

Article

A Social Media Analysis of the Experiences of Chinese Early Childhood Educators and Families with Young Children during COVID-19

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Abstract: This study used a small stories research narrative paradigm to examine social media posts that focused on efforts to sustain the delivery of early childhood education during COVID. Inductive and deductive content analysis focused on 1303 posts from 177 government officials and 1126 individual users (including preschools, kindergartens, teachers, and parents). The results include an analysis of conversational data that document implementation of the national policy to promote continuity of young children's learning, including digital resources used, learning content, and teaching approaches. Actor-centric contextual factors determined the success of delivering instruction remotely; however, other contextual components created the conditions that necessitated adaptation of instruction. The COVID outbreak (chrono-level) led to shifts in education delivery and informed national policy (macro-level), influenced the teachers' and parents' work contexts (exo-level), enhanced home-school collaboration (meso-level), and required implementation of technological solutions to support children's learning (micro-level). Contributions to theory, methodology, and practice are discussed.

Keywords: COVID-19; early childhood education (ECE); remote learning; technological pedagogical content knowledge (TPACK); China



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Beginning in 2020, the global coronavirus (COVID-19) outbreak emerged as a large-scale pandemic, not only threatening people's health but also impacting young children, families, and the entire field of early childhood education (ECE) [1,2]. Existing COVID studies have investigated the emotional states of young children and their families [3–7], early childhood educators' stress [8,9], classroom management strategies in a hybrid environment [10], physical activity studies [11,12], and child safety education [13]. However, current research has focused more on positivist paradigms that relied on surveys methodologies to explore parents' attitudes and perceptions [14–16] and kindergarten teachers' educational practices [17], as well as analysis of government ECE policies during the pandemic [18,19]. Among the social media research (SMR) studies, the majority focused on the broader K-12 context [20,21]. SMR studies specific to the ECE field have tended to explore how official policies were enacted in school practices [17,22] or studied the effect of the pandemic on children's remote peer communication [23]. There is a dearth of large-scale SMR investigations specifically focused on the multiple perspectives of early childhood educators and families with young children in China during the pandemic.

China's response to pandemic prevention and control had a striking effect on ECE. China was the first country worldwide to implement a lockdown policy, leading to the initial suspension of classes in 2020 at all Chinese preschools and kindergartens. With nearly 48.2 million Chinese children enrolled in preschools and kindergartens [24], China's COVID policies had a wide-reaching effect on ECE and continues to influence practice today. This study considers how government, teacher, and family factors influenced

Chinese young children's remote learning through social media data together during the COVID-19 outbreak.

1. Background

When the COVID-19 virus hit, Chinese schoolchildren across the nation were heading into the month-long Lunar New Year school break. China extended the New Year vacation nationwide for nine days (from 31 January 2020 to 9 February 2020), and schools remained closed to control contagion and protect children's health (Figure 1). On 27 January 2020 the Chinese Ministry of Education issued the Notice of Extension of the Resumption of Spring 2020 Semester, which required all schools in China to delay the start date of the Spring semester [25]. Thus, more than 220 million students remained at home, including 47 million 3- to 6-year-old children [26]. Subsequently, on 29 January 2020, the Chinese Ministry of Education launched a new policy, *"Disrupted Classes, Undisrupted Learning" Based on Web Platforms* [27], to prevent the virus from interfering with children's continuity in learning. The policy established national guidelines for converting education programs to remote delivery in children's homes. DCUL was the largest online education campaign ever enacted [28], and China became the first country to deliver large-scale remote education to hundreds of millions of students nationwide. Figure 1 details significant time points that affected ECE during the COVID-19 outbreak in China.

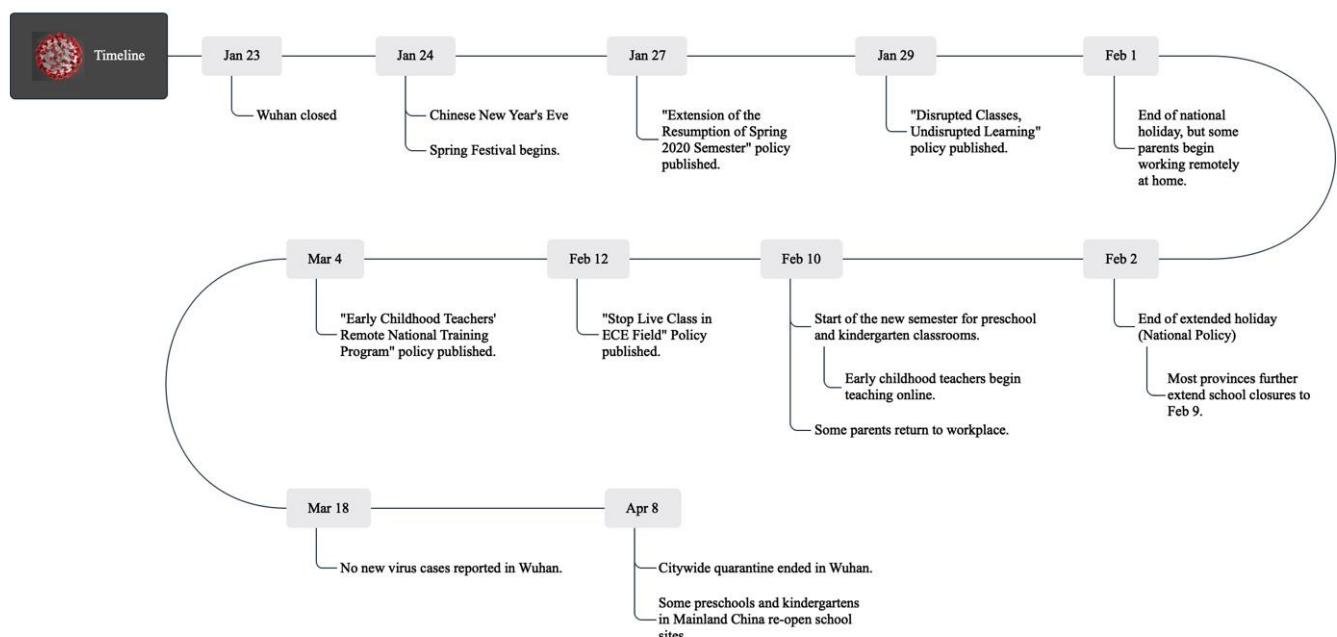


Figure 1. Significant time points [24–27,29–32] that affected young children's learning during the COVID-19 outbreak.

From 29 January 2020 to 9 February 2020, early childhood (EC) teachers urgently initiated preparation for remote education, and they started formal online teaching on February 10. On 12 February 2020, the Ministry of Education and Ministry of Industry and Information Technology further detailed the DCUL work arrangement and published the *Notice of Arrangement for "Disrupted Classes, Undisrupted Learning" during the Postponement for the Opening of Primary and Secondary Schools* [29]. The notice clarified that DCUL not only involved synchronous delivery of live virtual classes but also included a variety of pedagogic approaches to promote students' learning and development. DCUL required teachers to distinguish the actual needs of students of different ages and in different regions and design learning experiences to promote young children's well-being and academic progress. At a subsequent press conference, the Ministry of Education spokesperson stressed that live virtual classes should cease in the early childhood field and noted that

enactment of the DCUL policy should safeguard young children's health by protecting their eyesight from the strain of excessive time in front of digital screens and increase physical movements at home [30].

It is a considerable challenge to convert face-to-face education to remote education in such a short time due to an emergency event. Developing quality virtual environments requires extensive technical support [33] and pedagogic approaches that promote teacher–student interaction [34]. Nonetheless, due to the COVID-19 outbreak, remote instruction became a necessity rather than an option.

