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Exploring the Development of Kindergarten Educational Products in China's Emerging Technological Context: A Philosophy of Technology Perspective

Zhang Yufan*
University Putra Malaysia
Serdang, Selangor,Malaysia

Nurul Nadwa Zulkifli
University Putra Malaysia
Bintulu, Sarawak, Malaysia

Ahmad Fauzi Mohd Ayub and Nur Raihan Che Nawi
University Putra Malaysia
Serdang, Selangor,Malaysia

Abstract: This research analyses how emerging technologies merge with kindergarten educational product development via philosophical technological frameworks. The digital transformation speed of early childhood education in China produces key questions regarding how technological systems affect educational values and agency behaviour. Additional funding for educational technologies fails to bridge the ethical-epistemological conflicts which arise from technological product development approaches when compared to child developmental needs in terms of cognition. The study uses 2 Educational Technology (EdTech) implementation case studies in kindergarten schools to examine policy discourse through critical analysis and observe the technological interactions of 50 children adopting mixed research methods. The study discovered that the majority of examined digital products contained sophisticated technical capabilities but failed to fulfil developmental principles applicable to early childhood growth. The proposed research design framework redefines EdTech from self-contained devices to connection tools through which educators bring together technology and teaching. It implements four foundational principles which include physical alignment with users, clear conduct standards and cultural adaptation and developmental matching capabilities. This research unites philosophical theories of technology development with real-world

*Corresponding author: Zhang Yufan; *elsa_zhang1113@163.com*

applications in EdTech to build a fundamental moral foundation which creates technology systems that strengthen rather than restrict child self-determination powers and guide policy decisions regarding technological humanist approaches to early childhood education.

Keywords: Emerging Technologies; educational products; digital education; kindergarten curriculum; philosophy of technology

1. Introduction

The educational environment worldwide experiences transformative change through immersive technologies which human-computer interaction (HCI) which form new teaching approaches (Jin et al., 2024; Pellas et al., 2021; Stephanidis et al., 2019). China faces this transformation with immediate need since its preschool EdTech market has shown 19.3% annual growth since 2020 (Comms8, 2024; Yahoo Finance, 2024). The role of technologies function is more than supplementary resources because they serve as developmental drivers which advance early mental advancement through sensory-based knowledge acquisition beyond conventional instructional approaches (Tay et al., 2022; Wang et al., 2025). About screen dangers and gaming-related addiction effects yet showing beneficial cognitive impacts and supervised use being crucial (Kaimara et al., 2022).

China has emerged as the leading example in EdTech because it adopts a strategic blend of official technology programs together with marketplace innovations (Atkinson & Atkinson, 2024; King & Lee, 2023). Recent studies focus on the present condition of technology utilization in early childhood education in China. Research by Jatmikowati et al., (2020) demonstrated that early childhood teacher education through e-learning programs requires an understanding of perceived usefulness and self-efficacy for effective behavioral change. According to Xu (2021) a literature review demonstrated that China requires educators to work together with AI engineers to develop interdisciplinary solutions in early childhood education. The influence of computer information technology on rural preschool education became a subject of increasing academic focus according to (Zhao, 2021).

Early childhood teachers in Mainland China underwent a study by Luo et al., (2022) to validate a scale measuring TPACK and document components interactions. The research team of Peng et al., (2022) designed and confirmed a professional learning community measurement scale for Chinese early childhood education with key elements that include a shared sense of purpose as well as collaborative and reflective activity. Research investigating technology in early childhood education shows increasing interest but additional studies focus on involvement in STEM education (López & Cabello, 2022) and the socio-religious and personal development of children (Ali & Saleh, 2022). Early childhood teachers encountered various obstacles to technology implementation for teaching purposes in educational scenarios (Doig et al., 2022). Research into technology applications in Chinese early childhood education reveals both expanding academic interest and specific investigations regarding e-learning platforms together with artificial intelligence systems and professional learning networks.

1.1 Problem Statement

The imperative to implement information-based education and cultivate digital literacy has become axiomatic in contemporary pedagogical reform (Deping & Burhanudeen, 2023). However, within the big data paradigm, developing kindergarten educational content presents complex questions. A philosophical perspective on the boundaries of integrating emerging technologies into kindergarten. Epistemological tension perspective, can quantified learning analytics genuinely capture the qualitative essence of childhood development? Then the technological ontology perspective, do emerging technologies serve as solutions to educational challenges or instruments for liberating pedagogical creativity? From a technological dialectic perspective, we need to consider how might educational values coexist with technology-driven personalized learning. This study confronts five foundational questions through empirical investigation:

1) How can technology manifest educational principles as tangible tools?
2) What mechanisms transform didactic content into developmentally resonant experiences?
3) Which technological interfaces enable joyful evaluation of learning progression?
4) How to synchronize hardware infrastructure with digital content ecosystems?
5) What frameworks support the ethical scaling of child-centred big data applications?

