10.24193/ed21.2025.31.05

Implementing the RoboKids Program in Kindergarten: A Blended Learning Approach for Developing Preschoolers' Digital Skills

Onita-Maria Pavelea (Toderic), Cristian Stan

Educatia 21 Journal 31 (2025) – Special issue
Special Issue: Proceedings of 13th International Conference "Education, Reflection, Development" (ERD 2025)
Educatia 21 Journal, (31) 2025, Art. 05
doi: 10.24193/ed21.2025.31.05
Research article

Implementing the RoboKids Program in Kindergarten: A Blended Learning Approach for Developing Preschoolers' Digital Skills

Onita-Maria Pavelea (Toderic) [a*], Cristian Stan [b]

[a] *"Education, Reflection, Development" Doctoral School, "Babeș-Bolyai" University, Cluj-Napoca, Romania*
[b] *Faculty of Psychology and Educational Sciences, "Babeș-Bolyai" University, Cluj-Napoca, Romania*

*Corresponding author: *onita.pavelea@ubbcluj.ro*

Abstract

The article investigates the impact of the educational program RoboKids, implemented through blended learning activities, on the development of digital skills in preschool children. The research was based on an experimental approach, involving an experimental group and a control group, in order to assess the differences generated by the use of an innovative teaching-learning method. The intervention integrated ten educational digital applications into the daily kindergarten activities over a period of eight weeks, aiming to stimulate early digital skills through age-appropriate technological resources. The results, analyzed using both quantitative and qualitative methods, indicate a significant improvement among the children in the experimental group, highlighting the effectiveness of the blended learning model in the early development of skills required in today's digital society. Furthermore, the study proposes directions for optimizing the integration of technology into early childhood education, emphasizing the essential role of the educator in mediating the child–technology relationship.

Keywords:
digital skills; blended learning; preschool; kindergarten; develop

1. Introduction

Traditional education has long emphasized theoretical knowledge, but in today's context, this focus is no longer sufficient. As society evolves, online learning has become an essential part of the educational process. Research literature clearly highlights the widespread use of digital technology among preschool children, with touchscreen devices being the most frequently used. This popularity is likely due to the intuitive nature of touch interfaces, the ease with which new applications can be installed, and the enhanced portability of such devices. The growing integration of digital tools into young children's daily routines is a reality that both parents and educators must acknowledge (Mantilla & Edward, 2019). Studies suggest that preschoolers often become familiar with digital devices even before they are introduced to traditional books (Hopkins et al., 2013; Hooft Graafland, 2018).

The rise of digital education has created a pressing need for teachers to develop strong digital skills. Educators had to quickly adapt by learning how to effectively use digital platforms and tools to ensure the continuity of the learning process. This involved creating virtual classrooms, redesigning teaching materials for online environments, implementing digital assessment tools, and providing technical support to both students and their families. The transition required openness to new technologies, perseverance, and the ability to adjust to constant change. Within this context, digital education played a vital role in enhancing teachers' digital competencies, ultimately increasing the efficiency and adaptability of teaching and learning practices. Technology-based education plays a key role in preparing students for the demands of the future. It is essential that learners are taught to use technology in a thoughtful and responsible manner. At the same time, the educational process must promote the development of critical thinking, creativity, and problem-solving abilities, equipping students with the skills needed to navigate and adapt to the rapid pace of change in the digital world.

2. Theoretical foundation

The concept of blended learning emerged at the end of the 20th century and refers to the combination of face-to-face interaction between teachers and students with computer-assisted instruction. It is likely that this model will become increasingly dominant in the future. Technological advancements have led to the development of a wide range of tools, including social and informational networks, collaborative editing platforms, and virtual classrooms. Blended

