

# Applying activity theory to examine mobile application mediation of engagement and curriculum tensions in Chinese preschool

Yufan Zhang<sup>1</sup>, Nurul Nadwa Zulkifli<sup>2</sup>, Ahmad Fauzi Mohd Ayub<sup>3</sup>, Nur Raihan Che Nawî<sup>4</sup>

**Abstract:** As a response to the global impact of educational technology, the incorporation of technological tools into Chinese kindergarten settings is increasing. However, this has created a tension between using interactive technologies to increase student engagement, while still aligning with national early childhood education standards which advocate for hands-on, culturally responsive forms of learning. This study applies Activity Theory to better understand this systemic tension, while exploring the integration of a mobile app entitled "Preschool Treasure" within kindergarten settings. Through a qualitative single case study approach and drawing upon multiple data collection methods, including interviews with 6 teachers, 20 video observations of classroom practices, and policy document analyses, this study examined the relationships among digital tools, educational agents and 1 educational institution. The study revealed that contradictions between the design of the app and its pedagogical objectives have become educational possibilities instead of educational barriers. This research illustrates how the educators perceived the imperative to modify their pedagogical intentions during the incorporation of the application into their practice. By exploring a new application of mobile technology in Chinese kindergartens, this research highlights key drivers of sustainable integration: user engagement, cultural adaptability, and teacher professional autonomy. The study presents a pathway towards educational technology co-design that is collaborative and supports educators' contextual and curricular priorities.

## Article History

Received: 13 October 2025

Accepted: 20 January 2026

## Keywords

Digital teaching tool; Digital resources; Chinese preschool education; Activity theory

## Introduction

Globally, educators are taking advantage of more digital tools in early childhood education to increase student engagement, as well as student learning outcomes (Grimus, 2020). This is formally encouraged in China by the Ministry of Education of the People's Republic of China (MOE) with the call for the digital transformation of early childhood education (Ministry of Education of the People's Republic of China, 2025). Kindergarten teachers in China face systemic contradictions where interactive technologies like mobile apps risk displacing hands-on, culturally rooted pedagogies mandated by national standards (Huang et al., 2019). Despite the benefits of modernization, teachers in China are confronted with a conundrum between the need for culturally relevant practices and a reliance on standardized digital capabilities. Recent increases in the use of standardized mobile applications provide many engaging digital tools that allow children the advantage of engaging in creative and active learning, however teachers in Chinese kindergarten find it challenging to connect these two forms of instruction with the use of culturally relevant pedagogy mandated by their national standard. While interactive mobile application like "Preschool Treasure" are being used more frequently, kindergarten teachers are still challenged to situate their interactive features within established lesson plans, ultimately presenting a tension between new educational practices through technology and existing educational norms involving playfulness and

<sup>1</sup> University of Putra Malaysia, Faculty of Educational Studies, Department of Science and Technical Education, Serdang, Malaysia, e-mail: [gs61700@student.upm.edu.my](mailto:gs61700@student.upm.edu.my), ORCID: <https://orcid.org/0009-0004-7617-4485>

<sup>2</sup> University of Putra Malaysia Sarawak, Faculty of Humanities, Management and Science, Department of Science and Technology Directory, Bintulu, Malaysia, e-mail: [nurulnadwa@upm.edu.my](mailto:nurulnadwa@upm.edu.my), ORCID: <https://orcid.org/0000-0002-2232-3885>

<sup>3</sup> University of Putra Malaysia, Faculty of Educational Studies, Department of Science and Technical Education, Serdang, Malaysia, e-mail: [afmy@upm.edu.my](mailto:afmy@upm.edu.my), ORCID <https://orcid.org/0000-0002-4313-2922>

<sup>4</sup> University of Putra Malaysia, Faculty of Educational Studies, Department of Professional Development and Continuing Education, Serdang, Malaysia, e-mail: [nurraihan@upm.edu.my](mailto:nurraihan@upm.edu.my), ORCID: <https://orcid.org/0000-0002-7210-9430>

cultural relevance.

Although digital teaching may focus on subject specific academic goals in Primary Education, preschool focuses on developing holistically, including social skills and peer culture (Parker & Thomsen, 2019). For example, according to Palaiologou (2020), teacher's ability to successfully integrate digital tools into their play-based curriculum is a frequent challenge. As such, many early childhood educators are looking for ways to support social interactions through digital tools instead of providing isolated instruction with these digital tools (Ford et al., 2021; Undheim, 2022). To facilitate engagement, there needs to be consideration when developing a mobile application in the early childhood classroom, to assist teachers and students in meeting their needs. To achieve meaningful use of mobile applications in this context, it is necessary for researchers to move beyond examining just the application's functionality. Investigating the relationship between the cost, ease of use, and adherence to national curriculum standards is very important since these factors are critical to meeting students' and educators' true needs. The interaction between digital tools being introduced into an established community has proven to be a complex issue that requires further thought. Because Activity Theory provides an analytical framework to identify and analyze conflicting elements of the overall learning environment, researchers will utilize Activity Theory (AT) in this research project to understand how mobile applications can be successfully integrated into a kindergarten in China on a long-term basis.

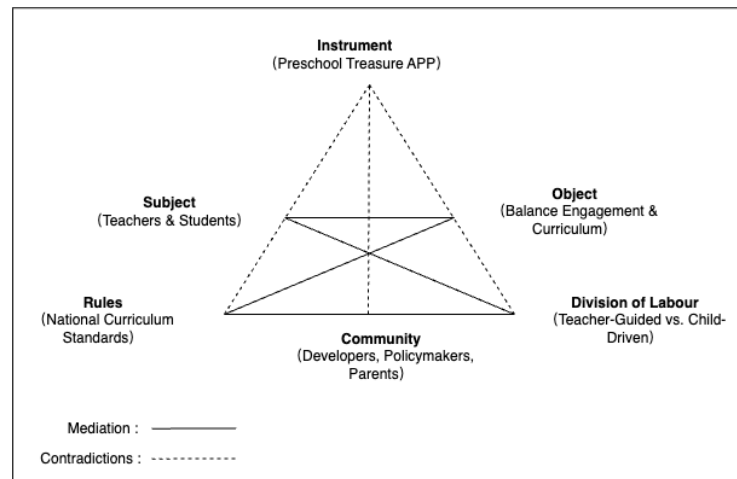
AT and the cultural debate to analyze these complex dynamics, for the purpose of analyzing the complexity associated with these interactions, the present research study uses the third generation Activity Theory (Engeström, 2014) as the framework through which to inform its analysis of the data. The third generation AT provides an alternative theoretical approach to viewing the use of technology in the classroom; rather than viewing the use of technology in the classroom as an isolated instance of technology use, the AT provides an opportunity to view the integration of technology in the classroom as a system of interacting parts that includes multiple sources of interaction. The Activity Theory consists of six interconnected elements: (1) Subject (students, teachers) seeking an Object (educational outcomes such as engagement, numeracy), mediated by the Tool (Preschool Treasure application), (2) Rules (implicit and explicit; e.g., national policy, cultural norms), (3) Community (families, school administrators), and (4) Division of Labor (roles within the classroom). AT establishes an innovative research framework to examine the collective outcomes generated by educational tools and subjects (Burner & Svendsen, 2020; Engeström, 2020). As Zhou and Yang (2025) explain in their research on STEM education, Activity Theory maps the interrelationships between curriculum and technology in Early Childhood Education. In particular, Engeström (2014) identifies Activity Theory as a mechanism for examining the integration of technology into learning environments by highlighting the interactions of tool, subject and object to inform effective technology integration. Educational technology research frequently examines how digital tools alter student interaction and engagement. For instance, Liaw et al. (2010) highlighted the significance of these tools in facilitating collaborative learning. There is information on the link between changing the curriculum and getting children involved in early childhood education using AT, especially in Chinese preschools outside of Western countries.

The current study was driven specifically by previous discussions about the significance of cultural context in Activity Theory. While many articles prior to this have shown that contradictions between nodes (contradictions in systemic structure) are the primary driver of innovation in Activity Theory, researchers have pointed out that several Activity Theory articles and studies do not apply sufficient theory to explain the impact local culture has on Activity Theory's application (Cong-Lem, 2022; Schmidt & Tawfik, 2022). Hopwood (2022) and Pettersson (2021) demonstrate how Activity Theory often considers digital tools to be "culturally neutral", overlooking their incompatibility with the educational values of many non-Western cultures. To fill this void, the present study analyzes the Rule-Tool contradiction as it appears in a Chinese context. We assert that the dissonance between the standard design practices of Western educational app developers (Tools) and China's policy mandates for "culturally responsive pedagogy" (Rules) is more than a technical issue, it represents a vital theoretical point of reference for understanding how cultural adaptability serves as a mediator for creating an Activity Theory.