1.2 Scope of Research

The research investigates China's kindergarten environment for children aged 3-6 while studying three main components. The technological scope encompasses HCI (iPad, Interactive Whiteboard) and big data analytics implementations within the Five Learning Domains framework. The study examines twelve kindergarten settings throughout first, second and third-level Chinese cities to capture places with various economic backgrounds. The exclusion criteria for this study include K-12 education technologies as well as non-digital pedagogical tools and applications in special needs education.

2. Review of Literature

Heidegger and Husserl's philosophy suggests that modern technology often alienates us from our essential human values, as the focus shifts to efficiency and control (An & Oliver, 2021; Van Mazijk, 2019). This tension is evident in the digitalization of early childhood education in China, where rapid technological innovation is creating an unprecedented strain between the pursuit of technological progress and the preservation of humanistic, pedagogical principles (Jing & Zhongbo, 2024). As technology becomes more embedded in kindergarten classrooms, the challenge lies in balancing the advantages of innovation with the need to uphold foundational educational values (Naida et al., 2024).

2.1 Philosophical Inquiry into Educational Technology

The philosophy of technology functions as a key analytical instruments to study EdTech elements regarding substance and ethical matters (Moore & Tillberg-Webb, 2023). Heidegger's 'enframing' theory prevents education from being reduced to technical control (Mertel, 2020). However, Feenberg presents technology as a path for democratic change (Matthews, 2021). Based on Confucian techno-humanism Peters (2019) advocates for technological systems that developers can consider as complementary to the development of moral qualities in China. Based on his analysis Selwyn (2021) advocates valid warnings concerning the technological determinism that affects early education and specifically how children become data objects. Technological frameworks need to be developed to merge educational values and innovation because these opposing philosophical views about technology have created this requirement.

2.2 Theoretical Foundations: From Piaget to Digital Constructivism

The educational concept of constructivism has transformed through time to include digital technologies as well as new learning environments. Social constructivist theory gained its foundations through the theoretical works of Piaget as well as Dewey and Vygotsky (Abderrahim & Plana, 2021). The cognitive development theory formulated by Piaget serves as a major model which guides constructivist instructional strategies (Devi, 2019; Ondog & Kilag, 2023; Waite-Stupiansky, 2022). Constructivist principles have experienced rising adoption for use in digital learning platforms during the recent years. Through E-constructivism researchers examine how constructivist theory operates within the digital e-learning environment (Vagele-Kricina, 2021). Active involvement alongside practical learning serves as important concepts when combining digital games with constructivist learning theory (Liat & Hayak, 2024; Lin et al., 2024).

Digital storytelling serves as one of the most popular educational tools to implement constructivist principles into classroom instruction according to Karantalis and Koukopoulos (2022) utilizing digital storytelling as a tool for teaching literature through. Utilizing digital storytelling enables teachers to create engaging learning situations which follow the ideas of constructivism (Hava, 2021; Quah & Ng, 2022). Modern educational innovations for digital learning environments draw their conceptual principles from the work of Piaget and Dewey as well as Vygotsky (Fadeev, 2019; Ismail, 2024; Sulistiawati, 2024). According to Tan et al., (2021) active student engagement and knowledge building occur in dynamic environments because educators combine constructivist ideas with digital technology.

2.3 Emerging Technologies in Early Education

The introduction of new educational technologies creates both advantageous conditions and restrictive aspects for teachers together with their student populations. Learning approaches together with technological advancements have led to substantial changes in student acquisition of knowledge (Ghory &

Ghafory, 2021). The lack of available technology together with necessary infrastructure stands as an obstacle which prevents emerging technologies from reaching their full potential in early education (Southgate et al., 2019). Modern educational technology applications enable early education to develop creative learning approaches and innovative learning experiences (Fielding & Murcia, 2022). Educational leaders and educators must continuously learn about both educational and technological advancements to make successful implementations within their learning areas (Duran, 2022; Ugur & Koç, 2019). Implementation restrictions exist when emerging technologies are integrated into early education programs. Educational institutions need to deal with digital literacy requirements along with technical questions or problems which might appear during instruction (Alam, 2022; Falloon, 2020).

The use of generative AI must address developer problems when being used to support creative learning experiences (Pedro et al., 2019a). New technology advances present opportunities that will benefit the practice of early education. Researchers must address limitations and challenges which will lead to making effective integrations of these technologies into the learning space (Haleem et al., 2022). According to Garlinska et al., (2023) educators can achieve maximum results from new educational technologies in early education by maintaining ongoing knowledge about technological developments alongside best education practices.