learning is a formal educational approach where children engage in a mix of online activities and traditional in-person learning, while also having some control over the timing, location, and pace of their educational experience. Although there is no universally accepted definition, blended learning is generally understood as the integration of traditional teaching methods with digital resources. While not a new concept, it gained significant attention during the widespread school closures caused by the pandemic. This approach allows educators to design learning experiences that align with their instructional goals. Blended learning has become a necessity, as it combines the strengths of digital technologies and online education with the benefits of face-to-face interaction, leading to a more adaptable and responsive educational process suited to today's challenges. With the increasing availability of technology and internet access, the blended learning model is gaining significant popularity. Nevertheless, face-to-face interactions should not be entirely replaced, as students still require direct communication and feedback to reinforce their learning. Technology equips educators with a wide range of tools to actively engage students, making the learning experience more dynamic. In this framework, blended learning fosters deeper student involvement, while the teacher's role evolves from a mere transmitter of knowledge to that of a mentor and learning facilitator.

Garrison and Kanuka (2004) describe blended learning as a thoughtful integration of face-to-face classroom experiences with online learning opportunities. From a theoretical perspective, the effectiveness of this approach lies in the strategic balance between teacher-guided activities and independent learning facilitated through digital applications. Blended learning merges traditional in-person instruction led by educators with digital technology, allowing the use of various online resources to create more personalized learning pathways for students. This model enables teachers to differentiate and individualize instruction more easily within daily routines. It also introduces a new dimension to the learning experience by embedding technology into the teaching process in a structured and purposeful way. As many educational institutions expanded their use of digital tools during the pandemic, blended learning has gained significant attention and relevance. It is now seen not only as a temporary solution but as a viable, long-term strategy for improving student engagement and instructional flexibility.

3. Research methodology

The present research set out to explore the effects of the "ROBOKIDS" educational program on the enhancement of digital competencies in preschool children, using a blended learning approach. The program combined classroom-based activities with interactive online tools, integrating a suite of digital applications such as Wordwall, Zoho Show, Jigsaw Planet, Bee-Bot, Canva, and AutoDraw, as well as introductory programming elements appropriate for early learners. The study was carried out over an eight-week period and involved two groups of children aged 5 to 6, all enrolled in the same early childhood education institution. The experimental group engaged in blended learning sessions incorporating ten carefully selected educational digital applications, while the control group participated in conventional activities without the use of digital tools.

The digital resources were chosen to address a diverse set of competencies, including logical reasoning, fine motor skills, the recognition of digital symbols, and foundational digital interaction abilities. The intervention activities were implemented twice a week, each session lasting approximately 20 to 30 minutes.

The autumn term began with a series of activities aimed at stimulating children's curiosity and creativity. The activity "Autumn Basket" offered a multisensory experience, combining natural materials with digital tools such as Jigsawplanet, Piktochart, and Picker Wheel. In "Rich Autumn", children were encouraged to express emotions using the ChatterPix Kids application.

As they became familiar with the learning setting, the activity "Kindergarten and Its Rules" facilitated the discovery of behavioral norms through interactive platforms like Canva and PowerPoint. Imaginative thinking was nurtured through "Guess the Favorite Character", where children identified well-known story characters using Wordwall and Canva.

In November, the focus shifted toward creative and musical exploration. "Colorful Hands" integrated painting with digital puzzle-solving, while "Let's Sing Our Names" introduced a rhythmic learning activity through Typatone and YouTube.

The classic story "The Ant and the Grasshopper" was brought to life with the aid of 3D visuals and augmented reality applications, blending storytelling with technology. The season concluded with "End of Autumn", a reflective task supported by Autodraw.

In December, the festive spirit was embraced through activities such as "Christmas Tree", which merged craftwork with digital components, and "In Search of Santa", an interactive learning experience guided by the Bee-Bot robot.

To evaluate the effectiveness of the intervention, a structured observational tool was developed and applied prior to the introduction of digital applications. The evaluation scale was specifically designed for preschool educators and aimed to assess the level of digital skill development among participating children. It was composed of two sections: an introductory part collecting demographic and contextual data (such as country, kindergarten, teacher name, child's name and gender, age, and group), and a descriptive section focused on 17 observable items related to basic digital competencies. Educators were instructed to rate each item on a four-point Likert-type scale: 1 – Low level, 2 – Moderate level, 3 – High level, and 4 – Very high level, based on their direct observation of the child's behavior during daily activities. This instrument served as a baseline reference and was also applied after the intervention, enabling a comparative analysis between the pretest and posttest stages.

