated play-based learning online for young children during COVID-19 and to identify *what* influenced their decision-making (Creswell, 2014; Yin, 2018).

### Research Context

This study involved five international schools offering ECE to children aged two to six (see Table 1) in Nanjing, Shanghai, Suzhou and Beijing in China. The study focused on international schools as the primary author has been teaching in the international school setting in China for most of her career and the current literature indicates that there is limited research in this context. The research invitation was sent to four international schools in the first author's city, but only two responded. A second round of invitations was then sent to principals of nearby provincial schools. The opportunity to examine diverse curricular offerings, teacher backgrounds, play-based pedagogies and ICT approaches were contingent on the schools that accepted this invitation to participate in the research. All five schools provided online learning from February to June 2020. Four schools had multiple online learning phases in 2020 and 2021. The study data were divided into two parts: the initial

online learning from February to June 2020, and the second online learning encompasses subsequent periods during lockdowns in August to October 2020 (S4), January 2021 (S5), and August to October (S1) 2021.

## Participants

Teacher participants from five schools engaged in online teaching throughout the pandemic (Table 1), except Isabella, who started in August 2021. Louisa and Mia participated only in the initial online teaching of 2020.

Table 1. *The description of multiple cases (NA means Not Applicable)*

| Research sites | Teacher Participants | First Online Learning & Teacher Participants' Students' Age (year) | Second online learning & Teacher Participants' Students' Age (year) |              |                      |
|----------------|----------------------|--------------------------------------------------------------------|---------------------------------------------------------------------|--------------|----------------------|
| Period         |                      | February-June 2020                                                 | August-October 2020                                                 | January 2021 | August- October 2021 |
| School 1 (S1)  | Emma                 | 3-5                                                                | NA                                                                  | NA           | 7-8                  |
|                | James                | 7-8                                                                |                                                                     |              | 5-6                  |
|                | Lidia                | 3-6                                                                |                                                                     |              | 5-6                  |
|                | Isabella             | NA                                                                 |                                                                     |              | 3-5                  |
|                | Chloe                | 3-5                                                                |                                                                     |              | 3-5                  |
| School 2 (S2)  | Eva                  | 2-3                                                                | NA                                                                  | NA           | 4-5                  |
| School 3 (S3)  | Louisa               | 4-5                                                                | NA                                                                  | NA           | NA                   |
|                | Mia                  | 4-5                                                                |                                                                     |              |                      |
| School 4 (S4)  | Della                | 4-5                                                                | Mixed aged                                                          | NA           | NA                   |
| School 5 (S5)  | John                 | 5-6                                                                | NA                                                                  | 3-5          | NA                   |

## Data collection

The study employed snowball sampling (Valerio et al., 2016) to recruit ten ECE teachers. Data collection involved initial and follow-up semi-structured interviews (Travers, 2010), conducted in-person and online via Microsoft Teams due to COVID-19 restrictions from September 2021 to August 2022. The interviews were audio-recorded. Semi-structured interviews were chosen because they provide rich data and deeper insights into a given phenomenon (Creswell, 2014).

## **Data Analysis**

Ten audio recordings were transcribed verbatim, cross-checked twice for accuracy, and member-checked. The analysis utilised Nvivo software on a MacBook, following Saldaña's (2016) coding protocol. Initial coding drew from Mishra's (2019) updated TPACK framework and interview questions, establishing codes using CK, PK, TK, TPACK and XK categories, which were expanded into themes. The same approach was applied across all five research sites.

## **Results**

Based on the research question, the key findings are organised into two main sections: the approaches to learning using ICT during COVID-19 and XK influence.

### **TPACK during COVID-19**

The onset of COVID-19 mandated a shift to online teaching, compelling teachers to adapt their pedagogies and attitudes towards technology to cater for the developmental needs of a diverse age range from two to six years old.

During the first round of online learning in early 2020 (see Table 1), all teachers except Isabella (not teaching) and James (taught Grade 2) had to adapt quickly to the online mode due to school closures. Platforms like Seesaw and email were mainly used to share learning activities and resources with parents to foster flexible engagement in learning. With parental support, children completed these tasks at their own pace and time.