Previous studies throughout the world have suggested that remote education for young children is especially challenging and requires additional care because of developmentally inappropriate digital resources or settings [35–38]; remote technical problems without enough supports, including downloading errors, login difficulties, audio, or video problems [39,40]; challenges sustaining young children's attention [41]; concerns about excessive screen time [15]; and the inability of young children, parents, and early childhood teachers to adapt to the changing learning environment [38,42,43]. These studies concur that remote learning for young children has a number of obstacles and limitations.

Research in China has demonstrated that the country confronted similar challenges to those faced by other nations [36] as they attempted to maintain daily routines and activities [17]. Nonetheless, remote education altered the way in which children, peers, and teachers interacted. During school closures in China, there was no face-to-face interaction due to stringent COVID policies [22,23]. Survey studies reported that online learning led to increased stress and anxiety in Chinese families [7], and parents expressed a preference for traditional learning, doubting the benefits of online learning in early childhood [14].

Unlike conventional survey research, this study uses social media research to delve into the experiences of early childhood educators and families of young children in China. Social media posts provide context-specific data that reveal the relationship and interactions between parents and teachers, which are worthy of more investigation.

2. Theoretical Framework

The technological pedagogical content knowledge (TPACK) framework was selected to guide the research. It provides a relevant paradigm for the study of the sudden and unplanned practice of online learning during COVID-19 [44]. Moreover, TPACK (See Figure 2) provides a narrative and visual illustration of seven knowledge domains that combine to create a uniquely situated knowledge set to support effective teaching and learning with technology [45]. Unlike other frameworks used to study technology integration, TPACK uniquely focuses on the contextual factors that influence how effectively teachers use technology [46]. As a result, TPACK is the most frequently used theoretical framework in existing research conducted on ECE technology in China [47–49], demonstrating its culturally-relevant application to the Chinese context.

Although the initial iteration of TPACK described a contextual component that shaped practice [50,51], subsequent researchers [52] have expanded on the original framework and aligned the contextual factors with Bronfenbrenner's ecological approach [53]. These advancements in understanding TPACK recognize that enactment occurs within specific instructional contexts [52,54–56]. In April 2019, Mishra revised TPACK to include XK (Contextual Knowledge) and formally re-conceptualized the contextual factors as a key element in the representation of the framework (as shown in Figure 2).

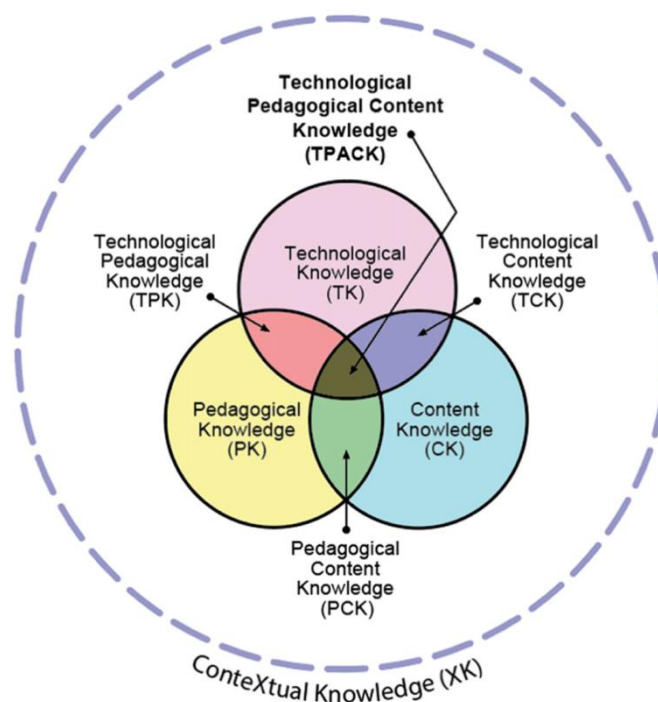


Figure 2. Revised version of the TPACK image (from [57]).

Research on TPACK in ECE has found the contextual factors to be especially salient [58]. The TPACK framework examines the interplay between actors (i.e., the teacher, parents, students, curriculum developer, or administrators) and five multilevel contextual dimensions [54]. When the actor is the teacher, the microsystem is the teacher's immediate environment, such as a particular classroom. The mesosystem involves the interrelation between two or more microsystems in the individual's life, such as the teacher's home and community. The exosystem is concerned with environments not directly related to the individual yet influencing their lives, such as students' homes (where parents are co-actors). The macrosystem includes societal conditions such as the influence of national policies. The chronosystem reflects the influence of time, such as changes in teachers' practices and environmental circumstances. All system levels influence school-home partnerships, with multiple mesosystemic intersections.

Prior TPACK studies have primarily focused on teachers but neglected the other actors at each level, such as parents [54]. There is a need to consider the perspectives of key stakeholders within each level rather than confining the perspective to the teachers alone. TPACK research to date has not studied how teachers and parents as co-actors consider and frame technological integration practice, especially during the COVID-19 outbreak. This study is likely to be among the early studies that document the myriad efforts for home-school collaboration and its transformation under the pandemic.

3. Research Objective and Question

In this study, we explored the design and implementation of instruction by early childhood educators in China during the pandemic. The study used social media (Weibo) posts from co-actors involved in young children's remote learning during COVID (including preschools, kindergartens, teachers, and parents). The purpose of this study was to address the following research question: How did early childhood educators collaborate with family members to sustain learning during the COVID-19 outbreak in China?

4. Methods

Applying a small stories research paradigm [59], this incident-based research describes the experiences of early childhood educators and families with young children in China

as they transitioned to remote learning during the COVID-19 health crisis. The TPACK theoretical framework [45] informed the social media content analysis of posts associated with implementation of the DCUL policy.

4.1. Small Stories Paradigm

The small stories research narrative paradigm [59] was employed in this study to capture a complex phenomenon using purposefully selected incidents [60]. Three separate but interrelated layers guided this study's narrative analysis [59]. First, Weibo social media served as the "site (of the stories' tellings and tales)" which captured the mundane, everyday experiences of the platform's Chinese users. Social media served as a tool for facilitating the creation of professional learning communities and communities of practice among early educators. Second, "the ways of telling" included the use of words, images, and videos in conversational exchanges. Third, "tellers" were the participants on the microblogging platform who communicated their stories and served as interactional partners who received and responded to other users' posts. This study methodology is suited to fragmented social media posts and has been extensively utilized in numerous social media studies [22,59,61].

Two essential concepts of the small research framework guided the selection of posts for analysis: critical moments and telling cases. The critical moments identified incidents worthy of further investigation [59]. The critical moments in this research were defined by the introduction of policies that disrupted normalcy and set additional processes in motion (Figure 2). A key critical moment in this research was the introduction of the DCUL policy in China in response to the COVID-19 pandemic, which defined the initial boundary for data collection and analysis. Another critical moment was the "Stop live class in ECE field" policy. By attending to small stories captured in posts, the data reflected a more contextualized representation, i.e., telling cases [62] that focused on a contemporary issue and explored views directly related to a phenomenon as they unfolded in practice, thereby making visible new insights.

Moreover, the small stories methodological paradigm relied on the researchers' own immersion and participation in social media culture to enable real-time tracking of interactions and responses [59]. This study benefited from the first author's own position as a mother of two early childhood children who participated in early learning efforts in the Hubei province of China. This systematic observation and participation in the activities and postings enabled identification of key posts and adaptive understanding of the small stories.