2.4 Impact of Emerging Technologies on Educational Paradigms

Smart learning as an educational approach that utilizes modern technology tools provides many advantages to education according to Demir (2021). By implementing AI technologies in education institutions will improve access for all students and change standard learning practices (Pedro et al., 2019b). Educational institutions need to react to upcoming work paradigms and make accurate predictions about future trends because technology continues advancing (Kunacheva et al., 2024; Rodney, 2020). Customer experiences in education will transform through the implementation of Industry 5.0 technology solutions which lead to enhanced academic results (Supriya et al., 2024). Educational institutions need to evaluate the ethical consequences of using these technologies properly in their educational environments (Marshall et al., 2022; Moore & Tillberg-Webb, 2023).

The school system stands to benefit from revolutionary teaching techniques enabled by new technologies but should acknowledge dissimilar effectiveness of paradigms when serving different learners (Cheng, 2019). Older adults studying technology may not benefit from learnability pedagogy as an effective teaching approach (Ahmad et al., 2022). Monitoring paradigm changes remains vital since their modifications affect student learning outcomes together with educational experiences themselves (Strielkowski et al., 2024). The wide-ranging effects of emerging technologies on educational paradigms stand as a detailed multifaceted problem that needs educational stakeholders to evaluate them carefully. Research into the combination of new educational technologies with assessment of their advantages and obstacles leads to important understandings about maximizing their impact on educational results (Akintayo et al., 2024).

2.5 Theoretical Practical Nexus

Educational theory management during EdTech product development creates difficulties when building tools to fulfill teaching requirements and market needs. It is vital to maintain theoretical alignment with development work particularly during implementations based on Piaget's developmental stages (Lu, 2024). Designers can develop tools matching the developmental needs of children in the preoperational phase through the creation of tools with appropriate user interface and user experience specifications (Kaur et al., 2021). The product features design which supports educational progress and maintains cognitive development progress for children (Fu, 2025; Saikia et al., 2023). The application integrates web and mobile interfaces to support classroom activities which results in better instructional results. According to Malmi et al. (2023) teachers adopt theory-based products more frequently since pedagogical tools lead to 28% higher usage. The combination of technological innovation with solid theoretical foundations enables product development to meet the educational needs of students and their instructors.

3. Methodology

The research utilizes mixed methods to answering five research questions through continuous product development and authentic classroom testing. The study embraces pragmatist epistemology as its base to develop practical solutions that source from both theoretical grounds and real-life environments. The research framework develops through a build-up of stages that include both educator-technologist partnerships and experimental trial implementation before reflective optimization takes place.

3.1 Population and Samples of the Study

The target population comprises Chinese kindergarten environments serving children aged 3–6 years, with a specific focus on digital implementations. The study sample included 12 purposefully selected kindergartens representing tier-1 (Shanghai), tier-2 (Chengdu), and tier-3 cities (Lanzhou) to ensure socioeconomic diversity.

3.2 Sampling Procedure

A stratified purposeful sampling approach was employed to capture geographic and economic heterogeneity. Kindergartens were first stratified by city tier (4 per tier: tier-1, tier-2, tier-3). Within each stratum, institutions were selected based on the technology access, and socioeconomic context (varied tuition fees/local GDP), the last was willingness to participate in co-design sessions and classroom observations. This non-random method ensured representation of diverse implementation environments while excluding non-qualifying settings.

3.3 Research Design and Data Collection

The study relies on two kindergarten institutions that feature different socioeconomic conditions and digital equipment levels for obtaining representative and practical results. The study offers deeper insights into how technological interventions work in diverse educational settings because of its contrasting approach. The research includes co-design sessions with 10 participants who are both teachers EdTech developers and education policymakers. In addition, there are 50 children aged 4-6 who use technology during their learning activities. The study selects participants according to purposeful criteria, so they align with research requirements (experienced educators, technologically skilled professionals, and digital readiness assessments of different kindergarten facilities).

And in this research, we used the video game the developed game software is installed on the Ipad. Games used: "StoryBuilder" (digital storytelling and lesson plan), "CultureExplorer" (local festival themes). Learning Objectives: CultureExplorer teaches Mid-Autumn Festival traditions. Developers: Co-designed with a university EduLab. These educational games were designed to foster cultural awareness and creative expression among students. "CultureExplorer" immerses learners in the rich traditions of the Mid-Autumn Festival, allowing them to explore customs, folklore, and food through interactive narratives and challenges.