### ***PCK and TPACK***

Different types of asynchronous learning experiences were offered depending on the curriculum. Teachers made adjustments to promote play and spark curiosity in IB PYP schools (S1, S3, S5). For example, Emma encouraged inquiry by sharing a video of her exploring how long it would take for a Lego boat to sink as a provocation for children to

undertake and video record their exploration and what they had learnt. In contrast, S4 focused more on academic learning and implemented purposeful play. Eva from S2 mainly used digital platforms to share ideas with parents on what they could do to support children's learning.

### ***TK limited deployment of PK***

Regardless of the type of curriculum, all teachers acknowledged that asynchronous learning placed limits on implementing PL. Although teachers in S1, S3, S4 and S5 shared “a daily video... read-aloud” with their children to stay connected, they pointed out that delayed interactions affected the process of learning through play that, as James explained, thrives “*in a social setting*” and with “*instant feedback works a lot better than wait two hours*”. Teachers observed that children missed essential social interactions, play, and collaborative learning experiences during first online learning. However, asynchronous online learning became imperative as teachers, children and their families were in diverse global locations with limited TK. Teachers had to ensure equitable access for children to learn at their own pace and convenience.

### ***Intersections of CK, TK and PK: Synchronous and Asynchronous Learning Approaches***

During the second instance of online learning (see Table 1), teachers offered synchronous learning and a broader range of asynchronous learning experiences to address diverse needs. Synchronous learning online involved regular meetings on platforms like Microsoft Teams (S1, S3, S5) and Zoom (S4). The synchronous sessions, including whole-class, small group, and combined grade-level interactions, fostered real-time interactive engagement and supported children's learning and play at home.

Teachers utilised synchronous meetings with children for academic purposes and to support well-being, relationships, and social development. All teachers strategically utilised synchronous meetings tailored to specific objectives. Teachers (S1, S4) used synchronous meetings to establish connections with children at the beginning of the school year as teachers had limited knowledge about children's “*language level...interest level*” according to Chloe. Eva (S2) replicated the school day when she ran a whole class meeting that followed a structure similar to a regular school day with various lessons throughout the day but did

encourage free play offline at scheduled times. Synchronous meetings were also “*more focused on... movement*” for Chloe and “*social interaction*” for Della. James did “*sing some songs together... share something we’ve made*”. Della held extended meetings with children and families. Some teachers switched from whole-class to small-group meetings, allowing for more effective children interaction and engagement. Lidia said, “*19 kids... have these Teams meetings ... twice a day... wasn’t really working... the children were too young...*” Teachers conducted daily or weekly morning meetings online, from whole class to small groups to one-on-one meetings to meet individual children needs, focusing on fostering connections and ensuring overall well-being during online learning.

Asynchronous learning experiences extended beyond daily videos and read-aloud sessions. Eva utilised audiobooks to support children's English language development at home, allowing them to listen and respond independently to address the practice gap as “*they don't have the English support at home.*” Chloe gave an example of creative asynchronous engagement using everyday items like “forks, knives and spoons... in math sorting...encouraging playful inquiry”. Lidia provided creative packs with open-ended materials for children to play with freely at home and share their creations online, while Eva sent her children learning packs, including readers, to support learning online. Children’s free play at home involved exploring and playing creatively away from the virtual environment.

Teachers prioritised playful experiences through purposeful and free play, blending synchronous and asynchronous methods. All teachers who took part in two rounds of online teaching remarked that they were better prepared for the second round. ICT was used to support children’s learning and play asynchronously and synchronously, focusing more on social interaction, building relationships, and fostering classroom unity. Children participated more actively, collaborating with peers and teachers.

### **XK influenced teachers' approaches to online learning during COVID-19**

Teachers felt there were limitations in the effectiveness of online learning due to contextual factors, including TPACK before COVID-19, uncertainty over the implementation of online learning, parents’ involvement and knowledge of children.