4.2. Data Source

Sina Weibo means small blogs and is a Chinese Twitter-like microblogging site. Weibo represents the highest proportion of the microblogging market in China, with more than 0.5 billion users. Over 97% of Weibo users are from China [63]. Therefore, researching the data of Weibo can help us understand Chinese people's thoughts over a wide range of subjects. Examples of Weibo posts collected during the COVID-19 outbreak period for this study are shown in Figure 3.

Python code, written specifically for this study, was used for the automatic retrieval of web page content, such as a post's title, hashtag, sender, time, location, comments, likes, and reposts, among others. Data ranged from 29 January 2020, when the Chinese Ministry of Education formally issuing the DCUL policy, to 24 March 2020, when preschools and kindergartens resumed plans for on-site instruction. The researchers only captured "original posts", which included text, video, and images and excluded retweets and promotion.



Weibo Post Examples (Text data-in Chinese Original)	English Translation	Categories
	<p>Today's UCUL schedule has been updated, please check it out! #Pre-school#COVID-19#Early Learner #UCUL</p> <p>Link:UCUL/Parent-child task schedule for Pre-school on February 6</p>	<p>1. Time coding</p> <p>1.1 Before February 12</p> <p>4. Teaching pedagogy (PK)</p> <p>4.1 Plan</p>
Weibo Post Examples (Video data-in Chinese Original)	English Translation	Categories
	<p>xx Preschool xx class xx teacher</p> <p>#UCUL# xx pre-school#Reading is seriously important (location:Chaozhou.Raoping county) xx preschool xx class xx teachers' weibo video.</p>	<p>1. Time coding</p> <p>1.2 After February 12</p> <p>4. Teaching pedagogy (PK)</p> <p>4.3 Assessment</p>

Figure 3. Example of Weibo Posts from the Data Set. *Note.* Hashtag # 停课不停学# means DCUL. For ethical considerations, the identity information was obscured.

DCUL itself was a Weibo hashtag and a hot topic. The collected raw data included the keyword, Weibo post ID (mid), username, created date, content, pictures, videos, user homepage link, brief user introduction, and location. Duplicate data were manually merged, and irrelevant data were manually eliminated. In total, 2962 posts concerning young children and DCUL were gathered, as illustrated in Figure 4. The week with the most posts (i.e., Week 2) coincided with the initiation of remote instruction. Subsequently, the number of posts began to decrease on the first day of week 3 (February 12) when the Chinese Ministry of Education issued a notice to cease delivery of live classes. Given the significance of February 12 as a key critical moment associated with implementation of the DCUL policy, the data were time-coded to facilitate analysis of change over time.

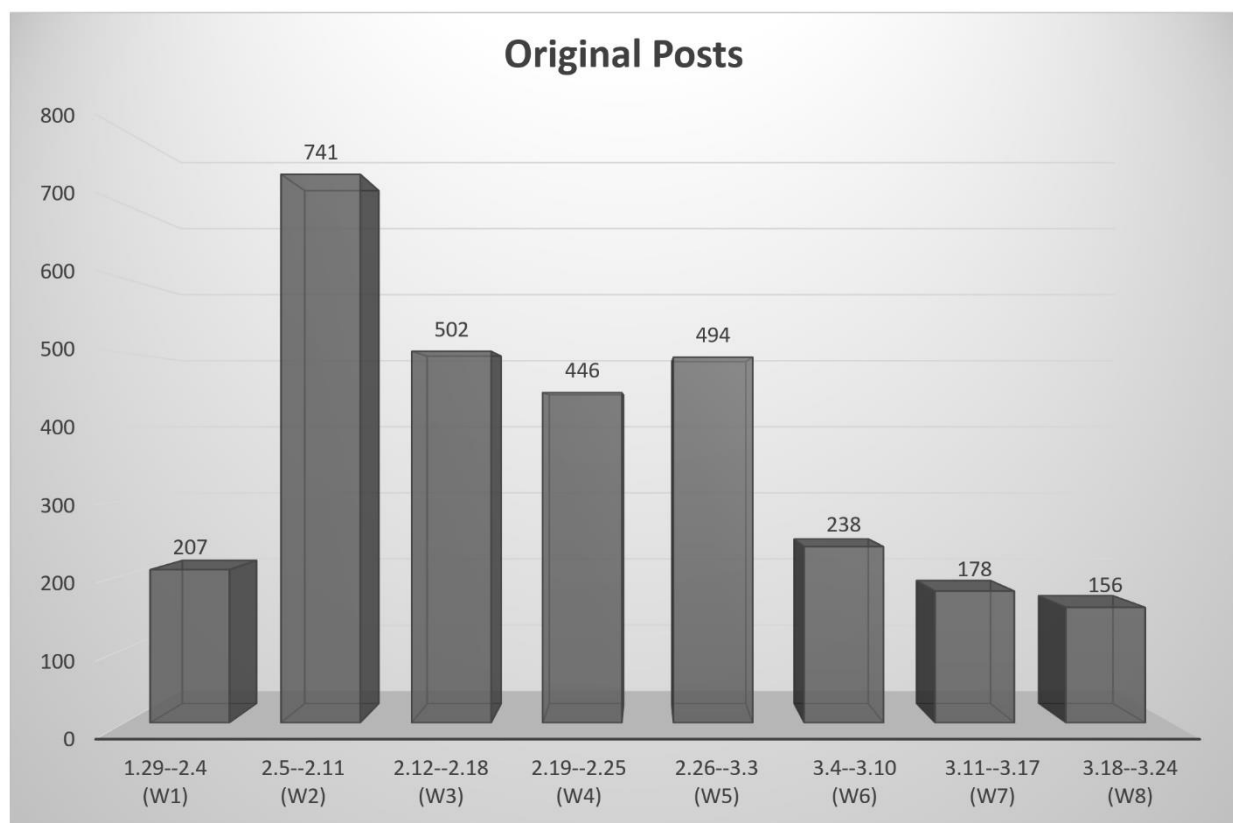


Figure 4. Total number of original posts gathered ($n = 2962$). Note. W1= Week 1.

4.3. Ethical Considerations

Weibo is a publicly available open-access platform, and users intend for their posts to be widely disseminated to a potentially vast audience. Based on standards of practice for research in social media platforms, active consent was neither feasible nor necessary since there is an implicit expectation by the users that they have surrendered the privacy of their content by posting in this public realm [64]. Nonetheless, we anonymized the data to provide additional protection of users' identities. Additionally, all coded data were initially analyzed in Mandarin and translated into English by three native Chinese researchers who are fluent in both languages. These steps ensured that the platform could not be searched to retrieve users' identifying information.

4.4. Content Analysis

Although prior research has demonstrated the value of large-scale quantitative social media studies [63], big data approaches also have limitations in recognizing complex phenomena [65]. Therefore, we used a small stories paradigm, a systematic content analysis technique for interpreting both textual data and visual data [59], to investigate the social media data from a micro-perspective.

Applying reflexive social media content analysis approach [66], the researchers inductively categorized themes and coding schemes and then sorted deductively to align with the TPACK framework. The sorting and coding stages are outlined in Table 1.

In the pre-coding stage of the data analysis, the researchers identified participants whose public posts related to the uninterrupted learning topic ($n = 2962$). Applying the inclusion criteria, the researchers retained individual posts from preschools, kindergartens, teachers, and parents and excluded submissions from irrelevant users such as journalists and technology companies. Several posts by government officials ($n = 177$) included learning and teaching resources. Therefore, the refined coding process focused on posts from government officials and individual users.

Table 1. The coding process, including inductive and deductive approaches.

