ISSN 2683-345X
journal homepage: http://ijiemjournal.uns.ac.rs/

International Journal of Industrial Engineering and Management

Volume 17 / No 4 / December 2026 / 399 - 410

Original research article

Adapting EdTech for Developing Educational Contexts: A Comparative Usability Study of ALPA Kids and ChatGPT

S. Rakic[a,b] 0000-0002-9021-8585, K. Lilles[c] 0000-0002-8834-7273,
J. Leoste[b,d] 0000-0001-6919-0082, M. Stefanovic[a,*] 0000-0002-0767-365X

[a] *University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia;*
[b] *IT College, Tallinn University of Technology, Tallinn, Estonia;*
[c] *Institute of the Estonian Language, Tallinn, Estonia;*
[d] *School of Education, Tallinn University, Tallinn, Estonia*

ABSTRACT

The COVID-19 pandemic significantly accelerated the development and implementation of educational technology (EdTech) applications across learning institutions. However, post-pandemic, many schools, particularly in developing countries, returned to traditional teaching methods, deepening the digital divide between regions. In contrast, developed countries continued to advance EdTech integration. At the same time, the emergence of Artificial Intelligence (AI) in education has introduced new learning opportunities while raising important concerns about trust, ethics, and appropriate use. A key challenge remains: how to assess the usability and adaptability of these digital tools across diverse educational contexts. In response, the authors developed the Usability Platform Test (UPT) within the Horizon Europe EdTech Talents project, offering a structured approach to collecting meaningful feedback from learners. This study applied the UPT in Serbia through two case studies: (1) the use of the ALPA Kids app with primary students during a period of school closure, and (2) the use of ChatGPT among gifted secondary students. Results showed higher usability scores for ALPA Kids in content and design, while ChatGPT excelled in communication but raised data privacy concerns. The findings confirm UPT's relevance and provide user-driven guidance for adapting EdTech tools to under-resourced, diverse learning environments.

ARTICLE INFO

Article history:
Received November 7, 2025
Revised March 31, 2026
Accepted May 26, 2026
Published online September 15, 2026

Keywords:
EdTech;
Digital Education;
Usability Platform Test;
ALPA Kids;
ChatGPT

*Corresponding author:
Miroslav Stefanovic
mstef@uns.ac.rs

1. Introduction

The COVID-19 pandemic significantly accelerated the adoption of digital tools in education, particularly within the framework of blended learning [1]. Faced with sudden and prolonged school closures, educational institutions worldwide were compelled to shift rapidly to remote education [2]. Teachers increasingly relied on video conferencing platforms, learning management systems, and a range of digital resources to ensure the continuity of teaching and learning [3]. This period sparked a wave of Educational Technology (EdTech) innovation, with new companies entering the market and established providers expanding their reach to address the urgent demands of remote education [4].

Published by the University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Serbia.
This is an open access article distributed under the CC BY 4.0 terms and conditions.
https://doi.org/10.24867/IJIEM-425

Despite this rapid technological advancement [5], the long-term integration of digital tools into mainstream education has remained uneven [2]. After the pandemic subsided, many teachers reverted to traditional face-to-face teaching, while others continued to incorporate digital tools to complement their instructional practices [4]. The extent of digital adoption varies considerably between developed and developing countries [6]. While technologically advanced nations have continued to invest in digital education-embedding these tools into their educational ecosystems to enhance learning outcomes-many developing countries, constrained by limited infrastructure and financial resources, have struggled to sustain the digital progress made during the pandemic [7]. This widening digital divide is reflected in international assessments such as the Programme for International Student Assessment (PISA), where higher-income countries consistently outperform their less-resourced counterparts.

In parallel, Artificial Intelligence (AI) [8] has begun to reshape the educational landscape by providing powerful tools to support both learners and educators [9]. AI applications-ranging from personalized tutoring systems and automated feedback mechanisms to intelligent content recommendations-have opened new possibilities for tailoring instruction to individual needs [10]. These technologies are not intended to replace teachers but to assist them by streamlining administrative tasks, identifying student learning gaps, and enabling more personalized and effective pedagogy. However, the integration of AI into education also presents a range of ethical, pedagogical, and technical challenges that require careful consideration [11]. A nuanced understanding of AI's potential, limitations, and appropriate use is essential for guiding responsible and inclusive innovation in the sector [12].