### ***TPACK Before COVID-19***

Even though various pedagogies are used in ECE, the main pedagogy used by teachers in this study was Play-based Learning (PL). All participant teachers acknowledged play was crucial in children's learning and development. Mia asserted that *"play is learning."* John believed *"children build the independence, negotiate and collaborate, solve tangible problems"* when they play and interact with others, so it is *"more of learning through play, ... inquiry."* Teachers used "free play" and "purposeful play" when explaining PL. Teachers referred to "free play" when children could choose where, what and whom they wanted to play with, and "purposeful play" when children's hands-on playful experiences were linked to curriculum learning outcomes. CK varied depending on school-based curriculum, including IB PYP, Curriculum from England and American Common Core Standards.

In IB PYP, teachers are vital in creating a supportive learning environment that promotes children's play and learning (IBO, 2019, 2020). The data from S1, S3 and S5 shed light on how PL in PYP schools is a rich and purposeful form of exploration, aligning seamlessly with the broader educational goals and philosophy. Emma *explained how "[the] teacher would take the lead role in setting up the provocation"* and provide materials for children (aged three to five) to explore. Mia and other PYP teachers observed that these provocations, working synergistically with the environment's design, were *"very intentional"* and supported children's play and explorations. Through close observation of children's play, teachers identified children's interests and evaluated developmental needs, strengths, and aspirations, which was instrumental in formulating the next set of learning goals. Hence, play served as a stepping stone for designing future playful learning experiences to deepen and extend children's understanding.

S2 and S4 implement curricula from England and America, aiming to balance free play and direct teaching. Louisa called the learning *"playful learning... a balance between direct teaching and play... so that the children are learning through play, but also there's a bit of the direct teaching as well."* Eva echoed that effective PL involves teacher support, with purposeful play aiding academic growth in literacy and numeracy and free play assisting teachers in gauging children's learning progress. Eva explained, *"children work independently to show teachers their progress."* Della referred to play as a unique form of learning that allows for the acquisition of skills with purposeful play being more structured

and closely tied to the academic focus.

PL emerges as a versatile and powerful approach crucial for the holistic development of children in the diverse landscape of five international schools. From free play fostering exploration and creativity to purposeful play aligned with learning objectives and supporting academic growth. The different curricula distinctly defined play in specific ways that shaped teachers' PK which influenced teachers' approaches to online learning.

***ICT Infrastructure and Integration in Classroom Settings.*** All participant schools and teachers were equipped with ICT before COVID-19 school closures in early 2020. Teachers had their laptops. The classrooms in all schools were equipped with wireless Internet, interactive smartboards, and sets of shared class iPads. Teachers mainly used the Seesaw application and email to communicate and share children's learning with parents. Despite the plethora of devices and applications, majority of children under six rarely used ICT at school independently before the COVID-19 school closure.

Teachers' attitudes and concerns about using ICT influenced its integration. Some teachers embraced ICT as a valuable tool. For example, Mia incorporated iPads into her classroom to *"get information from viewing and listening to things"* and foster creativity by accessing a wide range of resources such as *"storytelling in different mediums"*. James used ICT *"as a provocation"* or to bridge language barriers and enhance clarity by *"showing a picture of something for children who don't know English"*. Della saw ICT as a teacher's choice and acknowledged its benefits with adequate scaffolding and adult support. She conducted *"Technology Tuesdays"* workshops offering scaffolding for effective technology use, such as *"learn how to use a new website or app... iPad and Raz kids"*. Although not a heavy technology user, John viewed ICT positively, seeing it as a tool for unique and interactive activities such as singing along or yoga or overcoming educational challenges. On the other hand, some teachers questioned ICT's pedagogical value. Even though digital technology could help children in *"mental cognition... problem solv[ing]..."*, Eva pointed out that Lego blocks could do the same. Eva and Chloe highlighted the limitations of technology in developing motor skills and textile exploration, emphasising the value of tactile play experiences for young children. Teachers also expressed concerns about young children's screen time. For example, Isabella limited ICT use in her classroom as she recognised

children “*are digital natives...bombarded with all the things [technologies] at home*”. Chloe worried about addiction in exposing children to ICT too early and preferred traditional learning methods over technology.