Stage	Approach	N	Description
Pre-coding 1	Sorting for inclusion	2962	Read raw data and consider the coding process.
Pre-coding 2		1303	Retained posts from government officials ($n = 177$) and individual users ($n = 1126$).
Stage 1	Time coding	1303	Divided all data into two groups based on February 12 and sorted in chronological order.
Stage 2	Inductive	1303	Imported all text data into NVivo software for word frequency output and cluster analysis; identified possible themes.
Stage 3	Inductive	1303	Read and watched all text, images, and video posts, made notes, and organized possible themes. Identified possible examples for each theme.
Stage 4	Inductive and Deductive	1303	Grouped existing themes by topic. Further defined categories based on the TPACK framework. Built the detailed coding scheme (Table 2).

Note. N = Number of coded posts.

Table 2. Coding scheme.

First Level Code	Second Level Code	N	Description
1. Learning stage	1.1 Before Feb 12	410	Time coding
	1.2 After Feb 12	893	Time coding
2. Digital learning resources (TK)	2.1 Technological equipment	339	Smartphone, tablet, PC, or laptop WeChat, Meipian, Douyin, Ding Talk, QQ,
	2.2 Software	248	Weibo, Tencent Online Course, Huawei course marker
3. Learning content (CK)	3.1 General	291	Mathematics, language, arts,
	3.2 Specific	428	Physical movement COVID-19 knowledge
4. Teaching approach (PK)	4.1 Plan ahead	365	Teachers or parents' work before learning.
	4.2 Teaching strategies	834	Pre-recorded lessons Live virtual classes Virtual home visit Others
	4.3 Learning assessment	248	Parents record video Children's artifact Teachers record

Note. N = Number of coded posts. The number of total coded posts is 1303. A post sometimes contains different schemes; therefore, the sum of TK, CK, and PK posts exceeds the total number of posts analyzed.

In Stage 1, the researchers divided the initial possible themes by time coding to explore changes over time. We used Nvivo software during Stage 2 to assist in identifying possible themes with the word frequency output and cluster analysis. Videos were transcribed, and descriptions of images were included in the researchers' comment logs. Following four phase approach [67] to coding visual data, we (1) repeatedly viewed videos and images; (2) identified key themes within the data after reading and re-reading each log; (3) highlighted the representative units of information (sentences or conversation); and (4) created, selected, or grouped categories using similar codes generated for the text-based data (Stage 3). Stage 4 was the culmination of the coding process, resulting in the final coding scheme (Table 2) based on an integration of the inductive and deductive analysis [66,68].

To ensure consistency and accuracy of coding, interrater reliability tests were conducted at the beginning to screen for the inclusion of posts, and a final test occurred at the end of the coding process for the included posts. A sample of approximately 100 posts was randomly selected for each IRR test from the larger database. After the initial selection of posts, there was 89.7 percent agreement between the authors. Subsequent to the final

coding, we re-analyzed the percentage of agreement between the coders, which yielded a marginally greater level of agreement with an interrater reliability of 0.90. Peer debriefing [69] was also conducted by three native Chinese scholars (the first author and two other researchers who have been investigating TPACK for over ten years) to enhance the accuracy of the analysis and to confirm the translation of the information into English. Subsequently, an inquiry audit [69] by the author team provided an additional review process to confirm the trustworthiness of the results.

5. Results

After engaging in the stages of analysis, we investigated the contextualization of responses to DCUL in the remaining 1303 posts. With the closures of educational institutions, COVID-19 drastically changed the home and school learning environments. We organized the findings based on their relevance to the research question and aligned the information with the TPACK framework. The social media data reflected digital resources used (TK), learning content (CK), and teaching approaches (PK), as shown in Figure 5.

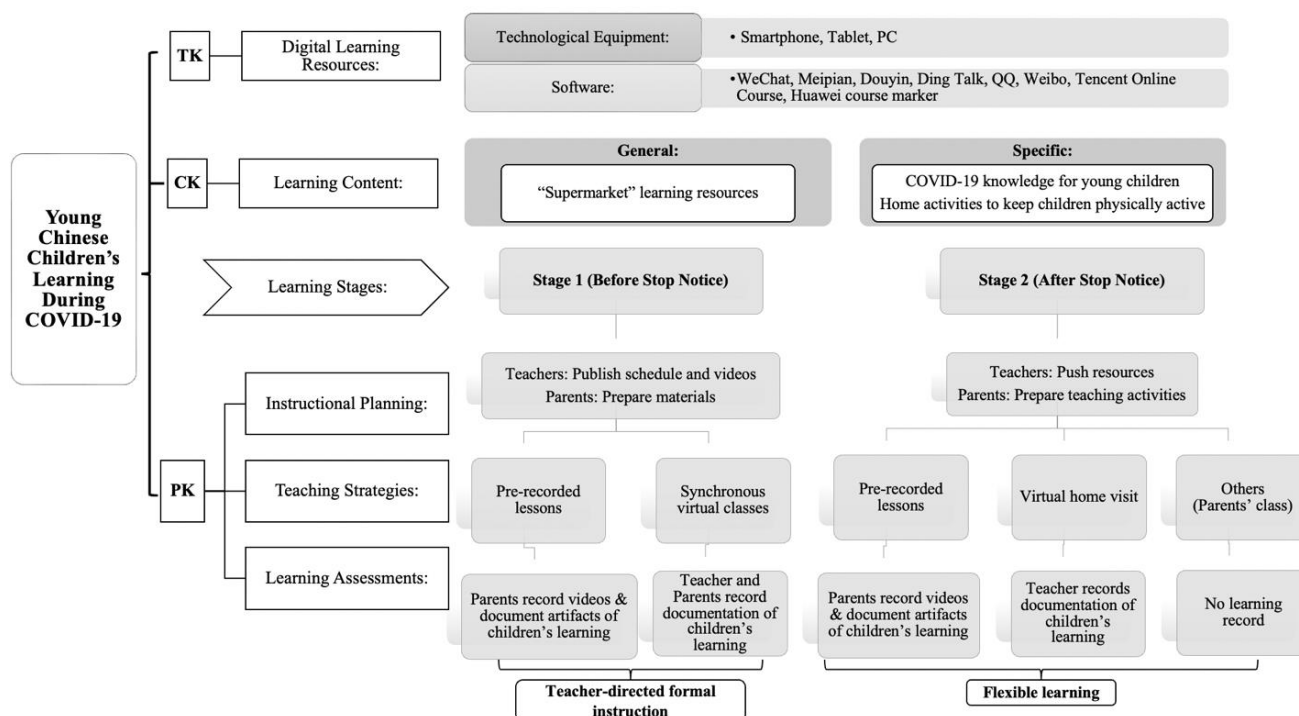


Figure 5. Summary of the Chinese children's learning model during the COVID-19 outbreak. Note. Stop Notice refers to the "Stop live class in the early childhood field" notice on February 12. February 12 was a flexible date for implementation. Some preschools and kindergartens were several days behind in terms of awareness of the Notice and subsequently changed their teaching strategies.

5.1. Digital Learning Resources (TK)

There were 339 posts (26% in 1303 posts) that mentioned technological equipment, including smartphones (240 posts, 70.7%), PC or laptop (68 posts, 20%), and tablets such as iPad (31 posts, 9.1%). Many early childhood educators were quarantined in their hometowns during the outbreak period since they were visiting family for the Spring Festival. Data showed that educators did not use specialized teaching, learning, or recording equipment at home, and the most frequently used device was their smartphones.

Digital learning resources also included software and apps to design and deliver instruction. There were 248 posts (19% in 1303 posts) that mentioned specific apps, and EC educators relied on the resources that were easily accessible on their phones or tablets. Table 3 summarizes the apps and their functions.