This study addresses this theoretical gap by examining the Rule-Tool contradiction in a Chinese context. We propose that the dichotomy of China's national policy regarding culturally appropriate pedagogy (Rule) versus educational applications (Tool) creates a theoretical space for understanding how cultural adaptability serves as a missing link between Activity Theory.

**Figure 1**

*Activity Theory Framework for Preschool Treasure Integration*



Through the use of Activity Theory frameworks, Activity Theory provides a lens to view the ways in which the design of the app does not support the educational purposes of the app being developed. The following diagram illustrates how the dual integration of Preschool Treasure creates systemically based contradictions. For example, during a math lesson in an urban kindergarten classroom, students were more focused on dragging animated pandas (the tool) than ordering numbers (the object). The instructor was subsequently forced to revert to physical manipulatives, thereby dividing the work through both physical objects use and the use of technology. These cases are consistent with Engeström's assertion that contradictions are not weaknesses, but rather opportunities to reconfigure our tools and practice (Engeström, 2014). This framework makes evident that many of us continue to employ tools that are not aligned with either our cultural or curricular goals, as well as potential solutions such as modular app design. Given the complicated, multilayered, and sociocultural nature of the challenges of integrating mobile apps into preschools in China, an analytical framework that moves away from simplistic cause-and-effect relationships and instead examines the sociocultural tensions that exist in the educational context is necessary. This research employs Activity Theory as the analytical framework to explore the interdependent and multidimensional ways that human activity works.

Studies on technology utilization in early childhood education focus on cognitive outcomes (Hamilton et al., 2021; Mertala, 2019) and teacher acceptance (Granić & Marangunić, 2019; Scherer et al., 2019), ignoring the inherent contradictions associated with these pedagogical approaches. Activity Theory employs contradictions to facilitate change (Blayone, 2019; Von Fircks, 2024) while offering a comprehensive framework for analyzing teaching environments, encompassing teachers, children, resources, regulations, and learning outcomes. The framework shows that integrating technology goes beyond just installing it; components need to be able to handle interactive tensions in real time. Research does not employ systematic methodologies to elucidate the utilization of mediation by mobile applications as a resolution for classroom contradictions, thereby impeding effective and sustainable pedagogical advancement.

Chinese preschool observations along with media reports validate three ongoing contradictions in educational practices. Preschool teachers encounter difficulties when integrating Augmented Reality (AR)-based storytelling activities within app-initiated curricula due to fixed educational sufficiency periods (Dias et al., 2020; Yan & Wang, 2022). The gamified approach of Babybus cited in Khasanah et al. (2023) does not provide enough flexibility to accommodate curriculum-specific needs such as ethnic minority

cultural integration in rural areas thus causing tool-design to disconnect from educational objectives. Professional development programs never teach teachers how to think critically about the relationship between technology and child development while improving teachers' app operations and technical abilities (Núñez, 2023). The issues show a broken relationship where mobile apps present one of two problems either they force strict assignments or break learning structure through multiple disconnected tools.

This research constructs Activity Theory to study mobile application mediation of the education system dilemmas between student engagement and curricular adaptation within Chinese preschools. The research depends on contradiction analysis to create practical and theoretical knowledge regarding human-centered technology integration. Specifically, it explores:

RQ1: How do contradictions within the preschool Activity Theory shape the integration pathways of mobile applications?

RQ2: What mediating role does application design play in aligning curriculum adaptability with sustained child participation?

RQ3: How do teachers negotiate the tension between strict curriculum standards and the demand for interactive, technology-enhanced pedagogies?

### Method

The research adopted a qualitative case study design to explore the integration of the *Preschool Treasure* a mobile application designed to assist teachers by incorporating kindergarten lesson plans, activity schemes, and schedules, into Chinese kindergarten teaching practices, while facilitating student engagement for curriculum reform. Given the complex ecological context of Chinese kindergartens, this study adopted a qualitative approach similar to prior investigations of early childhood technology (Weng & Li, 2020; Yang & Dong, 2024). This method allowed for the collection of rich, descriptive data regarding the *Preschool Treasure* app's function and its impact on teachers and students nuances that are critical for understanding sustainable integration (Creswell & Poth, 2016). Three primary methods: semi-structured interviews, classroom observations, and document analysis were employed to collect data, thereby ensuring methodological triangulation to enhance the research's validity (Bell et al., 2019; Morgan, 2022; Ruslin et al., 2022).

### Participants

Six teachers were purposively selected from a Chinese kindergarten context, which serves children aged 3 to 6 years. Participants were chosen based on their demonstrated digital proficiency in the classroom. Table 1 displays the diverse range of teaching experiences and educational backgrounds represented by the participants. This ensured that the sample would capture knowledge of how the application worked in a variety of teaching situations.

**Table 1**  
*Participants Profiles*

Teacher	Years of Teaching Experience	Educational Background	Classroom Size
A	Half Year	Master's in Early Childhood Education	25 Students
B	20 years	Diploma in Early Childhood Education	20 Students
C	5 years	Master's in Early Childhood Education	22 Students
D	3 years	Masters in Curriculum Design	24 Students
E	9 years	Bachelor's in Early Childhood Education	18 Students
F	2 years	Master's in Early Childhood Education	23 Students

### Data Collection

This study employs a qualitative research design grounded in Activity Theory to thoroughly investigate the mediating role of mobile applications in preschool classrooms. Through multiple qualitative

data sources, it seeks to interpret the complexities of teacher-child-tool interactions. Triangulating semi-structured interviews, participant classroom observations, and document analysis, the research emphasizes interpretive understanding of subjective experiences, contextual practices, and textual meanings. To ensure the reliability and depth of the data, classroom observations were conducted using a systematic and rigorous procedure. The observations took place at the public kindergarten in the northwest region of China.

The table below details the qualitative data collection procedures, analytical strategies, and their alignment with the research questions.

**Table 2**  
*Data Collection Details*

<b>Data Collection Method</b>	<b>Data Collection Details</b>	<b>Analysis Approach</b>	<b>Link to Research Questions</b>
<b>Semi-structured Interviews</b>	Participants: Preschool teachers (6) and app developers (2). Format: Audio-recorded, 30–45 minutes per session. Focus: <ul style="list-style-type: none"> <li>Teachers lived experiences of tensions between curriculum and engagement.</li> <li>Perceptions of app design’s adaptability.</li> <li>Narratives of negotiating structured vs. emergent practices.</li> </ul> Tools: Interview guide with open-ended questions.	Interpretive Thematic Analysis: <ul style="list-style-type: none"> <li>Transcribe and iteratively code transcripts.</li> <li>Generate themes.</li> <li>Interpret themes through Activity Theory’s contradictions and mediation concepts.</li> </ul>	RQ1: Uncover contradictions in the activity system.  RQ3: Reveal teachers’ meaning making in tension negotiation.
<b>Classroom Observations</b>	Scope: 20 classrooms using Preschool Treasure. Duration: 2–3 weeks per classroom; 15 hours of video/field notes per site. Focus: <ul style="list-style-type: none"> <li>Naturalistic teacher-child-app interactions.</li> <li>Contextual factors shaping curriculum adaptation.</li> <li>Emergent engagement patterns.</li> </ul> Process: <ul style="list-style-type: none"> <li>Collected contextual information related to the environment where the study was taking place</li> <li>Recorded a chronological log of both teacher and student behavior as well as technical fidelity</li> <li>Used a thematic checklist to assess how often teachers engaged in different pedagogical (teaching-related) behaviors</li> </ul> Tools: Field notes, selective audio-visual recordings (ethically approved).	Activity System Mapping: <ul style="list-style-type: none"> <li>Code interactions using AT components (subjects, tools, rules).</li> <li>Identify contradictions through critical incident analysis.</li> <li>Construct vignettes to illustrate mediation processes.</li> </ul>	RQ1 & RQ2: Explore how contradictions manifest in practice and how tools mediate them.  RQ3: Contextualize teacher strategies.
<b>Document Analysis</b>	Sources: <ul style="list-style-type: none"> <li>Teacher lesson plans (digital/physical).</li> <li>App design documents.</li> <li>Institutional policy texts.</li> </ul> Focus: Discursive alignment between stated goals and operational practices.	Critical Content Analysis: <ul style="list-style-type: none"> <li>Thematically code documents for implicit/explicit contradictions.</li> <li>Compare policy rhetoric with classroom/app design realities.</li> <li>Triangulate with interview and observation data.</li> </ul>	RQ2: Examine how design documents mediate (or hinder) curriculum-engagement alignment. RQ1: Trace systemic contradictions in policy-practice gaps.