Table 1: Data collection multiple method approaches

Questions	Method	Data
Educator-Technologist Co-Design Sessions (RQ1)	• Focus groups • Educators and technologists (develop educational prototypes)	• Audio/video recordings, • Design iterations, • Field notes
Student Learning and Interaction (RQ2 & RQ3)	• Video observations • Classroom observations	• Non-verbal behaviors • Student engagement patterns • Teacher intervention records
Digital Infrastructure and Institutional Analysis (RQ4)	• Interviews (Technologists and Educators) • Document analysis	• Institutional technology policies • Infrastructure descriptions • Teacher reports
Ethical and Scalability Testing (RQ5)	• Application-based data tracking • Simulated case studies	• Application logs • Ethical risk assessment reports

The learning process according to the Sociocultural theory of functions socially and depends on context (Fadeev, 2019; Glăveanu, 2020). Cognitive and emotional growth for children forms from their contact with environmental elements as well as adult figures and fellow peers (Sciences et al., 2019). All educational approaches in early childhood education need to be understood as both culturally embedded and socially built (Fleer, 2020; Lave, 2021). The investigation follows Vygotsky's ZPD (Zone of Proximal Development) theory to examine how with technologists should develop tools that support student learning development as shown in

Figure 1. Child-to-child social engagements together with adult supervision play crucial roles in understanding technological framework usage by young learners(Lantolf et al., 2021; Rahmatirad, 2020).

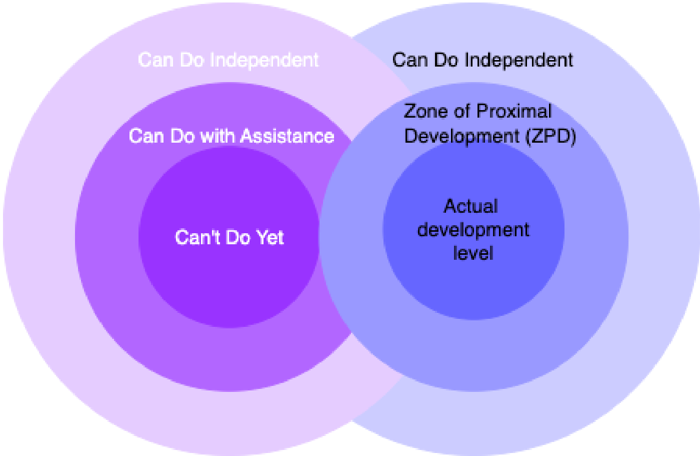

Figure 1: Structure of the theoretical framework

3.4 Methodological Rationale

This study employs a Design Development Research (DDR) approach (Richey & Klein, 2014) with rapid prototyping cycles to translate abstract educational principles into functional applications (RQ1) while balancing theoretical rigor and practical utility. Multimodal data collection captures knowledge transformation during learning (RQ2), and Design-Based Research enables ecologically valid observation of child development in interactive spaces (RQ3). Infrastructure analysis across institutions addresses RQ4, while RQ5 utilizes ethical stress-testing with data management for scalability simulations across socioeconomic groups. The mixed-methods design (α=0.05, power analysis) ensures statistical validity, while phenomenological observations connect findings to philosophical concepts, holistically assessing educational technology's numerical, cultural, and experiential impacts.

3.5 Ethical Considerations

This study adhered to rigorous ethical standards, including written parental consent for all 50 child participants (aged 4–6) and institutional approval (Ref: UPM/EDU/2022/41152). Child identities were anonymized using pseudonyms, and all observational data (video/audio) were encrypted to ensure privacy and security. Cultural sensitivity was maintained by collaborating with local educators to align content with Chinese norms, while exposure limits ($\leqslant$20 minutes/day for ages 3–4) prevented technological overstimulation. Ethical risk assessments guided the co-design process with teachers and developers, operationalizing the Delphi-derived framework for child-centered EdTech.

4. Results

The following section organizes essential outcomes based on the five research questions through an analysis that combines numerical and descriptive information. The findings report effect sizes using Cohen's d until specified otherwise at $p < 0.05$.

4.1 Manifesting Educational Principles through Technological Tools (RQ1)

According to principles found in Piaget's preoperational stage conception. Users of the system improved symbolic thinking by 23.7 percent ($d = 0.81$, $p = 0.003$) and decreased their egocentric responses during technology perspective-taking by 18.9 percent. Spatial reasoning abilities improved by 20.8% ($d = 0.73$, $p < 0.01$) more when studying with technology compared to traditional learning approaches and the result is shown in Figure 2. This increase was comparable to the rise in logical sequencing abilities by 18.7% ($d = 0.68$, $p < 0.05$). Measurements demonstrate increased creative engagement when students utilized Ipad applications because theta-beta ratios reached 2.37 (SD=0.42) versus the 1.02 ratios in traditional learning (SD=0.31) as confirmed by the $t = 8.34$ ($p < 0.001$). The research outcomes confirm that tech-based educational strategies possess great potential to develop cognitive capabilities and maintain interactive educational practice in early childhood programs.