Table 3. Summary of apps.

Software	Functions/Features	N	P (%)
WeChat	Communication, Promote resources	53	21.4
Ding talk	Clock in, Publish schedule, Live virtual class	52	21.0
Meipian	Push resources	41	16.5
Weibo	Microblogging site	38	15.3
QQ	Communication, Live virtual class	33	13.3
Tencent Online Course	Live virtual class	15	6.0
Douyin	Publish short videos	13	5.2
Huawei course maker	Course design and maker	3	1.2

Note: N = Number of coded posts; P = Percentage of analyzed posts.

For video recording (audio and video prerecorded instruction), EC educators relied on their phone's video-recording functions or other apps, such as the Huawei course maker app, Douyin. For live-streaming platforms (synchronous delivery), teachers used phone apps such as Ding talk, Tencent Online Course, and QQ. Moreover, teachers used QQ, WeChat, and Weibo as communication platforms for virtual home visits or to disseminate home learning resources to parents. In summary, due to being quarantined at home, the most frequently used devices were smartphones and phone apps to support EC educators' design and sustain undisrupted learning.

5.2. Learning Content (CK)

There were 669 posts (51.3% of 1303 posts) that mentioned learning content, including general subject content (291 posts, 43.5% of 669 posts) such as mathematics, language arts, etc., and specific content (428 posts, 64% of 669 posts), including COVID-19 knowledge and physical movements at home (shown as Table 2 and Figure 5). Some posts contained both general learning content and specific content, especially some government posts. Weibo was a critical platform for disseminating information on free educational resources for young children's home learning that were released by provinces and cities. 69 government posts included learning content. For example, the official Weibo account for Tianjin education published a post on February 10:

#DCUL# Tianjin education departments prepared ten family indoor game activities as a package for each age group of children (3–4, 4–5, and 5–6). Game activities cover five main areas of science, art, society, language, and health. Each package also added additional game activities for epidemic prevention and control.

Teachers' posts often referred to these local and national resources as the "learning supermarket", since early childhood educators and parents were free to "shop" for resources based on their identified needs. The centralized distribution of curated resources removed the burden on teachers to design their own activities from scratch and provided guidance for families as well.

Nonetheless, early childhood educators supplemented these resources with their own homemade mini videos. A total of 369 mini videos were posted, ranging in length from five seconds to five minutes. Most early childhood teachers chose to display only parts of their videos in their posts. About 27% of the videos centered on COVID-19 knowledge, including describing handwashing or explaining the virus. For example, on February 10, a teacher recorded an instructional video that featured a boy made of Legos wearing a mask (Figure 6, picture of the prerecorded lesson), and the Lego character explained to children the reason for the school closures and isolation at home in a way the children could understand.



Figure 6. Main teaching strategies.

It was notable that teachers continued to update learning content over time to further enhance children's understanding of COVID-19 safety measures. A teacher designed and published a series of original nursery rhymes with demonstration video posts after different time points. When the schools initially closed, the teacher composed a song, which included the following lyrics: "COVID-19 is very harmful, we should not underestimate it. Wash our hands, disinfect, and wear a mask to defeat it". On February 8, she created a song with the title of "You look good in a mask". In early March, as cases subsided but the quarantine was still in effect, the teacher created a new video song: "Mask still need it, we have to stay at home, keep a while, and we will be able to go out soon". She subsequently released another video with interactive clapping songs that taught children about the necessary precautions, including daily temperature checks, sleep, exercise, and wearing a mask.

While staying at home was enacted as a safety measure, the policy had unexpected negative consequences. In terms of physical health, the social distancing restrictions led to reduced physical movement [70]. To counter adverse effects among children, teachers described and modeled fine and gross motor activities with common materials found in homes in 43% of the videos. Others focused on alleviating eye strain from overuse of screens, such as this teacher's demonstration video that included eye exercises accompanied by a song:

- Do eye exercises, 1, 2, 3, Let's start!
- Look to the left for 5 s, 1, 2, 3, 4, 5. Return to the middle and stop.
- Look to the right for 5 s, then 1, 2, 3, 4, 5 return to the middle and stop.
- Look up for 5 s, then 1, 2, 3, 4, 5 back to the middle and stop.
- Look down for 5 s, then 1, 2, 3, 4, 5 return to the middle and stop.
- Close your cute eyes and raise your eyebrows five times, 1, 2, 3, 4, 5

The remaining videos were more focused on play-based learning experiences that connected to the school curriculum and standards. These included fun games and activities for holiday celebrations to coincide with events in February and March, such as Women's Day and Arbor Day. In summary, for learning content, early childhood educators developed personalized courses based on the resources released on national, provincial, and city educational platforms, mainly focusing on COVID-19 knowledge and physical movements at home (Figure 5).

5.3. Teaching Approach (PK)

Pedagogical knowledge was reflected in posts focused on planning teaching and learning activities, implementing instruction, and assessment. The results are summarized in Figure 5.

5.3.1. Advance Planning

Overall, 365 posts (28% of 1303 posts) described the preparatory activities of teachers or parents (Table 2). Before February 12 (Stage 1, Figure 5), EC teachers usually published schedules (for instance, the Weibo Text Post Example in Figure 4). Parents were responsible for preparing materials. One mom wrote, “Tomorrow’s online instruction requires parents to prepare ten empty beverage bottles. I am crying. I’m going to look through the trash in the community tonight to see if I can find any”.

After February 12 (stage 2, Figure 5), teachers typically pushed resources to parents, and parents made independent arrangements for children’s learning. The teachers’ workload after February 12 included video recording, preparation for parent classes, virtual home visits (from preparation to assessment), as well as online training and reflection. Early childhood teachers generally felt the workload was too heavy. One teacher wrote on February 26:

#DCUL# Although we don’t need to record videos now, we have to remote check in every day, prepare a parent–child activity to push, and some other temporary events. We have to be forced to study, write reflections, and publish results. It’s really exhausting.

5.3.2. Teaching Strategies

Overall, 834 posts (63.8% of 1303 posts) described teaching strategies (Table 2). For many schools the “stop notice” served as a dividing point for the types of teaching strategies enacted by early childhood educators. According to the first author’s personal experience, before February 12, the teachers at her daughter’s preschool and son’s kindergarten disseminated through WeChat lesson schedules for synchronous instruction, links to connect to the class, an app-guide, and a notice to parents to assist in preparation for each day’s lesson. Live teaching and communication happened every morning. Families logged in, and before the formal start of the live session, children had time to talk and connect with their friends. Parents were expected to accompany their child at all times. The first author and her husband shared responsibility for their children, and each took charge of one of the children every day, switching the following day. The teachers also published prerecorded lessons to facilitate children’s learning. After the “Stop Notice” was published on February 12 (Figure 2), her children’s preschool and kindergarten both announced an end to live sessions, and relied on prerecorded lessons, virtual home visits, and sessions for parents to provide guidance on how to promote early learning in the home (Figure 5). Weibo data presented a similar result and summarized the three main teaching strategies in Figure 6: Prerecorded lesson, live virtual class, and the virtual home visit.

Prerecorded Lessons. Both before and after the “stop notice”, teachers relied on video-recorded lessons as their main instructional strategy. The recording itself had apparent advantages for implementation. First, teachers could prepare learning engagements in advance with no need to coordinate delivery for synchronous access by children and families. One teacher posted:

#DCUL# I recommend using 3–5 min recordings. We can adjust, and children can watch repeatedly. There is no worry about network out-of-sync issues. Our preschool has used various strategies for a while, and I feel that recording has the best outcomes.