## Data Analysis

Data analysis follows an interpretive qualitative paradigm, constructing meanings through iterative engagement with data and Activity Theory. First, interview transcripts are line-by-line coded in NVivo to generate open codes, refined via constant comparison into themes and mapped to AT nodes. Data analysis is conducted from the collected observational information using activity system mapping, identifying major events and developing vignettes to demonstrate mediated action. Document review is conducted

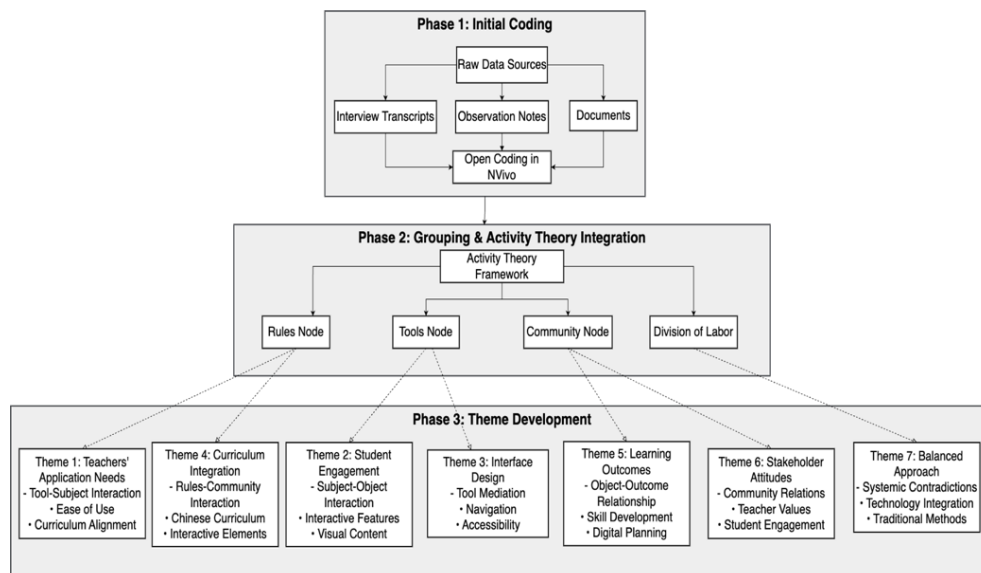
using critical discourse analysis. Triangulation, along with reflexive journaling, has been utilized as verification techniques to ensure validity and eliminate researcher bias.

The study used thematic analysis to examine the interview transcripts, observation notes, and documents. In this process, an inductive-deductive method was applied to the data with open codes generated first (Braun & Clarke, 2023), followed by the application of the Activity Theory Framework. A systematic three-phase method based on the Activity Theory Framework and qualitative methodology was applied to analyze the interview transcripts. During phase 1, the transcript of the interview, observation notes, and documents were reviewed line-by-line in NVivo for open codes. Using the constant comparison method, detailed notes were created for significant codes. In phase 2, codes were grouped into categories and matched with Activity Theory nodes to identify systemic contradictions and create activity theory maps for critical incidents. In the third phase of theme development, the codes developed based on theory were synthesized into 7 major themes, each linked with a particular component of Activity Theory as depicted in Figure 2. These themes responded to research questions related to the contradictions in the preschool activity theory framework, the mediation of curriculum delivery by Application Design, and teachers' response to the tensions caused by structured curricular delivery methods compared to technology-mediated engagement practices.

Although the primary coding was completed by the lead researcher to maintain consistency in the study, validation of findings through member checking with participant teachers and peer debriefing for further creation of coding structures assured that findings were validated and not merely the individual bias of the researcher (Creswell & Poth, 2016). The systematic approach allowed for a comprehensive examination of the data providing insights into the complex dynamics surrounding the integration of the “Preschool Treasure” mobile application.

Building on this analytical framework, the themes identified in this study emerged through a deliberate and iterative qualitative data collection and analysis approach. These were closely related to the four main research questions of the study, which aimed on comprehending the usage of the Preschool Treasure app in Chinese kindergarten classrooms.

**Figure 2**  
*Data Analysis Process*



### Validity and Reliability

In order to minimize researcher bias and rely on empirical data instead of recalling from memory, we added descriptions of the quality assurance steps, we take during our rigorous data collection process. Included in this process are the use of video recordings so that researchers could verify their live field notes and backtrack if necessary to provide retrospective verification, the use of thematic checklists for behavior

tracking after every session so that researchers can accurately identify critical incidents. The investigation was validated through three methods which included both methodological triangulation and member checking and reflexivity. Member checking provided interview participants with the opportunity to validate research results, but methodological triangulation used cross-analyses between interviews and observations alongside documents. Team sessions performed regularly functioned to maintain reflexivity through the discussion of researcher biases. According to Cypress (2017) these methods followed established qualitative research protocols to enhance reliability together with credibility of the study.

This study took place in a kindergarten with both teachers and children as participants. Due to the nature of the setting, ethics were of utmost importance throughout the research process. The study has followed the ethics outlined by an University as well as the ethics required by the kindergarten in China in which the research was conducted. Permission from the kindergarten was obtained before beginning any data collection. The teachers were given an information sheet about the study including the purpose of the study, how it would be conducted and possible risk associated with the study. All six teachers were asked to provide written consent to participate in the study and were informed in writing that they could withdraw from the study at any time without penalty or prejudice professionally. While the teachers were the main participants in the study, children were also part of the observation process. Therefore, passive consent notifications were sent to parents informing them of the researcher's presence and the use of video recording for research purposes. To help ensure participant privacy during the study, anonymity and confidentiality procedures were followed strictly. Therefore, the names of the kindergarten and teachers were changed (e.g., Teacher A, Teacher B) in all transcripts and final reports. Any identifiable information of students that was included in the observations was redacted. The data collected during the study included video recordings of 20 observation sessions as well as audio recordings of interviews. All such raw data is stored securely on a password-protected and encrypted hard drive with access limited to the researcher. It is important to note that the researcher acted in a non-intrusive manner while conducting the observations, in order to minimize disruptions to the learning environment. The observational protocol was designed to ensure that neither the use of the "Preschool Treasure" app nor the research process could negatively impact the psychological well-being or educational progress of the students or teachers.

## Findings

The first round of coding produced many commonalities about how the teachers used the Preschool Treasure application. The computer programmers derived codes from their review of the digital transcripts of the interviews through an iterative process that produced codes such as, "app navigation struggles" and "unexpected child discoveries," with, "curricular alignment struggles." Teacher A shared how children would become so captivated by the characters from Preschool Treasure, that they were distracted from the learning rationale behind the activity. Teacher A also described the interface of engagement (children's curiosity and interest) overtaking the learning during a segment of the interview, which he termed "engagement-learning tension." The observation notes showed that the children were very engaged during the interactive experience, but they didn't connect what they learned to any of the learning goals that had already been set for the activity. The researchers engaged in a continuous comparison process that not only improved their initial coding but also facilitated the recognition of the nuances between the use of technology in preschool (or classroom) settings and its applications for learning objectives by analyzing how pedagogical expectations (transitions) were identified in the classroom.

The comprehensive mapping of the codes helped to identify systemic relationships among the components of Activity Theory, which was an important part of the coding process. The "app navigation struggles" codes were placed under the Tools part of the analysis. This gave the researcher an indication that children had trouble finding their way around when they used Preschool Treasure to learn. By mapping the data to the Rules node of the activity system, the analysis examined the alignment of learning goals. This process revealed a systemic contradiction: a clear misalignment existed between the application (Tools) and the pedagogical expectations mandated by institutional policy (Rules). The coding of parent-teacher communication regarding the app's utilization was categorized under the Community mapping

dimension, as these communications between the teacher and parents influenced the implementation of the application. When teachers used *Preschool Treasure* to analyze the division of labor, they changed their responsibilities or teaching roles. The children acted as navigation guides while the teachers were there to help. In the end, the researcher found two types of contradictions: first, between the app's features and the teachers, and second, between the app's features and the curriculum requirements, which included the level of difficulty or the intended learning content.

The Activity Theory defined codes were explored through analysis that led to meaningful themes in the coding process. The theme of “Digital Navigation Competence” emerged as a theme from analyses of the tool subject elements (activity theory framework), recognizing how teachers' technical competence played a role on what happened during implementation. The theme of “Curriculum-Technology Synergy” evolved from the examines of the rules-community-tools, addressing how teachers negotiated between prescriptive learning outcomes and functions of the application. In describing one of the teachers' experiences she explained,

I use the treasure collections (digital badges) when we complete our phonics lesson. I see it grow naturally together, with our curriculum.