The disparity in digital and AI adoption has profound implications not only for student achievement but also for broader issues such as workforce preparedness and educational equity [13]. In response, international organizations and funding bodies have initiated efforts to promote the development and deployment of digital learning tools in less-developed regions. Nonetheless, significant challenges remain, particularly concerning the adaptability and usability of EdTech solutions designed in high-income contexts when implemented in low-resource educational environments [14].

This study investigates the usability and accessibility of EdTech applications originating from developed countries when introduced in different educational systems. Specifically, it examines the effectiveness of the Usability Platform Test (UPT) as a tool for evaluating the feasibility of such applications in new markets [14]. Two case studies are explored: the first focuses on the potential implementation of ALPA Kids, an Estonian language learning application, in Serbian elementary schools-highlighting a cross-national comparison between one of Europe's top-performing PISA countries and a developing system in the Western Balkans. The second case study explores the use of ChatGPT as an AI tutoring assistant for talented secondary school students from six schools in the Vojvodina region of northern Serbia. The study aims to examine how usability and perceived learning support of two different digital tools can be systematically evaluated using the UPT within a developing country context. This primary contribution of this study is the extension and contextual validation of the UPT within K–12 educational environments in a developing country context. While previous applications of UPT focused primarily on higher education and controlled testing environments, this research applies the framework across two distinct educational levels. primary and secondary, using two different digital tools. The comparison between ALPA Kids and ChatGPT serves as an empirical vehicle to examine how UPT captures usability and perceived learning support across age groups and technological formats. In doing so, the study provides structured evidence of UPT's adaptability while offering practical insights for EdTech implementation in digitally emerging educational ecosystems. Rather than conceptualizing the contrast strictly in terms of national wealth, this study approaches the "developed vs. developing" distinction as a difference in digital ecosystem maturity, institutional readiness, AI literacy exposure, and systemic integration of EdTech. While intra-national disparities certainly exist, cross-national comparisons between digitally mature systems (e.g., Estonia) and emerging digital education ecosystems (e.g., Serbia) provide a meaningful lens for examining contextual usability adaptation. The focus is therefore not economic determinism, but ecosystem alignment, pedagogical integration, and digital literacy infrastructure. To address the proposed research gap, the authors propose the following research questions:

- RQ1: How do students from developing countries respond to the integration of modern EdTech tools in their learning environments?
- RQ2: How effective is the UPT in assessing the adaptability of EdTech applications across different educational contexts?

- RQ3: What are the similarities and differences in perceived learning support and usability dimensions between the ALPA Kids application and the AI-based ChatGPT tool when applied in a developing country context?

By addressing these questions, the study contributes primarily to the validation and broader applicability of UPT across different educational levels and technological formats, while also offering practical insights into the adaptation of EdTech tools within digitally emerging educational ecosystems. The rest of the paper is structured as follows: Section 2 presents a literature review on EdTech in global education and the gamification of learning and describes the EdTech app ALPA Kids. Section 3 outlines the methodology and presents UPT as a tool along with the case study in Serbia. Section 4 presents the results and a discussion of the radar diagram findings, as well as practical and theoretical implications. Finally, Section 5 concludes with key findings and limitations of the study.

2. Literature Review

2.1 EdTech in Global Education

EdTech has emerged as a promising solution to address challenges in educational systems, particularly in developing countries [15]. Research indicates that EdTech interventions focused on self-led learning and instructional improvements are most effective in raising learning outcomes [15]. Successful implementations often involve ongoing teacher professional development, interactive multimedia features, and a focus on phonics and progressive reading skills [16]. EdTech can also support learners with disabilities, though more robust research is needed in this area [17]. The field of EdTech research has evolved over time, with recent trends focusing on data-driven approaches, smart technologies, and learning analytics [18]. However, challenges remain, including hardware sharing, mobile-dominant computing, and cultural adaptation, particularly in developing countries [19].

The integration of digital technologies in education presents both promising opportunities and notable challenges for students and educators. Screen time, when used appropriately, can significantly enhance learning by providing access to high-quality educational content, fostering cognitive and creative development, and improving literacy and numeracy skills [20]. Digital platforms facilitate personalized learning experiences, enabling students to progress at their own pace and engage with interactive materials that cater to diverse learning styles [21]. Additionally, educational technologies have been shown to support collaboration, critical thinking, and problem-solving skills, equipping students with competencies essential for success in the modern digital economy [22]. However, the benefits of screen-based education must be weighed against its risks. Excessive screen exposure has been linked to negative cognitive, emotional, and physical health outcomes, including reduced attention.