However, video recordings required teachers to face complex challenges to ensure that the resources met their students’ developmental needs and sustained young children’s attention. Some teachers experimented with augmenting audio with toy figures or used face filters to transform their own face into a favorite animal. For example, a teacher made a video about a bunny returning home. She added rabbit ears to her head, which made the role-playing livelier and more engaging.

Teachers not only used prerecorded videos to design playful learning experiences that were accessible to their students and flexible for families to watch when convenient for their schedules, but many educators also preferred this modality since they could curate the content and structure the environment to safeguard their own privacy. Using toys with voiceover audio allowed teachers to promote storytelling without featuring their own face on the screen.

However, some teachers were not digitally adept and struggled with designing approaches to keep children engaged and connected to the learning experience. They were aware that children would co-view the videos with their family members, and the educators were sensitive to critiques about their teaching, appearance, and overall demeanor. Since the prerecorded lessons were stored in the school's digital lessons folder, the videos became available to a larger audience of users that extended beyond the students in the class. Content underwent a strict review process, and supervisors needed to approve videos before posting. Parents and children could only access videos after they were released by reviewers. One teacher complained, “#the video review is so unreasonable#, I am going crazy. I need to record it over and over. Negative review opinions can come from anywhere, such as using the wrong words, having a less-than-friendly expression, standing too far away, using too low voice”.

Live Virtual Classes. Typically, during live virtual classes, learners would benefit from real-time interactions, including receiving feedback as needed. However, using remote pedagogy with young children in China required parents to navigate unique dilemmas. One mom recorded her daughter's live learning experience by text and emoji (Figure 7).

Before class: I told my girl: "English class is coming within three minutes, we sit down" My girl said yes with her mouth but was still playing with her toys on the sofa after one minute 😊.

Just started the class: The teacher said hello to everyone, and my girl began to look for the keyword in various ways. I asked her why. She said: "I wanted to say hello to my teacher." Then, she carefully selected all expressions and said she would choose the best one for at least three minutes 😊.

During the lecture: "Mom, I want to drink water"; "Mom, I want to go to the restroom"; "Mom, I want to eat something." She had all kinds of movements in her chair, and then she switched the camera view. After the class, the teacher asked me why my girl's screen was blank for the second half of the class 🙋.

During the discussion: "Mom, why did the teacher not call me when I raised my hand?" I still think that she is very ambitious to get the trophy. I was just happy; the next second, she said, "This is too difficult. No, I don't want to listen anymore" 🙄.

Figure 7. A recorded live learning experience by a mom in Weibo.

This example captured the developmental challenges for young children, who are naturally active, to participate in live online lessons that required them to remain stationary and focused on the screen. Many parents reported that their children did not cooperate at all, and families expressed stress with the responsibility for managing their children's learning. The findings revealed that younger children, ages 3–4 years old, were more disengaged than older children, ranging from 4–6 years old. In China, EC classrooms are divided into three grades: Xiao'ban (3–4 years old), Zhong'ban (4–5 years old), and Da'ban (5–6 years old). A parent commented, "My 3-year-old son can't just sit and watch the screen. He always looks for something else to do and is hard to follow with teachers' remote instruction. I can't handle him". Thus, many parents of preschoolers felt pressure to keep their child engaged.

From the perspective of the early childhood educators, the live classes were especially difficult, and their challenges were reflected in posts with the hashtag #how hard it is for teachers to open online courses at home#. Teachers struggled to prepare remote learning

experiences that retained the essentials of early childhood practice. As early childhood centers throughout Hubei province closed, most schools were not yet ready for unified online lessons, and teachers faced burdensome and stressful workloads to transition to remote instruction. One teacher said, “It is too difficult to condense knowledge into 3–5-min videos for young children”. Early childhood teachers emphasized that it was more difficult for 3- to 4-year-old children because they are so young and needed opportunities to learn through play and movement. Another teacher reflected, “I don’t know how to prepare for 3- to 4-year-old children, should I choose dance or finger movement?”. Moreover, many teachers stated that the centralized distribution of educational resources did not include sufficient tools for young children, and activities needed to be planned that had minimal requirements for materials since children had limited access to supplies while quarantined at home. As one teacher noted, “I must carefully think to choose the lessons that do not need many materials because some children are in their hometowns, even without colorful pens at home”.

During online synchronous teaching, one teacher, who was visiting her parents in her hometown when the quarantine was implemented, commented on the difficulties instructing classes when she did not have her own room and had to share the space of her parents’ apartment. Although she tried to design playful activities to engage the children, she also felt self-conscious interacting with the children while other adults watched her. She stated, “As an early childhood teacher, I really have no face to sing and dance under my parents’ eyes, and I really cannot face my students’ whole families watching me perform for the camera like a moving monkey”.

The teacher emphasized that her live lessons elicited little interactivity. The teacher on one side sang and danced, and the children and their parents on the opposite screens did not respond at all. The children and their families needed support on how to engage in the live sessions, but even with guidelines to clarify expectations, parents often encouraged children to demonstrate obedience by passively observing with little active participation. Given the challenges with synchronous instruction, early childhood classrooms gradually ceased use of the live strategy soon after issuance of the “stop notice”.

Virtual Home Visit. After the “stop notice”, “formal communication among young children, parents, and teachers primarily assumed the form of a virtual home visit”. Teachers typically used communication apps, such as WeChat and QQ, to connect with families for virtual home visits. Early childhood educators preferred using more intuitive and common apps rather than the leading online official communication software (i.e., Ding talk), which is widely used with older children [71]. The data suggested that the group virtual home visits (one teacher talking with more than two families at the same time) was the most common strategy (as shown in Figure 6), and individual home visits (one teacher with one family) supplemented the group sessions. The home visits centered on technology-mediated family engagement to support parent–child interactions to keep children learning and socially engaged during the crisis. Discussions focused on how to embed learning experiences within children’s current living conditions (i.e., regular daily routines, participation in housework, etc.), status checks on children’s social development and emotional well-being, and strategies to educate children about the virus, including developmentally appropriate epidemic prevention knowledge about COVID-19. Teachers provided suggestions and feedback in response to parents’ and children’s questions and helped set realistic expectations for children’s learning.

Based on the data, parents and teachers both approved of and accepted the virtual home visit strategy, although sometimes parents could not obtain the information they urgently needed, such as the date school would reopen. Most parents could understand communicating in the context of uncertainty during the outbreak. However, there were problems with virtual home visits; for example, sometimes young children found it hard to participate, and communication became disjointed when too many families came together. One mom commented,

#DCUL# I prepared the whole day for the virtual home visit; however, at the critical moment, my kid fell asleep. Could you imagine a middle-aged mother wearing a suit on her upper body with pajamas on her lower body facing the embarrassment of the teacher and other families alone?

Other Approaches. Teachers also implemented some informal teaching approaches during the outbreak period, such as parent classes. Generally, a parent class involved the sharing of resources (WeChat articles, Meipian, and other web-based teaching resources), with web seminars and video conferencing occasionally added. The resources included precautions during the outbreak, healthy living habits, family indoor interactive games, and useful educational apps. It is worth noting that the teachers chose resources, especially educational apps, based on their own experiences and internet queries. One teacher stated that her decisions were guided by her assessment of the app's educational value, the cost of the resource, feedback from users in the app review comments, and whether the app design would appeal to young children. Some teachers complained that they did not know whether they recommended the "right" resources to parents. The Chinese government did not provide detailed guidelines about choosing apps for young children's learning, so early childhood educators were left to figure out for themselves how to select resources and provide appropriate guidance to families. Many educators were ill-prepared for this role [47].