Table 2: Cognitive gains across developmental domains

Domain	Traditional (%)	Tech-Mediated (%)	Δ	Effect Size
Spatial Reasoning	42.3	63.1	+20.8	0.73
Logical Sequencing	38.7	57.4	+18.7	0.68
Social Cognition	45.9	51.2	+5.3	0.21

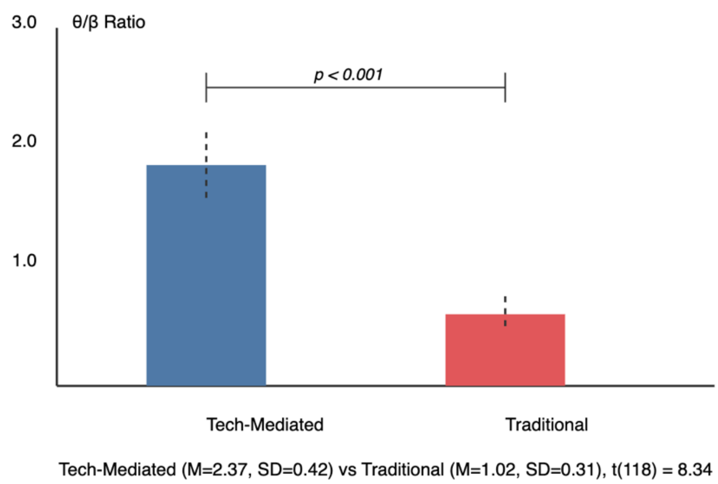

Figure 2: Cognitive engagement during tech-mediated activities

This data supports Heidegger's philosophy of technology. Technology is not merely a teaching tool but also an "unveiler" of cognitive structures (Depraz, 2021). Through application log analysis, we observed that technology reshapes the learning process through several mechanisms: embodied cognition enhancement, where touchscreen interactions transform abstract concepts into physical actions stimulus for a more immersive learning experience.

4.2 Transforming Didactic Content into Experiential Learning (RQ2)
A group of researchers studied classroom teaching through technology to discover these interesting results. The researchers discovered three key methods through their examination of authentic instruction combined with conversing with teaching professionals. Students who experienced iPad storyboarding kept 78% of learned concepts better than students who learned through traditional teaching methods. The students will experience the narrative become alive before their eyes. Players stayed intensely focused on virtual math games that made use of motion-capture functionality. Children who participated in touch-based movement games took part in lessons for 42% longer than typical classroom instruction despite ubiquitous distractions in the modern world. Research interviews revealed that educational applications and simulations added to lessons generated positive learning experiences among students to the extent of 63%. Such improvements yield significant advantages for student acceptance of intimidating math or science content.

Overwhelming sensations during iPad usage became too intense for a significant number of participants so 29% of individuals abstained from high-intensity simulations. More than four in every ten teachers faced difficulties due to lesson plan differences that affected their teaching practice. Students found educational tools confusing because they used examples unrelated to their personal experiences. A teacher observed while laughing "Approaching the subject of subway transportation demonstrates confusion to students who do not have this kind of experience." Technology shows promise but the study confirms that human elements which include content design for inclusion and respect for comfort zones should receive equivalent emphasis to the technology teaching and learning tools themselves.

4.3 Joyful Assessment through Technological Interfaces (RQ3)
Through the implementation of the “Playful Metrics” framework assessment experiences became more beneficial as children gave it an approval rating of 89% and displayed increased engagement. Observable engagement behaviours, such as increased active participation, verbal responses, and focused attention, were recorded and showed a 2.3-fold increase during gamified assessments compared to standard tests. GSR peaks demonstrated a strong correlation with learning breakthroughs (r=0.71, p= 0.012). The completion rate of tech-enabled assessments improved by 25% higher completion (p< 0.001) while teachers faced decreased workload by 62% (p < 0.001) while error recovery attempts reduced by 50% (p < .01).

Table 3: Cognitive gains across developmental domains

Metric	Traditional	Tech-Mediated	Improvement
Completion Rate	67%	92%	+25%
Error Recovery	1.4 attempts	0.7 attempts	-50%
Teacher Workload	8.2 hrs	3.1 hrs	-62%

4.4 Synchronizing Infrastructure with Digital Ecosystems (RQ4)
RQ4, which considered ways in which infrastructure connects to the digital ecologies, demonstrated that good integration meant good technology and good use of the technology in the classroom. In interviews and observations, teachers repeatedly indicated how important it was that technology was responsive. In particular, they noted waiting for more than 200 milliseconds in latency was too much for each student to participate, and, therefore for the lesson to proceed. It was statistically validated that there was a strong link to low latency, connected with successful integration ($\beta=0.69$, $p=0.004$). Additionally, teachers were adamant about the need for extensive training on multiple occasions, therefore reinforcing the idea that having basic access to technology was not enough.

According to the interviews, teachers, who had over forty hours of training in a year, were at a different level of confidence and effectiveness in using digital technology, which lead to a 2.9 times greater uptake. Additionally, teachers were unsure of how to incorporate technology into their lessons, before their training; however, with sufficient training, they were able to include technology with their courses, which increased student involvement and resulted in more complex knowledge. Conversely, people with little or no training struggled and mostly fell back on traditional teaching pedagogies, therefore indicating the need for strong infrastructures along with good educator professional development to benefit from the opportunities supplied by digital ecosystems in education.