A third theme had to do with the evolving dynamics present in the classroom and emerged during the analysis phase of the division of labor, as the teachers role shifted from educators to facilitators guided by student exploration through app use. Each theme corresponded directly with the components from the Activity Theory framework while correlating with research questions pertaining to contradictions experienced in the preschool context and educators reconciliations toward the balance of well-established learning and the engagement possibilities offered through technology.

### Observation Note

During a three-week classroom observation, the researcher focused on the integration of *Preschool Treasure* in a kindergarten math activity. Through participatory field notes and thick description, a core contradiction emerged between tool mediation and curricular objectives. For instance, in a “number sequencing” task using the app's drag-and-drop game, the teacher aimed to enhance children's numeracy skills. However, observation records revealed:

Children A repeatedly clicked on animated animal icons, accidentally covering number cards. Teacher B reminded, ‘Finish the task first,’ yet Child A persisted in exploring animations. Eventually, Teacher B closed the app and switched to physical number cards. (Observation Date:05/11/2024, Class: Senior Group)

Such incidents were coded as tool-object contradictions: While the app's interactive design (tool) intended to boost engagement, its entertainment elements (e.g., animations) diverted attention from the core objective (number sequencing). Activity system mapping further identified teachers' mediation strategies.

### Documents Analysis

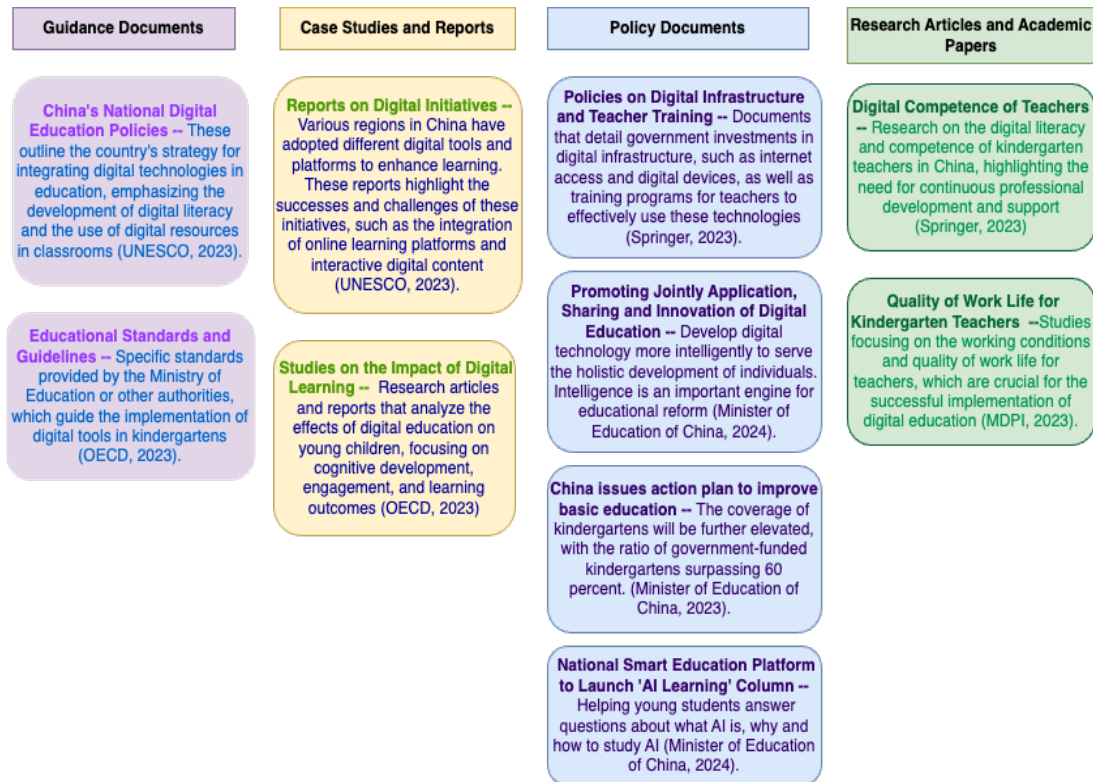
The analysis of documents for *Preschool Treasure* included the developer's guidelines, the local preschool curriculum frameworks, and the regional Digital Education Guidelines for Preschools. Through an analysis of the documents using Critical Discourse Analysis, the discrepancies between technical scalability and localization of the curriculum became evident. The Developer Guidelines stated “standardized design for Scientific Rigor”, and the kindergarten curriculum required “Culturally Responsive Emergent Activities.” For example, the Developer Guidelines recommended that Math modules be aligned to National Numeracy Standards; however, the document did not provide any support for teachers to adapt their modules where necessary to reflect the students' cultural background. Teacher C stated,

I wanted to add abacus elements but the Game Rules were locked out on the application.

These discrepancies have been coded as a rule-tool conflict in the analysis because the policy documents (rules) suggested some flexibility, while the app's standardized design (tool) restricted this flexibility.

When comparing the data from the document analysis to the data from the interviews, it became evident that teachers felt restricted by the app’s inability to allow them to customize content to meet their unique student population’s needs. As a result, mobile apps must provide a balance between standardized content and modularity to allow dynamic adaptation to the needs of the curriculum being taught.

**Figure 3**  
*Documents Display*



Activity Theory provides the theoretical framework for this research, which seeks to understand ways in which Educational Activities are presented as dynamic systems mediated by tools (Holland & Lave, 2019). In this context, *Preschool Treasure* functions as a mediating tool that shapes the relationship between teaching strategies and learning outcomes. The *Preschool Treasure* was thus viewed as a tool to mediate the link between instructional strategies and the resulting learning outcomes. These policy documents cement the understanding of the relationship between teaching strategies and learning outcomes in education and reveal a systemic view of contradictions imposed by the use of technology-based methods in education. Chinese National Policy texts such as the Digital Educational Policy and the Guidelines for Digitalization in Early Childhood Education provided a framework for developing technology-mediated learning in specifying the importance of culturally relevant design and delivering dynamic curricula as a standard in developing technology-mediated methodologies. However, when such elements and educational outcomes are introduced through the technical documentation for *Preschool Treasure*, it allows the researcher an opportunity to substantiate the predicaments between rule and tool, gaining an entry into empirically validating the theoretical framework for their use in their own studies.

An important part of the organizing process was identifying systemic relations within the Activity Theory elements through the methodical mapping of the codes. Under the Tools section of the analysis, the “app navigation struggles” codes were mapped, giving the researcher proof that children had trouble navigating *Preschool Treasure* when it was being used for educational purposes. When the researchers examined the code for aligning learning objectives using rules, they found evidence of differences between the expectations of institutional policy (rules) and the features or output of the application. As a result, the code was given the status of a rule. Since communications between the teacher and the parent or parents influenced the application's implementation in some ways, the coding of parent-teacher communications

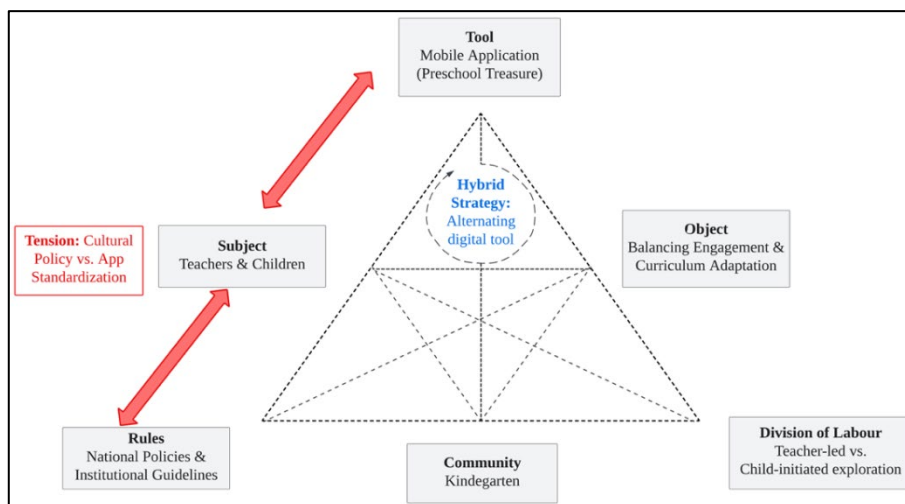
regarding its use was categorized under the community mapping dimension. During the division of labor analysis, teachers observed that when using *Preschool Treasure*, they modified their duties or teaching roles because the children served as guides while the teachers aided. In the end, the researcher discovered first contradictions between the app's features and teachers, followed by secondary contradictions between the app's features and curriculum requirements, such as the intended learning content or degree of difficulty, as they proceeded through the software development and mapping process.