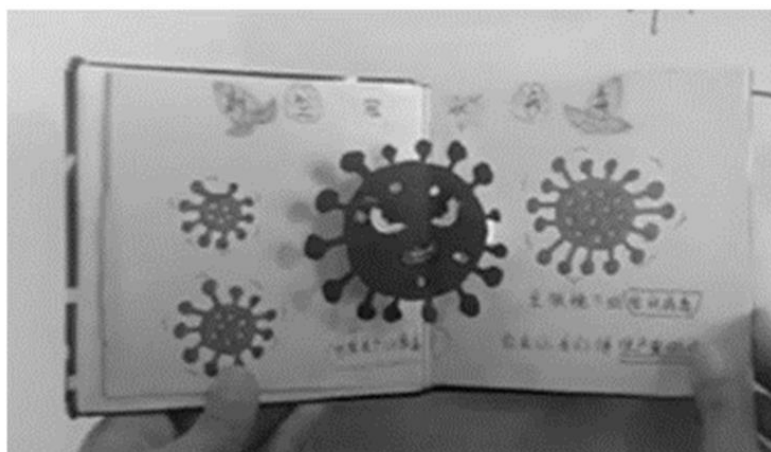
5.3.3. Learning Assessment

Overall, 248 posts (19% of 1303 posts) captured assessments or evaluations of learning (Table 2). Assessing children as they learn from home created challenges for early childhood educators who often rely on careful observation of children in the classroom to see evidence of their growth and learning over time. Remote instruction necessitated alternative approaches for formative assessment, including parents' recorded videos, children's artifacts, and teachers' records. Parents' recorded videos were widely used in the outbreak period after both prerecorded sessions and synchronous instruction led by teachers. Activities were assigned as homework, and parents used smartphones or tablets captured mini videos or vlogs that documented their children as they completed an activity. Then, the parents posted the records into WeChat class groups by the due date. Group members were free to download other families' videos. Teachers provided comments and feedback on the videos submitted by families. Figure 8 includes a parent's documentation of the video screenshot of her daughter completing a physical movement activity while observing the teacher's video. Parents sent the assessment to the class WeChat group. A mom complained in a post:

I have to convince my boy to learn a nursery rhyme from the teacher's prerecorded video every day, and then record his activities and feedback and send the video to the WeChat group to hand in as finished homework. It is really more tiring than going to work! It takes too much time for me!

Teachers also requested parents to take photos of children's artifacts (Figure 8) as part of the assessment process. For example, children used a color pen to draw the virus, cut it with scissors, glued it to paper, and decorated the page with other images to show strategies they learned to stay safe, such as small kids wearing masks. Parents wrote the child's name and the date on the artifact before uploading to WeChat.

Additionally, teachers posted evaluation feedback and formal record sheets, which were often part of the mandated practices of the early childhood centers. Typically, they sent each individual child's report directly to parents via their WeChat account. A whole class report summarized the aggregated outcomes for all of the children and was stored in the class folder. The assessment record usually included children's names, gender, age, virtual home visit times, identification of the caregiver who attended the session with the child, the purpose of the home visit, description of the visit, specific notes about individual children, and notes to identify learning needs and guide instruction in the following days (as shown in Figure 8). One teacher wrote,



Children's artifacts



Parents' recorded video

幼儿园幼儿家访记录

家访记录分析者: 班级: 小班

幼儿姓名	幼儿性别	幼儿年龄

家访时间	家访地点	各自家中视频	被访者与幼儿关系	母子
2020.2.16				

家访原因 (或需要): 了解孩子疫情期间的的生活情况。

家访实录:

师: 新年好! 放假有出去玩吗?

幼: 没有啊。爸爸妈妈, 外面有病毒, 不能出去的。我天天呆在家里。

师: 那在家里每天都做什么呀? 有没有想我呀?

幼: 玩玩玩具。看汪汪队, 爸爸妈妈在家也会陪我玩, 还有爷爷奶奶会带我出去散步。宣老师, 我想你了。我想上幼儿园了。

师: 在哪儿散步? 我也想你, 很快我们就上幼儿园了, 要好好在家听话, 还不能出去玩。

母: 没有出去玩。就有时天气好, 爷爷奶奶会带她在楼下戴着口罩晒晒太阳, 走走。

师: 特殊时期, 还是在家里更安全健康些。可以在家里散步, 听听音乐做运动。

母: 好的好的。一直都在家。孩子身体状态也挺好的。没什么事。

师: 疫情期间还要坚持做好自我隔离和防护哦! 每天有量体温。饭前便后洗手吗?

母: 体温每天晚饭后量, 发到微信群里。吃饭前我们也会提醒孩子洗手。现在有点贪玩, 不好好吃饭了。

师: 建议每天早晨和晚上都量一次体温。为了孩子健康, 家里也要常保持通风, 定期消毒哈。毕竟和长辈一起住人还蛮多的。

母: 好的。谢谢老师提醒了。我们也都注意着健康。卫生。

师: 好的。

幼: 好的。

师: 好的。

Teachers' record

Figure 8. Main learning assessment.

I feel I become a writing worker to write reports every day. I need to record every virtual home visit. Then, I need to replay them to finish the teachers' comments for each child in their separate report. More stressful is to respond to general questions and comments of parents, provide comments on children's learning progress, and brainstorm possible discussion topics for the next virtual home visits to be included in the class report.

Overall, the characteristics of learning before and after the "stop notice" differed. The uninterrupted learning before the "stop notice" involved teacher-directed formal learning; after the "stop notice" remote learning involved more flexible instruction. Flexible learning included a learner-centered constructivist approach that provided children and their families with increased choice, convenience, and personalization by using a range of technologies to support the teaching and learning process [72,73]. After February 12, the flexible learning approach, such as virtual home visits, parent classes, and prerecorded lessons, helped parents feel more self-determined and independent; however, educators continued to feel burdened by the instructional demands.

6. Discussion

Using social media, the results included an analysis of stories in conversational data that document implementation of learning based on multiple actors' practices in China during the COVID-19 outbreak. TPACK contextual factors provided a valuable framework

for understanding the driving forces for technology integration. Early childhood educators designed and sustained learning in response to COVID-19 by adhering to national policies, increasing and changing the nature of home-school collaboration, and using technology to support learning. The early childhood educators were more likely to select digital resources (TK), learning content (CK), and instructional approaches (PK) that promoted home-school collaboration and mutual engagement of parents as co-teachers. Parents supported children's learning by preparing materials, facilitating teaching activities, recording student videos, and documenting artifacts.

The actor-centric contextual factors determined the overall success of delivering instruction remotely; however, the other contextual components created the conditions that necessitated teachers' enactment of TPACK to ensure continuity of instruction. Teachers' practices were influenced at each level. The COVID outbreak (chrono-level) led to shifts in education delivery and informed national policy (macro-level), influenced the teachers' and parents' work contexts (exo-level), enhanced home-school collaboration (meso-level), and required implementation of technological solutions to support children's learning (micro-level).

6.1. The Impact of COVID on Young Children's Learning (Chrono-Level)

The chronosystem accounts for variability across time as contextual factors change [54]. In this study, COVID not only changed the children's daily experiences (microsystem), but it also moved schooling to a technologically mediated environment jointly facilitated by the teacher and parents (mesosystem and exosystem). Subsequently, COVID affected teaching and learning as well as the landscape of home-school collaboration across time. With the passage of time, children changed, the environment of schooling changed, and the approaches to ICT integration evolved to meet shifts in the chronosystem dimension. Most immediately, COVID influenced the format and content of young children's learning. COVID-19 knowledge became common as a topic of instruction, and new remote learning procedures were widely implemented into the teaching strategies. As time has passed, educational strategies may continue to evolve in the post-epidemic era.