4. Results

The collected data were subjected to both descriptive and inferential statistical analysis in order to examine the impact of the educational intervention. Frequencies and percentages were used to outline the distribution of responses across the four levels of skill development for each item. In addition, comparative analyses were performed between the pretest and posttest stages, both within and between the experimental and control groups. To determine the statistical significance of the differences observed, Chi-square (χ^2) tests were applied for each item. This allowed the identification of potential improvements attributable to the intervention program. All statistical procedures were conducted using SPSS (Statistical Package for the Social Sciences), and the level of significance was set at $p < 0.05$.

As illustrated in Table 1 no statistically significant differences were observed between the experimental and control groups during the pre-test stage for any of the four items included in the subscale Correct Use of Digital Devices. A similar trend was maintained in the post-test stage for three of the items, with the exception of item 4 – completes the required tasks within the digital applications – where participants in the experimental group achieved significantly higher performance compared to those in the control group ($\chi^2 = 25.041$, $p = .003$, $p < 0.05$).

Tabel 1

Comparative Analysis – Pretest vs. Posttest for the Subscale "Correct Use of Digital Devices

ITEM	COMPARISON: CONTROL GROUP – EXPERIMENTAL GROUP PRE-TEST	COMPARISON: CONTROL GROUP – EXPERIMENTAL GROUP POST-TEST
1. Correctly uses the mouse in various digital activities.	χ^2=6.528, p = .686 P > 0.05	χ^2=4.003, p = .676 P > 0.05
2. Correctly uses the power on/off button of the phone/tablet during digital activities.	χ^2 = 13.963, p = .124 P > 0.05	χ^2 = 7.694, p = .261 P > 0.05
3. Correctly uses the keyboard of the phone or tablet.	χ^2=7.510, p = .276 P > 0.05	χ^2=7.639, p = .265 P > 0.05
4. Completes the required tasks within the digital applications.	χ^2=11.721, p = .237 P > 0.05	χ^2 = 25.041, p = .003 P < 0.05

The lack of significant differences for the other three items at post-test can be attributed to the fact that most children already demonstrated relatively high levels of competence during the pre-test phase in areas such as: using the mouse in various digital tasks, correctly handling the power button of a digital device, and operating the keyboard on a phone or tablet.

Tabel 2

Comparative pretest–posttest overview for the items corresponding to the subscale

ITEM	COMPARISON: CONTROL GROUP – EXPERIMENTAL GROUP PRE-TEST	COMPARISON: CONTROL GROUP EXPERIMENTAL GROUP POST-TES
5. Completes the digital puzzle game using the correct pieces to form the full image.	χ^2=3.628, p = .727 P > 0.05	χ^2 = 17.541, p = .034 P < 0.05
10. Verbalizes actions performed when completing tasks within digital applications.	χ^2 = 10.550, p = .262 P > 0.05	χ^2 = 15.550, p = .039 P < 0.05
11. Anticipates the steps required to complete tasks within digital applications.	χ^2 = 5.590, p = .771 P > 0.05	χ^2 = 14.939, p = .041 P < 0.05
14. Completes complex tasks within digital applications using the blended learning method.	χ^2 = 11.167, p = .234 P > 0.05	χ^2 = 16.556, p = .033 P < 0.05

Table 2 presents the comparative data for the subscale Ability to Perform Tasks and Interact Effectively with Digital Applications. During the pre-test stage, no statistically significant differences were observed between the experimental and control groups for any of the four evaluated items. However, in the post-test phase, the experimental group demonstrated significantly higher performance across all

dimensions. Specifically, children in the experimental group showed greater accuracy in completing digital puzzles, more frequent verbalization of actions while using digital tools, better anticipation of the steps required to accomplish tasks, and an increased ability to carry out complex tasks within applications when the blended learning method was applied.