The assessment of the documentation demonstrated the tense relationship between the actual technological implementation in digital transformation initiatives and the institutions that make claims. Progressive policy narratives provided new approaches for reforms, but their actual implementation faced restrictions from the philosophical approach used to create tool systems. The quantifiable data showed that the average time children spent using *Preschool Treasure* (28 minutes) ruled shorter than non-digital tool engagement (37 minutes) within the single pilot kindergarten thus revealing a direct contradiction between planned flexibility and tool-based limitations. These findings advocate for a policy-design-practice feedback loop, integrating teacher agency most of participants emphasized the need for co-design rights into technological governance to advance sustainable digital ecosystems in early education.

To systematically visualize these tensions and their mediation mechanisms, the Activity Theory diagram (Figure 4) conceptualizes the integration of *Preschool Treasure* within the preschool classroom as a dynamic system comprising six interconnected nodes: subjects (teachers and children), tools (the mobile application), object (balancing engagement and curriculum adaptation), rules (national policies and institutional guidelines), community (teachers, children, and developers), and division of labor (teacher-led instruction and child-initiated exploration). Arrows denote mediational relationships, with red highlights marking primary contradictions. For instance, the rule-tool contradiction manifests as policy mandates for culturally responsive pedagogy (Ministry of Education of the People's Republic of China, 2022) conflicting with the app's standardized design, which restricts localized content customization. This tension is partially mediated by teachers' hybrid strategies, such as alternating between digital and physical tools during observed sessions. The adaptive practices serve as implementations of the previous described feedback loop which demonstrates how teaching capabilities alter the ways policy guidelines are executed and affect tool effectiveness.

**Figure 4**

*Activity Theory of "Preschool Treasure" Integration with Contradictions and Mediations*



The described framework serves to interpret upcoming empirical data while identifying intervention methods that address broken systems. The theoretical framework of the diagram receives support through data collected from interviews and observations and analysis of policy documents. All surveyed teachers except one expressed expressed frustration regarding the application's lack of relevance to their specific educational context. The teacher expressed their inability to implement abacus aspects into math sections

of the platform similarly to “rule-tool contradiction” defined by the model. Teachers utilized a mediation strategy by deactivating app characteristics that were irrelevant to their curriculum needs to maintain educational focus in their classrooms. The diagram reflects the findings from Gravel (2020) that systemic contradictions generate new pedagogical approaches by demonstrating the integration of digital and physical tasks.

### Discussion

Within the framework of Activity Theory, systemic contradictions served as a driving force behind the development of adaptive integration strategies, rather than simply presenting barriers. The following examples illustrate this point. The first example of a secondary contradiction you applied is the contradiction between the Tool and Object, where the animations from the app (Tool) that were supposed to be engaging to students, instead drew attention away from curriculum-aligned activities such as number sequencing (Object). As a result of this misalignment, teachers found themselves needing to incorporate a hybrid method of the delivery of instruction. The second example you provided of a Rule-Tool contradiction was between the national policy requiring that teachers implement what is termed as, “culturally responsive pedagogy” (Rule) versus the app being designed in a standardized format (Tool). Therefore, teachers were forced to supplement the app with cultural activities such as creating decorations for Chinese New Year. The last contradiction presented is the Community-Tool contradiction between the need of teachers to have a localized version of the app, and the need for developers to provide an app that offers scalability. This conflict led the grassroots community to support a model of co-design and created the necessary momentum for innovation as all stakeholders developed strategies for integrating the curriculum and app with their own unique context.

The Preschool Treasure app’s engaging animations (Tool) often distracted students from curriculum-aligned tasks (Object), such as number sequencing. This mismatch led teachers to adopt hybrid practices. The second, Rule-Tool Contradictions. The app’s strict, standardized design (Tool) ran counter to national policies that promoted “culturally responsive pedagogy” (Rule). Teachers addressed this by adding offline cultural activities (like making Chinese New Year decorations) to the app content. Then, in Community-Tool Contradictions, teachers demanded localized customization while developers prioritized scalability. This conflict sparked grassroots support for co-design models in which teachers participate in the creation of apps. Contradictions presented chances for innovation rather than obstacles, encouraging stakeholders to create context-sensitive integration strategies.

Through the examination of the relationship between the design of applications and their connection to curriculum, several key themes were identified. Modularity played a large role in this relationship because apps that had customizable features allowed teachers to align the use of the app to their specific curriculum objectives by changing storylines and difficulty levels, for example, adding common tools to a math game (abacus beads) helped build an app’s connection to a teacher’s curriculum. Teachers were also able to take advantage of the importance of including the culture in the design of the app. For instance, when the app represented the local culture (i.e., demonstrating urban family life or referencing local festivals) it resonated with students (resulting in a deeper connectivity), thus capturing and retaining the students’ interest. Lastly, the purpose of the user interfaces needed to be as simple and intuitive as possible to reduce cognitive overload on the user. Overly complex designs led to children’s superficial interactions (e.g., randomly clicking on animated objects), which led to increased distractions from the app’s educational outcomes. Therefore, in order to support the curriculum’s goals, the design of the application needed to focus on the user and, therefore, provide a balance between interactivity, flexibility, and the importance of cultural recognition.

The results further provided three primary strategies teachers could leverage to mitigate the conflict between emergent, technology-mediated engagement and the traditional curriculum delivery. The first strategy was “temporal hybridity.” This is the intentional planning of activities in order to transition between the more exploratory facets of app-mediated learning (e.g., interactive storytelling) and the more traditional tasks associated with a curriculum (e.g., phonics via textbook). The second strategy was

“pedagogical bridging.” Apps were often used to provide a “bridge” between learning segments or as a form of motivational reward (i.e., completing a worksheet before engaging in an educational game). The third and final strategy that teachers displayed was “critical improvisation.” Teachers were often able to modify or circumvent the restrictions of the app by integrating culturally appropriate content into the app, such as telling the story in the app using regional dialects, or disabling certain features that were not aligned with their instructional objectives.

These strategies demonstrate how important it is for teachers to have agency and be able to adapt, while also ensuring that school districts continue to create an environment where all educators receive systemic support. Teacher agency and adaptability require ongoing systemic support through targeted professional development opportunities and by providing teachers with co-design rights in educational technology development to implement and sustain scalable best practices.

### **Teachers' Perceptions of the App's Usability and Alignment with Curriculum Goals**

While *Preschool Treasure* is seen by the teachers as an engaging tool for students, there are challenges associated with defining the explicit curriculum objectives through its use. As Teacher C states, “*Preschool Treasure's* interactive, story and game-based elements engage a children's attention.” It is challenging for Teacher C to relate the educational activities conducted via *Preschool Treasure* to the targets outlined in the curriculum. The AT framework features this fundamental contradiction between student engagement and curriculum requirements since the educational app functions as the mediation tool that links teaching staff with learning targets although it fails to completely resolve the conflict between disruptive educational methods and established curriculum standards (Engeström, 2014).

Research by Alam and Mohanty (2023) mirrors the difficulties teachers encounter when trying to merge digital resources with rigid educational structures particularly in educational systems strong with established traditional teaching practices. The Ministry of Education of the People's Republic of China (2019) specifies that digital tools should support traditional educational practices without replacing them as both methods must keep fidelity to each other.

### **Student Engagement and Interactive Learning**

The observations showed the app led to higher student involvement caused by its interactive parts. The app prompted better participation between students in storytelling activities compared to regular language instruction techniques. The student passionately stated,

I really enjoy the app stories since I can interact with characters through touch to control their movements.

The educational app demonstrates fundamental aspects of AT because it uses interactive features to create a process-based bonding between students and learning outcomes (Chung et al., 2019; Griffith et al., 2020).

The teachers questioned if students spent too much time using the app because they believed this might reduce their physical learning opportunities and social interactions. The app delivers effective engagement yet teachers need to establish opportunities for direct physical learning along with face-to-face student interactions according to Teacher B. Current research (Işıkoğlu et al., 2023; Poquet & De Laat, 2021). combines with this discovery to warn about digital tool excess in early childhood education as it threatens whole child development.

### **Challenges in Balancing Digital and Traditional Methods**

Most interviews along with observation data pointed towards the difficulty experienced by teachers while combining digital tools with their established teaching procedures. Please note that the educational application enabled creative approaches to student engagement although its usage sometimes generated conflicts with the established Chinese kindergarten curriculum. The app extends a wide range of possibilities yet Teacher D noted that their curriculum exists with strict requirements about what topics must be taught and when. Limiting educational tools to traditional methods alongside modern approaches is a difficult task to achieve. The tension emerges from the analysis of contradictions between rules of

curriculum requirements and the using tools of the app according to Kessler (2020).

Digital tools have a specific purpose according to early childhood education guidelines from the Ministry of Education of the People's Republic of China (2023) which notes that these tools should serve to complement traditional teaching approaches. Specifically, this policy supports teachers' views by demonstrating the requirement of framework changes to effectively merge digital learning tools with traditional educational systems.