6.2. Policy Impact on Undisrupted Learning (Macro-Level)

China's top-down model for enacting and implementing national policies has heavily influenced ECE development in the nation [74]. The findings of this study reflect the effects of the Chinese policies, especially the two critical moments: the DCUL policy and February 12 announcement. Results suggested that educators' transition happened in terms of teaching design, methods, and assessments after the February 12 announcement (Stop Notice). At the macro-level, national policies were instrumental in its influence on encouraging some forms of ICT integration by teachers and discouraging other forms of digital learning with young children. However, the data revealed no substantial increase in play-based learning after policies discouraged synchronous instruction. Conversely, some preschools viewed the policy's prohibition on virtual classes as a push to focus on educational resources, which is consistent with the findings of [17]. As a result, a gap emerged between macro-level policy expectations and actual instructional practices.

6.3. Teachers' and Parents' Work Contexts during COVID (Exo-Level)

The exosystem is outside of young children's daily activities but may still have effects. Young children's undisrupted learning during home isolation was affected by both parents and teachers as collaborative educators. As teachers' work environments suddenly changed from preschool classrooms to their homes, numerous shifts occurred in their immediate environment. Distractions in the home setting, conflictual emotions about teaching from home, challenges in locating sufficient technological and instructional resources from home and adapting pedagogy to delivery in the home setting influenced their practices.

Similarly, for many parents, their work environment changed during the pandemic, and the home became a multi-purpose setting with exo-level impacts on young children's

undisrupted learning experiences. Changes in the physical context of parents' work created conflicts with parents' work assignments, job policies, and work colleagues, which typically did not directly intersect with children but had a significant influence on parents' emotions, family atmosphere, and parents' time to engage in their young child's learning. Other international studies from Ethiopia [75], Italy [76], and the United States [77] show similar effects.

6.4. Collaboration Matters to Sustain Undisrupted Learning (Meso-Level)

Despite the challenges, remote learning by preschoolers in China promoted home-school collaboration. During the regular school calendar, young children are in preschools or kindergartens five days a week and at home on weekends. Home learning provides support for and supplements the school learning system. During the outbreak, the situation changed drastically; the school system became the support and supplement for the home learning environment. Typically when parents opt to educate their child at home, there is little to no involvement of an outside educator [78]. COVID created a special context that elevated family-school engagement through technology. Because of young children's age and skill level, preschoolers required extensive parent support to sustain the continuity of their learning. Conversely, in the undisrupted learning experience, teachers participated by providing remote guidance and assistance rather than direct facilitation of instruction. Thus, the implementation of undisrupted learning in ECE in China involved robust family-school co-education.

The roles of parents and teachers changed during the process of co-education. While delivering remote learning, teachers acted as guides or instructors, facilitators, or assistants. Simultaneously, parents served as supervisors or collaborators as they observed their children participating in the live sessions and aided in their children's learning based on the guidance of the teacher. Other studies [2,17,79] reported similar findings with shifting roles during COVID. In addition, family-school co-education enhanced interaction between parents and teachers. Parents developed a greater understanding of their children's daily learning experience. Similarly, the virtual home visits helped the teachers appreciate their students' family environment and parents' childrearing approaches. Nonetheless, after the synchronous teaching sessions ceased, direct interactions primarily occurred between parents and teachers, and children's opportunities for social communication with classmates and the teacher diminished.

6.5. Centrality of Technological Resources to Implementation (Micro-Level)

Technology was central to successful implementation of DCUL and delivery of remote education during the COVID-19 outbreak [80]. In the early childhood co-education experience, home learning environments for young children transformed into a technology-supported flexible learning space [81].

Nonetheless, the co-education experience also revealed the differential access to technology among families. From the teachers' and parents' voices, the authors became aware of the fact that digital resources are in short supply, and it was challenging to supplement these resources during the quarantine period. The most frequently used digital resources were smartphones, which parents and teachers personally owned. However, this led to conflict because children needed phones to access online resources, and parents simultaneously required their phones to work at home. Moreover, issues of inequitable access to technology undermined opportunities for children from under-resourced families.

Concerns remain in ECE about how to best facilitate meaningful interactions through online learning. Recent research suggests that remote learning involves less collaborative engagement than in person interactions [82]. Future research still needs to discern whether the challenges of technology-mediated synchronous instruction were associated with the developmental capacity of young learners or more reflective of the pedagogical practices of the teachers in this new environment. Numerous studies have shown that young children can become digital storytellers [83], media creators [84], and computational thinkers and

coders [81] with appropriate pedagogies. Therefore, effective instructional strategies for remote learning with young children need further exploration.

7. Limitations

There are several limitations associated with the methodology used in this research. Social media posts are not a collection of purposeful research data and were created by users based on their own interests and activities, so there are inherent biases in the available information that may skew the findings. Generating data requires access to a smartphone and internet connection, which may bias the data due to differences in socio-economic status. Moreover, social networks may have geographic differences in popularity, so the research may lack representativeness of educators and families from rural areas or communities that generate less social media content [64]. Even if the amount of data retrieved is sufficient in quantity, it may be curated by users or organizations, leading to information loss. Users may delete their original posts during or after collection. Additionally, the Chinese government censors Weibo posts to suppress rumors and sensitive content [64], which may have resulted in missing posts. It is also impossible to avoid subjectivity when analyzing content during the coding process, especially the first author's position as a mother who participated in this initiative. Users typically posted mundane, ordinary, and trivial events or moments from their everyday life, and these threads were woven into the analysis. In the small research paradigm, social media posts present a fragmented telling that lacks the full context of the story [59]. Additionally, since adults posted on Weibo, the article is missing children's voices.

8. Contributions and Implications of this Study

To date, TPACK research has not investigated how teachers and parents, as co-actors, frame technological integration practice, particularly during the COVID-19 outbreak. By considering a variety of ecosystem elements and their interrelated connections, the contextual-based TPACK theory provided a lens to gain a comprehensive understanding of teachers and parents as co-actors to facilitate young children's remote learning in China. Although there have been numerous micro-level studies, research at the meso-level, exo-level, and other levels in the Chinese ECE context is lacking. By using the updated iteration of the TPACK model and aligning the analysis with the contextual factors of Bronfenbrenner's ecological approach, this study bridged the gap.

This study also contributes insights for the methodology. The majority of existing SMR research has focused on a single activity or specific event, such as remote peer communication [23] or virtual home visits [22]. Rarely have publications integrated a micro perspective with the small story paradigm to get a picture of the learning of young children. This research provides evidence of these occurrences.

This study also contributes the following useful applications. First, it highlights contextual factors, especially cultural and technological contexts. Second, although there are many studies on young children's learning during the COVID period [17,85–87], few studies have comprehensively summarized young children's learning through large data and at various levels with multiple actors. China was the first country to enact nationwide ECE policies for remote learning. The implementation of large-scale co-education in China represents not just a crisis response plan but also an exploration of technology-based teaching and learning approaches for young children by the Chinese government, preschools and families (multi-actors). The practices outlined in this article provide a detailed reference for other countries regarding disrupted learning in ECE. Moreover, this article offers a preliminary analysis of the large-scale implementation of co-education for young children while staying at home. This comprehensive introduction demonstrates how a top-down country like China can achieve large-scale family-school co-learning with the support of technology. Subsequent research into the continuity of learning during the COVID-19 epidemic should explore the many social issues that deserve further analysis. The concerns of families of children with exceptionalities, children from under-resourced

homes, and differential access to quality education between urban, suburban, and rural areas reflect a few of the critical areas for ongoing investigation.

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