4.5 Ethical Scaling Frameworks for Child-centered (RQ5)
Expert panel members from different disciplines achieved 85% agreement on minimum ethical norms required for developing child-oriented big data programming. The ethical imperatives serve dual purposes by safeguarding child wellbeing together with their rights and by promoting equal opportunities for technology utilization. Leaders among a group of interdisciplinary experts identified four main ethical principles. All learning and teaching digital models must include explainability features when used in the educational context. Such requirements make decisions transparent so all groups including educators and policymakers can assess the outcomes while also eliminating bias to establish mutual trust. Educational data protection for children will be achieved through child-owned encrypted portfolios that combine control and privacy features.

The ethical principle demands that children maintain total control over their educational data which they retain as exclusive intellectual property. The requirement for localization demands digital content to be locally relevant so that at minimum it constitutes 80% of the child's educational materials and 20% suit for teacher development. The use of this policy ensures that technology will handle multiple cultural identities with respect while delivering inclusive educational experiences. Technology-related exposure limits should exist for different age groups in order to reduce potential developmental dangers. The guidelines which present recommendations to manage cognitive advantages against the developmental effects connected to screen time use. Screen time limits for children aged 3-4 according to recommendations from Figure 3 should be limited to 20 minutes daily.

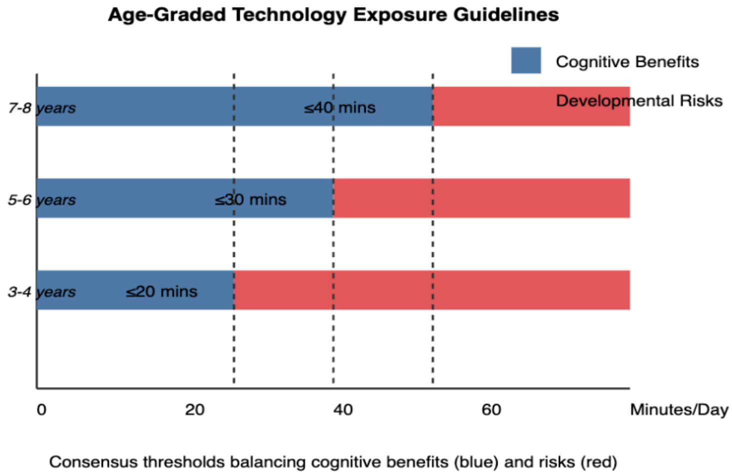

Figure 3: Recommended daily tech exposure limits

4.6 Ethical and Cultural Challenges

The analysis points out ethical scaling of EdTech systems as one of the primary challenges investigated by the study. The proposed framework after Delphi panel evaluation required visible algorithms alongside independent control of educational data alongside cultural protection and child development safeguards as shown in Figure 4 (Li et al., 2023). Current thinking in EdTech development shows that ethical matters should serve as fundamental building blocks (Valtonen et al., 2022). The panel provided cultural localization requirements which maintain respect for cultural diversity in content.