### **Professional Development and Systemic Support**

Teacher A explained that effective use of the app depends heavily on professional development focused on skill development for curriculum alignment and classroom management. The AT concept of community and division of labor emphasizes that tool implementation success requires involvement and collaboration of all stakeholders (Bower, 2019).

Modern scientific research demonstrates failure to provide adequate support for teacher training leads to difficulties implementing digital tools (Akram et al., 2022; Amhag et al., 2019). The Ministry of Education of the People's Republic of China (2022) supports improved digital infrastructure alongside teacher training programs while addressing the rising awareness of this necessity in the country.

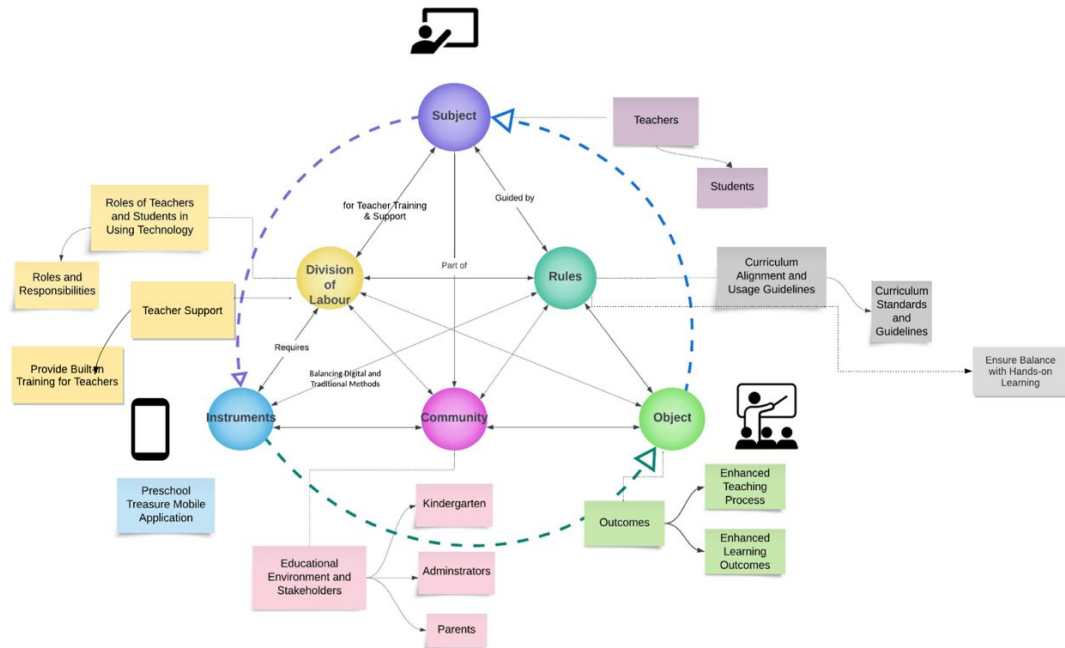
### **Cultural and Contextual Considerations**

The research demonstrated that cultural elements together with contextual factors determined how the app would be implemented. Teachers highlighted that the application developers made it for young learners, yet some features failed to suit Chinese kindergarten educational practices and cultural expectations. The app faces challenges because student backgrounds lack familiarity with many of the characters and stories presented according to Teacher E. Research (Brown et al., 2019) supports the essential requirement to incorporate culture-based design into education technology which makes this discovery significant.

From an AT perspective, this issue reflects the influence of cultural-historical factors on the activity system, where tools must be adapted to fit the specific context in which they are used (Grimalt-Álvaro & Ametller, 2021). Preschool Treasure serves as a mediating tool that shapes the relationship between the teacher and the students' learning objectives. The app's success lies in its ability to engage students interactively while supporting teachers in meeting curriculum standards, aligning with AT's emphasis on tools as mediators that must fulfil both motivational and educational needs within the classroom.

Using a previous example (Figure 4) to help visualize some systemic contradictions that impact implementation will help to provide a better understanding of the evolution of the teachers' adaptive strategies that led to the development of the re-mediated activity system as shown in Figure 5. In this newer version, the previously identified tensions have been resolved. For instance, the Tools component of the system has evolved from the original mobile application to now include a new "Hybrid Tool Kit" consisting of both mobile and offline materials. Furthermore, the Rules component has also been redefined to allow teachers more local flexibility. The new graphical depiction of the activity system represents how the system has moved from being one that is contradictory towards becoming a sustainable model for integrated teaching and learning.

**Figure 5**  
*Framework for Complementing the Preschool Treasure in Kindergarten Education*



This study extends the application of Sannino and Engeström’s (2018) Activity Theory by identifying ‘cultural-contextual adaptability’ as a critical, yet underexplored, dimension in technology-mediated early education. While recent scholarship acknowledges that digital tools are rarely culturally neutral (Teräs et al., 2020), our findings empirically demonstrate how implicit cultural norms interact with explicit policy mandates to generate specific secondary contradictions. For example, the app’s lack of dialectal support or localized festival modules (Tools) conflicted with both national policies (Rules) advocating inclusive digital ecosystems and teachers’ contextual needs. This aligns with Al Hashlamoun’s (2021) argument that neglecting local semiotics creates systemic barriers, necessitating a revised model where cultural adaptability functions as a primary mediating mechanism. This study extends the application of Activity Theory by identifying cultural-contextual adaptability as a critical, yet underexplored, dimension in technology-mediated early education. While traditional models prioritize the subject-tool-object triad, our findings highlight how implicit cultural rules interact with explicit policy mandates to generate secondary contradictions. For example, the app’s lack of dialectal support or localized festival modules (tools) conflicted with both national policies (rules) advocating inclusive digital ecosystems and teachers’ contextual needs, necessitating a revised model that incorporates cultural adaptability as a mediating variable.

The research highlights the necessity of modular application design to attain a balance between flexibility and standardization. Most participants agreed that developers should incorporate features that allow teachers to function as co-designers. To align with vision of Artificial Intelligence (AI) enhanced, educator-led learning established in the Notice on Strengthening AI Education in Primary and Secondary Schools (Ministry of Education of the People's Republic of China, 2024), policy reforms should require iterative feedback mechanisms among educators, developers, and legislators.

### Conclusion

The results indicate that while the Preschool Treasure app successfully increased student engagement and academic success. Corroborating Hatzigianni et al.’s (2023) findings on the positive developmental impact of digital tools the study also revealed critical systemic conflicts specific to the Chinese context. Unlike Hatzigianni et al. (2023), whose research reflects Western early childhood models prioritizing open-ended, child-centered play, this study demonstrates a tension with the more structured,

collective pedagogical framework found in Chinese kindergartens. Consequently, the prescribed local curriculum often sits in opposition to the rigid, individualized design of digital tools. Users struggled with ineffective interfaces and a lack of culturally appropriate content, supporting An and Oliver's (2021) contention that educational technology must be consistent with regionally specific cultural phenomena to be effective.

The findings of this study affirm the existence of an emerging consensus in Activity Theory about the importance of flexibility in integrating technology into classroom instruction, specifically positioning flexibility in terms of the cultural-contextual factors that aid in mediating these systemic changes. While the foundational framework established by Engeström (2014) relies on the notion that contradictions create the tension necessary for driving change; nevertheless, many recent studies assert that explicitly integrating cultural resources into this framework is critical in mediating these systemic changes (Von Fircks, 2024). This study supports this idea. As a result of resolving the rule-tool contradictions, the teachers involved not only implemented technical solutions, but also developed hybrid pedagogical practices. Specifically, the teachers were able to combine elements of physical and digital play in their approach to instructional practices. This finding dovetails with the emerging trend of looking at how digital learning is impacted by cultural differences and strengthens the argument for broadening the definition of Activity Theory to include the adaptability of Activity Systems to the local culture (Yang & Li, 2019).

The findings of this study suggest that educational technology development is moving toward what is now referred to as a "glocalized" approach, one that aligns the fast-moving global technological landscape with the individualized, localized needs of educators. In order to achieve this alignment, it is imperative for developers of Educational Technology to develop modular applications (meaning the app can contain multiple modules representing similar or equivalently educational contexts) that allow educators to customize the content based on their specific context. Additionally, to facilitate feedback on the effectiveness of the application, policymakers should create a robust, organized mechanism to allow the creation and implementation of feedback between educators and Educational Technology developers.

Hence, engagement with the application under evaluation should not solely be an indicator of "success or failure"; rather, it should be understood as a process by which educators provide students with an authentic learning experience. Authentic learning experiences are achieved only through a collaborative design process where digital tools create authentic experiences which effectively meet the particular curriculum and cultural needs of a particular kindergarten.