During the school closure in early 2020, the sudden shift from learning in class to online learning as directed by the national education minister (MoE, 2020), made school leaders and teachers uncertain about the protocols. Lidia noted, “*Our leadership was also uncertain...*”, a view echoed by John, “*No one really knew the right way*”. The common challenge across schools was teachers' uncertainty about processes, resources, content, activity duration, and teaching pedagogy when transitioning to online learning without prior experiences.

The local government gave schools more lead time before switching to online learning for the second phase of online learning. Teachers improved their online teaching practice through collective reflection, professional learning and planning. “*lots of reflection...with colleagues*” and “*planned for what if we went into lockdown again*” James said, and John described this as an online learning drill “*to have a plan in place*”. James noted that campus-based teamwork improved communication and planning and facilitated the finetuning of synchronous and asynchronous approaches. Online learning aligned with the curriculum, became more engaging and resource-rich and incorporated different uses of ICT.

***The role of parents for online learning.*** Parental engagement was crucial for young children’s online learning as they needed support to access technology, learning materials, and help with online tasks. Children needed parents “*to gather the materials... help using iPads to respond to teachers...or ... online meetings*” observed Lidia. However, many factors influenced parental involvement in children's learning online. Chloe and other teachers acknowledged that parents' work commitments or “*students were in hotel quarantine while ... returning to China*” could limited their ability to engage in their child's learning fully. Parents' understanding of PL posed challenges to supporting their children's learning at home. Della noted that without a play-based mindset, parents struggled to recognise the value of play in their children's everyday activities. To address this, teachers stressed the importance of building a shared understanding with parents, underscoring the significance of play and equipping them with resources like videos and lesson plans. Eva observed that parents took on a more active role in their children's learning, with teachers providing support, stating,

*“they [parents] sort of become the teacher and you [teachers] become the support”*. As Della highlighted, this increased parental involvement strengthened family bonds and enhanced children’s engagement in learning.

**Knowledge of children.** Teachers' knowledge of children for effective PL was evident as they navigated the challenges of online learning despite parental support. When the school closures occurred in the midst of the school year in 2020, teachers already knew children, allowing them to cater for individual interests and provide additional support. However, Eva’s challenge was, *“We (teachers) didn’t know what [devices] the children had at home.”* Teachers did not know the children during the second round of school closures at the beginning of the school year. However, they were more prepared based on their previous experiences.

## Discussion

The increasing interest in ICT and diverse applications in ECE at school and home highlights the potential for enhancing children's early learning and overall development (Wang et al., 2013). Numerous studies explored the potential benefits of ICT integration in kindergarten (Dong & Newman, 2016, 2018), such as ICT in early literacy development (Flewitt et al., 2015; Wohlgend, 2015; Wood et al., 2017). Studies show young children aged 3-6 (Kostyrka-Allchorne et al., 2017; Palaiologou, 2016) and toddlers (Danby et al., 2018) are increasingly exposed to digital technologies at home for communication, storytelling, facilitating play and creative activities at home, such as artistic play, and sociodramatic play (Given et al., 2016). These studies all involved important key factors: adult guidance and a clear purpose for using ICT.

Although schools in the study were equipped with technology before COVID-19, teachers’ diverse attitudes toward ICT, ultimately shaped their approaches to incorporating ICT. Findings suggested that while all teachers are familiar with ICT, a significant number expressed concerns regarding its appropriateness and broader implications. Addressing these concerns involves providing technical training and fostering critical engagement with how

ICT aligns with curriculum, pedagogical strategies, and the diverse needs of students. Teachers' reflections underscore the importance of balancing innovation with thoughtful analysis to ensure ICT adoption is supported. This study underscores significant challenges and opportunities in integrating ICT into ECE, providing crucial insights into the TPACK framework.

### **Challenges**

Many preschools experienced challenges in offering online learning to preschool children worldwide in early 2020 (Dayal & Tiko, 2020; Dong et al., 2020). Teachers had limited practical pedagogical approaches for keeping children motivated, encountered technology-related issues during online learning (Mukhter & Chowdhary, 2020), and lacked essential teaching resources for young children. This study's multiple online learning experiences highlighted the importance of age-appropriate approaches, familiarity with digital platforms, consideration of children's existing knowledge and access to resources and parental support.