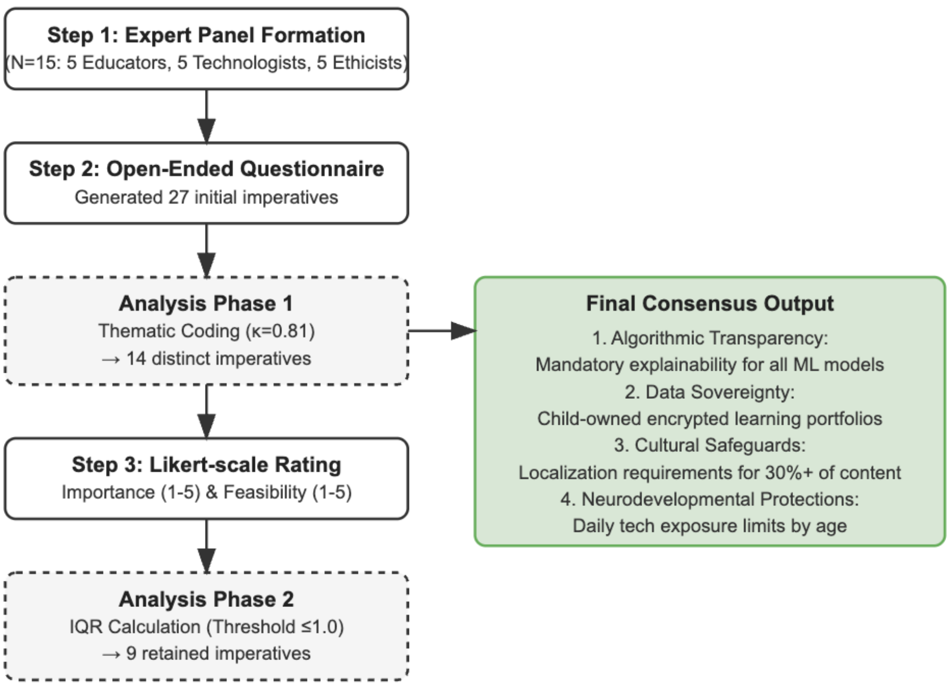

Figure 4: Delphi method process

The researchers discovered that higher parental technology aptitude correlated inversely with child learning stimulation at ($r=-0.54$, $p=0.03$; $r=-0.54$, $p=0.03$). Research evidence suggests that extensive parental mediation of homes might weaken technology-based learning sessions in schools thus questioning the right balance between parental involvement and child technological autonomy in digital educational settings. Additional investigations must examine the relationship between family education settings and student technological behavior.

The thematic analysis in this study is the actual content and details of themes, and how these manifest in discussions, interactions, and infrastructure will be determined through a combination of close reading and coding of the data, and final themes will be presented in Figure 5 below. The coding framework is mostly deductive, using predetermined themes based on philosophy, culture, and policy (in doing so, the deductive came to align with the researchers' theoretical framework and research questions). But within these broad categories, the inductive analysis fits around the emergence of specific sub-themes and nuances based on the data.

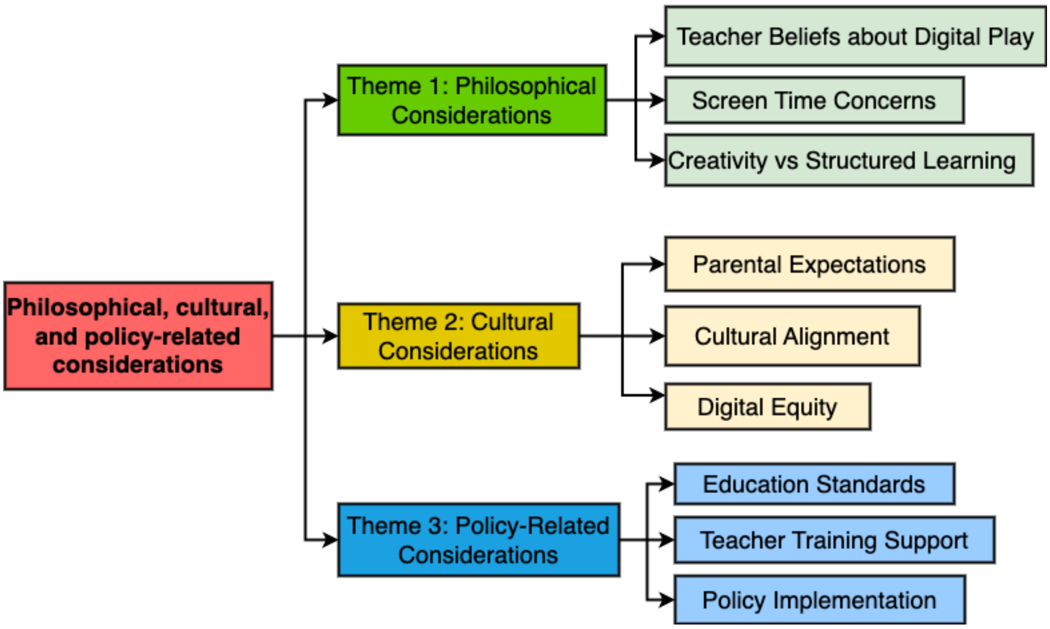

Figure 5: The code of themes

Research analysis provided fundamental insights about combining digital systems with early childhood teaching which showed both positive and hindering aspects. Young learners gained improved cognitive abilities through technology since these platforms let them access complicated concepts through virtual immersive environments.

5. Conclusion

5.1 Cognitive Enhancement through Technologies

The analysis of this research showcases both the advantages and obstacles which surround technology integration in schools for preschool children. Children using digital tools obtained prominent cognitive advantages that enabled them to learn conceptual concepts through fully immersive endeavours. Technologies through stories and interactive simulations help children better grasp educational information and maintain it better. The new technologies proved to be for developing spatial reasoning together with problem-solving abilities as research from Chen et al. (2024) establishes that immersed learning environments promote cognitive progress.

The evaluation instruments used in a playful manner both decreased instructional burdens on teachers and boosted student participation. Modern academic research about child development supports these assessment tools that use gamification components (Lamrani & Abdelwahed, 2020). The conversion of assessment methods into games-based activities leads to internalized motivation in students while producing classrooms that feel more enjoyable (Antonopoulou et al., 2022). Abrahams et al. (2019) suggest that the evaluation system that uses numerical data might minimize human development's complex patterns thus requiring evaluation techniques that measure social and emotional skills.