In addition, applying an Activity Theory perspective to this study enables one to move beyond the notion of binary evaluation of success or failure in relation to technology integration. Through Activity Theory's emphasis on the relationship between Subject (teacher) and Object (student development), one is able to understand how the introduction of technology from the *Preschool Treasure* application acted as a stimulus for systemic change rather than just an additive measure. Hence, Activity Theory reinforces that the value of digital tools does not derive from their additional functions but rather from their ability to create 'expansive learning' within school systems. The findings of this research suggest that when the contradictions inherent within systems are made visible and are addressed collectively, they can be reframed from barriers to the development of innovative pedagogical practices and cultural renewal.

### **Contributions and Limitations**

The research analysis of digital tool integration in Chinese kindergartens utilizes Activity Theory as it introduces fresh insights about this process from non-Western settings. This research shows how cultural elements along with contextual features produce enhanced app effectiveness in education yet this essential factor. The research synthesizes these insights into a framework for "glocalized" educational technology that balances global digital trends with local collectivist values. Practically, the study advocates for "co-design" policies that bridge national guidelines with classroom reality. It recommends that developers prioritize modular, customizable templates; policymakers establish structured feedback loops; and educators pursue professional development in critical digital pedagogy. Ultimately, this approach ensures digital tools are not just technically sound, but culturally responsive and curricularly aligned. The findings

presented in this study were derived from a limited qualitative case study of only one mobile application and six educators working in the same school, therefore the findings should be considered as analytical generalizations rather than as statistical generalizations. The narrow scope of this case study did allow for an in-depth view of two major “Rule-Tool” tensions, and future studies should be conducted to provide insight into the possibility of sustaining hybrid pedagogical practices over the long-term.

## Declarations

### *Authors’ Declarations*

**Acknowledgements:** Not applicable.

**Authors’ contributions:** Author Yufan Zhang wrote the original manuscript. Author Dr. Nurul Nadwa Zulkifli, and Author Prof. Ahmad Fauzi Mohd Ayub and Dr. Nur Raihan Che Nawi contributed to the revision and review process. All authors have read and approved the final manuscript.

**Competing interests:** The authors declare that they have no competing interests.

**Funding:** Not applicable.

**Ethics approval and consent to participate:** Ethical approval was obtained from the Ethics Committee for Research Involving Human Subjects (JKEUPM), reference no: JKEUPM-2023-1181. All interviews with adults were conducted with the consent of the participants, and observations of minors were undertaken with the consent of their guardians.

### *Publisher’s Declarations*

**Editorial Acknowledgement:** The editorial process of this article was completed under the editorship of Dr. Eleonora Teszenyi through a double-blind peer review with external reviewers.

**Publisher’s Note:** Journal of Childhood, Education & Society remains neutral with regard to jurisdictional claims in published maps and institutional affiliation.

## References

- Akram, H., Abdelrady, A. H., Al-Adwan, A. S., & Ramzan, M. (2022). Teachers’ perceptions of technology integration in teaching-learning practices: A systematic review. *Frontiers in Psychology, 13*, 920317. <https://doi.org/10.3389/fpsyg.2022.920317>
- Alam, A., & Mohanty, A. (2023). Educational technology: Exploring the convergence of technology and pedagogy through mobility, interactivity, AI, and learning tools. *Cogent Engineering, 10*(2), 2283282. <https://doi.org/10.1080/23311916.2023.2283282>
- Al Hashlamoun, N. (2021). Cultural challenges eLearners from the GCC countries face when enrolled in Western educational institutions: A thematic literature review. *Education and Information Technologies, 26*(2), 1409-1422. <https://doi.org/10.1007/s10639-020-10313-1>
- Amhag, L., Hellström, L., & Stigmar, M. (2019). Teacher educators’ use of digital tools and needs for digital competence in higher education. *Journal of Digital Learning in Teacher Education, 35*(4), 203–220. <https://doi.org/10.1080/21532974.2019.1646169>
- An, T., & Oliver, M. (2021). What in the world is educational technology? Rethinking the field from the perspective of the philosophy of technology. *Learning, Media and Technology, 46*(1), 6–19. <https://doi.org/10.1080/17439884.2020.1810066>
- Bell, C. A., Dobbelaer, M. J., Klette, K., & Visscher, A. (2019). Qualities of classroom observation systems. *School Effectiveness and School Improvement, 30*(1), 3–29. <https://doi.org/10.1080/09243453.2018.1539014>
- Blayone, T. J. B. (2019). Theorising effective uses of digital technology with activity theory. *Technology, Pedagogy and Education, 28*(4), 447–462. <https://doi.org/10.1080/1475939X.2019.1645728>
- Bower, M. (2019). Technology-mediated learning theory. *British Journal of Educational Technology, 50*(3), 1035–1048. <https://doi.org/10.1111/bjet.12771>
- Braun, V., & Clarke, V. (2023). Thematic analysis. In F. Maggino (Ed.), *Encyclopedia of quality of life and well-being research* (pp. 7187–7193). Springer. [https://doi.org/10.1007/978-3-031-17299-1\\_3470](https://doi.org/10.1007/978-3-031-17299-1_3470)
- Brown, B. A., Boda, P., Lemmi, C., & Monroe, X. (2019). Moving culturally relevant pedagogy from theory to practice: Exploring teachers’ application of culturally relevant education in science and mathematics. *Urban Education, 54*(6), 775–803. <https://doi.org/10.1177/0042085918794802>
- Burner, T., & Svendsen, B. (2020). Activity theory—Lev Vygotsky, Aleksei Leont’ev, Yrjö Engeström. In B. Akpan & T. J. Kennedy (Eds.), *Science education in theory and practice* (pp. 311–322). Springer. [https://doi.org/10.1007/978-3-030-43620-9\\_21](https://doi.org/10.1007/978-3-030-43620-9_21)
- Cong-Lem, N. (2022). Vygotsky’s, Leontiev’s and Engeström’s cultural-historical (activity) theories: Overview, clarifications and implications. *Integrative Psychological and Behavioral Science, 56*(4), 1091-1112. <https://doi.org/10.1007/s12124-022-09703-6>