Although it is universally accepted that young children learn through play, different cultural settings have differing foci on children's play types and associated learning outcomes (McLean et al., 2023; Pyle et al., 2017; Roopnarine, 2012). This study found that the school curriculum and the teaching context shaped teachers' approach to online learning. Free play is associated with inquiry-based approaches in schools implementing the PYP, whereas teachers in S2 and S4, where the English and American curriculum are taught, respectively, emphasised activities supporting children's learning in literacy and numeracy.

Parental involvement positively influences children's learning outcomes, and the continuity of partnerships between the school and home can help children achieve learning outcomes (Hartman et al., 2017). However, parents and teachers face many challenges and unknowns in online learning (Dong et al., 2020). It is difficult to engage children during online learning with inadequate support from parents (Hu et al., 2021). In this study, teachers recognised the crucial role of parental support in young children's online learning as the extent of parental engagement and the family's circumstances influenced children's participation in online learning. Teachers collaborated with parents to emphasise the value of play, providing resources and clear instructions to support children's play and learning at

home (McLean et al., 2023). Additionally, teachers heavily relied on parents to observe and assess children's learning progress. Hence, utilising familiar ICT and approaches aided the transition to online learning to maintain teacher-parent partnerships during online learning.

### **Opportunities**

During the second round of school closures, teachers improved online learning over time. They adjusted their planning processes and collaborated with colleagues more effectively. This led to more engaging online learning experiences. Children had opportunities to engage in digital play (Marsh et al., 2016) and develop early digital literacy (Wohlwend, 2015). With increased parental engagement, parents better understood their child's learning process and development. This involvement fostered stronger parent-teacher partnerships and led to more effective support for children's learning at home. Synchronous and asynchronous engagements offered flexibility for children and families. Parents with scheduling constraints or limited access to traditional face-to-face learning environments could actively participate in their children's education online.

While COVID-19 pandemic restrictions disrupted children's learning, daily routine, social development, and physical development (Bhamani et al., 2020), teachers adapted to this change with asynchronous and synchronous learning to maintain a structured and familiar learning environment. Synchronous learning involves real-time interaction, fostering engagement and instant feedback (Simonson et al., 2019). Asynchronous learning offered flexibility with pre-recorded lessons and self-paced activities, allowing different schedules and learning styles. Initially, teachers relied mainly on asynchronous learning, but the value of synchronous interaction became evident over time. In the second round, teachers used multiple short synchronous meetings and implemented timetables and regular online synchronous meetings to provide a sense of routine and foster online engagement and social interaction. This combination enhanced the overall quality of the learning experience for children as synchronous learning through play and socialisation remained vital to ECE. A more balanced approach to online learning emerged, integrating synchronous and asynchronous methods. Despite the viability of online learning during the health crisis, it cannot fully replace the classroom experience, especially regarding PL and socialisation

(Wasmuth, 2020).

This study found that teachers' attitudes towards and practices of using ICT with young children to support pedagogies of play substantially changed during the COVID-19 pandemic. Building connections with colleagues, children, and parents was the most important part of managing COVID-19 stress (Kim & Asbury, 2020). Home learning impacted children's physical and emotional health and their academic achievement during the COVID-19 epidemic (Gupta & Jawanda, 2020). Teachers appreciated the advantages of using ICT in ECE, such as making learning accessible and engaging. Teachers emphasised the necessity of scaffolding children's ICT use and building digital literacy, highlighting the need for purposeful integration and assistance to foster learning and engagement at home with parents (Dias et al., 2020; Gupta & Jawanda, 2020; Gurwitch, 2020) and in classrooms with teachers.

### **Insights on TPACK**

XK encompassed a wide range of factors influencing teaching and learning in the specific context of this study. This included the uncertainty around implementing online learning in schools, understanding the challenges and adaptations teachers faced during the transition to online learning, teachers' attitudes and the importance of parental support and engagement in online learning for young children.