Table 3.

Comparative pretest–posttest analysis for the items in the subscale Attention and engagement in digital activities

ITEM	COMPARISON: CONTROL GROUP – EXPERIMENTAL GROUP PRE-TEST	COMPARISON: CONTROL GROUP – EXPERIMENTAL GROUP POST-TEST
7. Difficulty level in completing tasks assigned by digital applications	χ^2 = 10.953, p = .279, P > 0.05	χ^2 = 18.080, p = .029, P < 0.05
9. Level of concentration during the use of digital applications	χ^2 = 7.029, p = .634, P > 0.05	χ^2 = 10.839, p = .257, P > 0.05
12. Applies knowledge from other learning domains in digital applications (language and communication, science, aesthetics and creativity)	χ^2 = 5.914, p = .758, P > 0.05	χ^2 = 18.895, p = .024, P < 0.05
13. Shows interest in digital applications used on phone/tablet	χ^2 = 11.111, p = .248, P > 0.05	χ^2 = 5.862, p = .742, P > 0.05
16. Uses algorithmic elements when coding educational robots	χ^2 = 9.111, p = .327, P > 0.05	χ^2 = 17.972, p = .031, P < 0.05

The data presented in Table 3 show that, at the pre-test stage, there were no statistically significant differences between the experimental and control groups for any of the five items included in the subscale Attention and Engagement in Digital Activities. At the post-test stage, this situation remained unchanged for the items related to the level of concentration during digital application use and the degree of interest shown toward the digital tools used on phones or tablets.However, significantly higher performance was recorded in the experimental group for three items: the perceived difficulty in completing tasks within digital applications, the ability to apply knowledge from other experiential domains (language and communication, science, aesthetics and creativity), and the use of algorithmic elements when coding educational robots.

5. Conclusions

These results underscore the educational potential of integrating digital tools through a blended learning approach in early childhood education. The ROBOKIDS program not only supported the acquisition of basic digital skills, but also encouraged more complex forms of learning, such as logical thinking, task planning, and the application of interdisciplinary knowledge. The statistically significant improvements observed in 11 out of the 17 evaluated items demonstrate the relevance and effectiveness of a carefully structured digital intervention. Moreover, the findings reaffirm the critical role of preschool educators in facilitating meaningful digital interactions, guiding children in a developmentally appropriate way, and ensuring that technology is used as a tool for learning, not just entertainment. Despite its promising outcomes, the study has certain limitations, including the relatively short duration of the intervention and the limited geographic scope of the participant sample. These aspects suggest the need for further research involving larger and more diverse populations.

In conclusion, the partial confirmation of the research hypothesis offers a strong argument for embedding structured digital activities in early childhood curricula, provided they are implemented with pedagogical intent and supported by trained educators. Future research should explore the long-term impact of such programs on children's holistic development, including their digital responsibility, creativity, and problem-solving abilities.

Authors note:

Onita-Maria Pavelea (Toderic) - Professor for Preschool Education, Kindergarten with Extended Program Number 12, Bistrița, Faculty of Psychology and Educational Sciences

Cristian Stan - Director of the Doctoral School Education, Reflection, Development, Faculty of Psychology and Educational Sciences

References

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *The Internet and Higher Education*, *7*(2), 95–105. https://doi.org/10.1016/j.iheduc.2004.02.001

Hooft Graafland, J. (2018). *New Technologies and 21st Century Children: Recent Trends and Outcomes*. OECD Education Working Papers, No. 179. OECD Publishing. https://doi.org/10.1787/19939019

Hopkins, D., Green, C., & Brookes, F. (2013). The impact of technology on children's development. *Early Child Development and Care*, *183*(1), 1–13. https://doi.org/10.1080/03004430.2011.638259

Mantilla, A., & Edwards, S. (2019). Digital technology use by and with young children: A systematic review for the Statement on Young Children and Digital Technologies. *Australasian Journal of Early Childhood*, *44*(2), 182–195. https://doi.org/10.1177/1836939119832744