- Chung, C., Hwang, G., & Lai, C. (2019). A review of experimental mobile learning research in 2010–2016 based on the activity theory framework. *Computers & Education*, 129, 1–13. <https://doi.org/10.1016/j.compedu.2018.10.010>
- Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage.
- Cypress, B. S. (2017). Rigor or reliability and validity in qualitative research: Perspectives, strategies, reconceptualization, and recommendations. *Dimensions of Critical Care Nursing*, 36(4), 253–263. <https://doi.org/10.1097/DCC.0000000000000253>
- Dias, M. J. A., Almodóvar, M., Atilas, J. T., Vargas, A. C., & Zúñiga León, I. M. (2020). Rising to the challenge: Innovative early childhood teachers adapt to the COVID-19 era. *Childhood Education*, 96(6), 38–45. <https://doi.org/10.1080/00094056.2020.1846385>
- Engeström, Y. (2014). Activity theory and learning at work. In U. Deinet & C. Reutlinger (Eds.), *Tätigkeit—aneignung—bildung* (pp. 67–96). Springer. [https://doi.org/10.1007/978-3-658-02120-7\\_3](https://doi.org/10.1007/978-3-658-02120-7_3)
- Engeström, Y. (2020). Concept formation in the wild: Towards a research agenda. *Education et Didactique*, 2, 99–113. <https://doi.org/10.4000/educationdidactique.6816>
- Ford, T. G., Kwon, K. A., & Tsotsoros, J. D. (2021). Early childhood distance learning in the U.S. during the COVID pandemic: Challenges and opportunities. *Children and Youth Services Review*, 131, 106297. <https://doi.org/10.1016/j.childyouth.2021.106297>
- Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic literature review. *British Journal of Educational Technology*, 50(5), 2572–2593. <https://doi.org/10.1111/bjet.12864>
- Gravell, J. D. (2020). *Learning to teach with technology: Interest convergence, identity, and designing for novice teacher critical technology literacy* [Unpublished doctoral dissertation]. University of California.
- Griffith, S. F., Hagan, M. B., Heymann, P., Heflin, B. H., & Bagner, D. M. (2020). Apps as learning tools: A systematic review. *Pediatrics*, 145(1), e20191579. <https://doi.org/10.1542/peds.2019-1579>
- Grimalt-Álvaro, C., & Ametller, J. (2021). A cultural-historical activity theory approach for the design of a qualitative methodology in science educational research. *International Journal of Qualitative Methods*, 20, 1-12. <https://doi.org/10.1177/16094069211060664>
- Grimus, M. (2020). Emerging technologies: Impacting learning, pedagogy and curriculum development. In S. Yu, M. Ally, & A. Tsinakos (Eds.), *Emerging technologies and pedagogies in the curriculum* (pp. 127–151). Springer. [https://doi.org/10.1007/978-981-15-0618-5\\_8](https://doi.org/10.1007/978-981-15-0618-5_8)
- Hamilton, D., McKechnie, J., Edgerton, E., & Wilson, C. (2021). Immersive virtual reality as a pedagogical tool in education: A systematic literature review of quantitative learning outcomes and experimental design. *Journal of Computers in Education*, 8(1), 1–32. <https://doi.org/10.1007/s40692-020-00169-2>
- Hatzigianni, M., Stephenson, T., Harrison, L. J., Waniganayake, M., Li, P., Barblett, L., Hadley, F., Andrews, R., Davis, B., & Irvine, S. (2023). The role of digital technologies in supporting quality improvement in Australian early childhood education and care settings. *International Journal of Child Care and Education Policy*, 17(1), 5. <https://doi.org/10.1186/s40723-023-00107-6>
- Holland, D., & Lave, J. (2019). Social practice theory and the historical production of persons. In A. Edwards, M. Flear, & L. Böttcher (Eds.), *Cultural-historical approaches to studying learning and development* (Vol. 6, pp. 235–248). Springer. [https://doi.org/10.1007/978-981-13-6826-4\\_15](https://doi.org/10.1007/978-981-13-6826-4_15)
- Hopwood, N. (2022). Agency in cultural-historical activity theory: Strengthening commitment to social transformation. *Mind, Culture, and Activity*, 29(2), 108-122. <https://doi.org/10.1080/10749039.2022.2092151>
- Huang, R., Yang, W., & Li, H. (2019). On the road to participatory pedagogy: A mixed-methods study of pedagogical interaction in Chinese kindergartens. *Teaching and Teacher Education*, 85, 81–91. <https://doi.org/10.1016/j.tate.2019.06.009>
- Işıkoğlu, N., Erol, A., Atan, A., & Aytetin, S. (2023). A qualitative case study about overuse of digital play at home. *Current Psychology*, 42(3), 1676–1686. <https://doi.org/10.1007/s12144-021-01442-y>
- Kessler, M. (2020). Technology-mediated writing: Exploring incoming graduate students’ L2 writing strategies with Activity Theory. *Computers and Composition*, 55, 102542. <https://doi.org/10.1016/j.compcom.2020.102542>
- Khasanah, U., Asry, W., & Latifah, N. (2023). Improving early childhood language development through “kiki miu-miu” youtube videos. *Journal of Childhood Development*, 3(2), 24–35. <https://doi.org/10.25217/jcd.v3i2.3780>
- Liaw, S.-S., Hatala, M., & Huang, H.-M. (2010). Investigating acceptance toward mobile learning to assist individual knowledge management: Based on activity theory approach. *Computers & Education*, 54(2), 446–454. <https://doi.org/10.1016/j.compedu.2009.08.029>
- Mertala, P. (2019). Digital technologies in early childhood education – a frame analysis of preservice teachers’ perceptions. *Early Child Development and Care*, 189(8), 1228–1241. <https://doi.org/10.1080/03004430.2017.1372756>
- Ministry of Education of the People’s Republic of China. (2019). *Opinion on implementing the national primary and secondary school teachers’ information technology application ability enhancement project 2.0*. [http://www.moe.gov.cn/srcsite/A10/s7034/201904/t20190402\\_376493.html](http://www.moe.gov.cn/srcsite/A10/s7034/201904/t20190402_376493.html)

- Ministry of Education of the People's Republic of China. (2022). *Notice on issuing the educational industry standard 'basic classification codes for digital educational resources'*. [http://www.moe.gov.cn/srcsite/A16/s3342/202302/t20230214\\_1044628.html](http://www.moe.gov.cn/srcsite/A16/s3342/202302/t20230214_1044628.html)
- Ministry of Education of the People's Republic of China. (2024). *Notice on strengthening artificial intelligence education in primary and secondary schools*. [http://www.moe.gov.cn/jyb\\_xwfb/gzdt\\_gzdt/s5987/202412/t20241202\\_1165500.html](http://www.moe.gov.cn/jyb_xwfb/gzdt_gzdt/s5987/202412/t20241202_1165500.html)
- Ministry of Education of the People's Republic of China. (2025). *Opinions of the ministry of education and other nine departments on accelerating the digitalisation of education* [http://www.moe.gov.cn/srcsite/A01/s7048/202504/t20250416\\_1187476.html](http://www.moe.gov.cn/srcsite/A01/s7048/202504/t20250416_1187476.html)
- Morgan, H. (2022). Conducting a qualitative document analysis. *The Qualitative Report*, 27(1), 64–77. <https://doi.org/10.46743/2160-3715/2022.5044>
- Núñez, D. (2023). *A descriptive qualitative study exploring middle-school teachers' perceptions of professional development on technology integration* [Doctoral dissertation, Abilene Christian University]. Digital Commons @ ACU. <https://digitalcommons.acu.edu/etd/547/>
- Palaiologou, I. (2020). Teachers' dispositions towards the role of digital devices in play-based pedagogy in early childhood education. In I. Palaiologou (Ed.), *Digital play and technologies in the early years* (pp. 83-99). Routledge. <https://doi.org/10.4324/9780429444418>
- Parker, R., & Thomsen, B. S. (2019). *Learning through play at school: A study of playful integrated pedagogies that foster children's holistic skills development in the primary school classroom*. The LEGO Foundation. [https://research.acer.edu.au/learning\\_processes/22](https://research.acer.edu.au/learning_processes/22)
- Pettersson, F. (2021). Understanding digitalization and educational change in school by means of activity theory and the levels of learning concept. *Education and Information Technologies*, 26(1), 187-204. <https://doi.org/10.1007/s10639-020-10239-8>
- Poquet, O., & De Laat, M. (2021). Developing capabilities: Lifelong learning in the age of AI. *British Journal of Educational Technology*, 52(4), 1695–1708. <https://doi.org/10.1111/bjet.13123>
- Ruslin, R., Mashuri, S., Rasak, M. S. A., Alhabsyi, F., & Syam, H. (2022). Semi-structured Interview: A methodological reflection on the development of a qualitative research instrument in educational studies. *IOSR Journal of Research & Method in Education*, 12(1), 22–29.
- Sannino, A., & Engeström, Y. (2018). Cultural-historical activity theory: Founding insights and new challenges. *Cultural-Historical Psychology*, 14(3), 43-56. <https://doi.org/10.17759/chp.2018140304>
- Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Computers & Education*, 128, 13–35. <https://doi.org/10.1016/j.compedu.2018.09.009>
- Schmidt, M., & Tawfik, A. A. (2022). Activity theory as a lens for developing and applying personas and scenarios in learning experience design. *The Journal of Applied Instructional Design*, 11(1), 55-73. <https://doi.org/10.51869/111/msat>
- Teräs, M., Suoranta, J., Teräs, H., & Curcher, M. (2020). Post-covid-19 education and education technology 'solutionism': A seller's market. *Postdigital Science and Education*, 2(3), 863-878. <https://doi.org/10.1007/s42438-020-00164-x>
- Undheim, M. (2022). Children and teachers engaging together with digital technology in early childhood education and care institutions: A literature review. *European Early Childhood Education Research Journal*, 30(3), 472-489. <https://doi.org/10.1080/1350293X.2021.1971730>
- Von Fircks, E. (2024). Interdependence and cultural resources to mediate change: What was missing in Engeström's third generational activity theory. *Human Arenas*, 7(4), 931–943. <https://doi.org/10.1007/s42087-022-00303-9>
- Weng, J., & Li, H. (2020). Early childhood technology education in China: A case study of Shanghai. *Early Child Development and Care*, 192(4), 589-605. <https://doi.org/10.1080/03004430.2018.1542383>
- Yan, C., & Wang, L. (2022). Experienced EFL teachers switching to online teaching: A case study from China. *System*, 105, 102717. <https://doi.org/10.1016/j.system.2021.102717>
- Yang, T., & Dong, C. (2024). What influences teachers' implementation of ICT in early childhood education? A qualitative exploration based on an ecological-TPACK framework. *Computers and Education Open*, 7, 100228. <https://doi.org/10.1016/j.caeo.2024.100228>
- Yang, W., & Li, H. (2019). Changing culture, changing curriculum: A case study of early childhood curriculum innovations in two Chinese kindergartens. *The Curriculum Journal*, 30(3), 279–297. <https://doi.org/10.1080/09585176.2019.1568269>
- Zhou, W., & Yang, W. (2025). Integrating story-based STEM design challenges in early childhood curricula: An activity theory perspective. *International Journal of Technology and Design Education*, 35, 483–506. <https://doi.org/10.1007/s10798-024-09917-2>