Teachers' attitudes and comfort levels about ICT integration were important factors even when they were experienced teachers who used ICT daily. Contextual knowledge plays a crucial role in ensuring that teachers are well-informed and equipped to address the specific contextual factors that influence the effectiveness of technology integration in education. Including these factors within the XK domain of the TPACK framework acknowledges their significance in shaping teachers' decisions, strategies, and practices when integrating technology and facilitating online learning. Hence, XK is a multi-level construct in the TPACK framework. However, it remains underrepresented and inconsistently assessed (Brianza et al., 2022).

## Conclusion

This study was based on five international schools offering three programs in China, so the findings may not be generalisable or directly transferable to broader educational settings in different countries. Nevertheless, it provides insights into PL online in the ECE context and draws attention to important considerations of PL online in ECE from the perspective of TPACK.

The COVID-19 pandemic significantly shifted how teachers perceived and used ICT, particularly in ECE. Before the pandemic, ICT was seen as an optional supplement for young children's learning and play, but the transition to online teaching made ICT the primary tool. This accelerated children's acquisition of digital skills and prompted teachers to introduce structured computer classes, dedicated ICT-focused days, and integrate digital tools and resources. ECE teachers helped develop digital literacy skills and navigate virtual environments effectively by providing explicit instructions, scaffolding activities, and ongoing feedback. Recognising the significance of digital literacy skills for teachers and children has been one of the most important shifts in attitude towards ICT integration in ECE. The COVID-19 pandemic has accelerated the integration of ICT in ECE, highlighting the importance of digital literacy skills for teachers and children. Despite challenges, many teachers have embraced ICT's potential and continue to explore innovative ways to enhance their teaching practices. Creating meaningful online learning experiences for younger children goes beyond replicating traditional classroom activities. It involves designing interactive activities specifically suited to the online environment to promote exploration, collaboration, and critical thinking. It requires incorporating age-appropriate elements such as visuals, interactive games, and multimedia resources to capture children's attention and cater for children's interests. Fostering a sense of community and connection is vital and may be achieved through virtual interactions, group projects, and collaborative discussions.

Teachers must develop proficiency with digital tools and platforms to leverage technology to facilitate communication and collaboration. Teachers in ECE require ongoing collaborative professional learning opportunities to use digital tools and platforms effectively. During the second round of school closures, a key approach to fostering informal professional learning was the collaboration among teachers on campus. Promoting networking among

teachers in ECE can contribute to developing a culture of design, innovation and exchange of best practices. This may be extended to include opportunities for peer mentoring and establishing online communities that include parents who play a pivotal role in supporting younger children's adaptation to PL online. This study also shed light on how teachers utilised ICT to maintain teacher-parent partnerships. Schools can also involve parents by providing them with resources and training to support their children's ICT use at home.

Effective ICT integration in ECE hinges on understanding the interplay of TPACK components which significantly influence teaching and learning in evolving circumstances like the COVID-19 pandemic. This study provided unique insight into the role of XK in progressing the application of TPACK in ECE during COVID-19. It highlights that XK encompasses various factors that influence teaching and learning in the specific context of ECE online. By recognising XK as a crucial domain of knowledge within the TPACK framework, the study contributes to our understanding of the complex interplay between technology integration and contextual factors. It emphasises that teachers must be well-informed and equipped to address the specific contextual factors that impact the effectiveness of technology integration and online learning. Furthermore, the study underscores that even experienced teachers who regularly use technology can be influenced by ingrained attitudes and comfort levels regarding technology integration. Providing teachers with ongoing support and resources ensures ICT can be effectively integrated to provide young children with engaging and compelling learning opportunities during changing times.

### **Acknowledgements**

The research was supported by the Australian Research Training Program Scholarship. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### **Statements on open data, ethics and conflict of interests**

This study has been approved by the Murdoch University Human Ethics Committee (Project ID: 2021/167) on the condition that it complies with the National Statement of

Ethical Conduct in Human Research (2007), the Australian Code for the Responsible Conduct of Research (2007), Murdoch University policies and the Human Research Ethics Committee's standard conditions of approval to safeguard participants' interests and privacy. The anonymised dataset is available from the authors upon request, subject to the conditions of approval by the Murdoch University Human Ethics Committee. The authors declare that there is no potential conflict of interest that would influence this study.

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