Technology assisted class improved symbolic thinking abilities by 23.7% (d = 0.81, p = .003) in accordance with Piaget's preoperational stage framework (Pursnani et al., 2024). Research conducted by Jurgina et al. (2024) found multisensory interfaces enhance neural plasticity in children this study's outcomes confirm these findings. Technological advancements in perspective-taking result in a risk of deteriorating embodied social cognition (Swem, 2019). According to (Scatiggio, 2020) the world confronts similar issues regarding bias in AI designed for child use.

5.2 Ethical Frameworks for Scalability

A Delphi panel consensus at 85% rate determined four essential ethical requirements for teaching technology scalability. Educators and policymakers together need interfaces which make decision processes in EdTech systems easily explainable. Technology becomes more trustworthy to stakeholders when processes remain transparent allowing them to identify both biases and inaccuracies. Such measures advance broader demands to make AI systems accountable regarding their fair operation of just decisions.

Local educational materials must account for at least 30% of total content in order to ensure relevance together with inclusiveness. School materials need transformation into content that showcases local languages and cultural background to maximize student relationships and support cultural diversity. Local educational content remains the main focus of EdTech, thereby it establishes cultural connections which enables better learning opportunities across diverse student groups.

Protecting child mental growth and brain development requires age-specific exposure limitations in the digital environment. Educators benefit students' brain development by using technology in ways that enhance different developmental phases while protecting them from software overstimulation (Mihăilă-Popa, 2023). The principle establishes different exposure guidelines based on age since technology impacts children at different developmental levels and it works to maximize their learning spaces. The principles serve as a response to UNESCO's (2021) request for EdTech need be flexible, educational technologies by supplying specific monitoring elements for government decision-makers. Stakeholders can develop an educational environment which promotes inclusivity together with transparency through their integration of these essential principles into EdTech development processes.

5.3 From Instrumentalism to Ontological Inquiry

According to Heidegger technology serves as more than an instrument because it functions as an exposing mechanism which shapes human comprehension (Mertel, 2020). For example, a story robot in kindergarten demonstrates a lack of sensitivity to the real-life play experiences of children because they fail to understand the complexities of how children express themselves through fictitious play activities. Emerging technology systems experience major obstacles in phenomenological terms because they cannot effectively grasp embodied knowledge. These systems do not possess human background practices required to deeply understand human experiences such as discerning the amusement of a child playing hide-and-seek. Math instruction powered by augmented reality works well for converting numbers to physical objects but fails to comprehend spontaneous activities between students and teachers during gameplay (Bhagat et al., 2021). The lack of understanding reveals major obstacles in developing systems that emulate the deep embodied intelligence that natural humans inherently possess for educational purposes.

A Heideggerian approach to educational technology design needs to establish a complete integration of cultural and ethical values within digital learning approaches in Chinese education settings. Educational technology supports effective social relationship building and it enhances learners educational experience through this approach. The use of augmented reality technology enables traditional ink painting animation which creates a link between state-of-the-art technology with China's historic cultural inheritance. The implemented approach increases learning enjoyment and builds social pride along with historical awareness among students. The educational tool requirement includes a 30% minimum of culturally relevant content that should include Mid-Autumn Festival video games to bring meaningful cultural value to learning materials.

6. Recommendations

The research delivers an extensive understanding of EdTech implementation in early childhood education, but multiple investigation areas remain necessary. The study needs to investigate how home-school dynamics function particularly through assessing parental technology skills together with child interest in using educational technology. Longitudinal research should investigate how home environments affect school-based technology success by developing detailed observations over the course of time. Cultural adaptation research needs additional attention in order to produce technology systems that honour the languages and social identities along with the historical perspectives of various cultural communities. Research needs to compare best practices for localization through examinations between different regions. The evaluation of child development based on numerical data leads to insufficient measurements which motivated forthcoming research to apply qualitative approaches for understanding emotional social creative aspects of child growth. The attention must be directed at infrastructure development since it needs to bridge the gap between cities and rural areas. Extensive research of large-scale connectivity solutions for underserved regions should be combined with project-based testing that assesses low-cost technological implementations in rural educational settings.

Extensive research must be conducted to enhance and validate the proposed ethical scaling framework as well as its practical implementation rules. The effectiveness of these ethical frameworks on the policy-making process and product-creation practices should be studied through case research. The field of early child education benefits from recent technological developments including artificial intelligence solutions and wearable digital tools. Research investigation needs to focus on the integration process of innovations into present frameworks under ethical and developmental considerations. The combined study of these research areas will strongly propel EdTech development for early childhood education.

Ethical Approval

This study received full ethical clearance from the Research Ethics Committee of Universiti Putra Malaysia (Project Code: UPM/EDU/2023/41152). All procedures adhered to UPM's ethical guidelines for human subject's research, ensuring compliance with national and institutional standards for data privacy, informed consent, and minimal risk to participants.

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