2.2 Mobile Applications and Gamification in Language Learning

For language learning, mobile applications have emerged as effective tools in schools, offering opportunities for both in-class and out-of-class learning [23]. These apps can enhance various language skills, including vocabulary acquisition, reading comprehension, and overall language proficiency [24]. The research of [25] highlights the positive impact of educational apps on student English as a Second Language acquisition outcome. Students who used these tools exhibited higher levels of language proficiency compared to the group who received only traditional classroom instruction. Features such as inbuilt narration, real-time conversation prompts, and augmented reality have shown positive impacts on language learning outcomes [26].

Many learning applications use motivation enhancing strategies like gamification, which involves the application of game-like elements such as points, badges, and leaderboards in educational settings, has demonstrated notable advantages in improving student motivation, participation, and knowledge retention [22]. By making learning more interactive and enjoyable, gamification encourages students to take an active role in their education, leading to deeper engagement and enhanced problem-solving abilities [22]. Research suggests that gamified learning environments can promote persistence, self-efficacy, and a sense of accomplishment, as students are rewarded for their progress and achievements. Despite these advantages, gamification also comes with potential drawbacks. The competitive nature of many gamified systems may lead to stress and anxiety in some students, especially those who struggle to earn rewards or keep up with their peers [22]. Additionally, the digital divide remains a pressing issue, as students from lower-income backgrounds may lack access to

the necessary technology and internet connectivity, creating disparities in learning opportunities [20].

To maximize the benefits of screen time and gamification while mitigating their risks, educators and policymakers must implement balanced approaches. Encouraging moderated screen use, incorporating structured breaks, and ensuring diverse learning activities that include both digital and non-digital methods can help prevent negative effects on students' cognitive and physical well-being [20]. Similarly, designing gamified learning experiences that emphasize collaboration rather than competition and align with clear educational objectives can foster a more inclusive and effective learning environment [22]. Ultimately, the key to harnessing the power of digital education lies in thoughtful integration, ensuring that technological tools serve as enhancements rather than replacements for fundamental learning experiences. Moreover, the evaluation of a smartphone application is an important consideration before its employment [27].

2.3 ALPA Kids App

ALPA Kids, the EdTech app under study, is an EdTech service that develops culturally relevant, age-appropriate mobile learning games for children aged 3 to 8. The platform addresses the global need for quality educational content in children's native languages, but is also used for second language acquisition. The app offers more than 100 minigames that teach subjects such as the alphabet, numbers, nature, and mathematics, all tailored to reflect local cultures and languages. This approach not only enhances language skills but also fosters a deeper connection to the child's cultural heritage. ALPA Kids collaborates with local educators to ensure the content aligns with early childhood education curricula and supports holistic child development. The app is available in 15 languages, including Estonian, Ukrainian, British English and several Indian languages, and is used in over 170 countries, in total by more than 2 million young learners. It has been recognized with awards such as the “Estonian Language Act” by the Ministry of Education and Research in Estonia and the "With Children and For Children" Award by the Estonian President.

The ALPA Kids application has been the focus of multiple studies analyzing its role in early childhood education, particularly in language acquisition, game-based learning, and digital education technologies. Research highlights its effectiveness in supporting preschool and school language learning, personalized education, and the integration of digital tools into teaching methodologies.

Studies by [28] and [29] explore ALPA Kids’ contributions to game-based learning in Estonia. Megahed’s research emphasizes mobile learning and its role in supporting language acquisition among non-Estonian-speaking preschool children, particularly Russian speakers, demonstrating that digital games can boost engagement and facilitate cultural integration. Kippar’s study further examines personalized learning approaches, showing that ALPA Kids adapts to individual learning needs, making it a valuable tool for early childhood educators.

In the context of refugee education, [30] and [31] analyze ALPA Kids’ role in helping Ukrainian refugee children learn Estonian. Their findings indicate that digital learning games provide a structured, engaging, and stress-reducing environment for children coping with trauma, while also improving language comprehension and cultural adaptation. Both studies highlight the importance of putting focus on the differentiation of the learning process and collaboration between educators and parents. Additionally, [32] investigates ALPA Kids within screen-based learning environments, emphasizing its role in developing problem-solving, collaboration, and self-directed learning skills among preschoolers. Her study highlights the importance of teacher guidance in optimizing the effectiveness of digital learning tools.

These studies underscore the positive impact of ALPA Kids, particularly in language learning, personalized education, and digital game-based learning. While the studies affirm its effectiveness in engaging learners and supporting multilingual education, they also suggest that teacher training, curriculum integration, and parental involvement are critical to maximizing its potential. Future research should focus on long-term outcomes and strategies for broader implementation in diverse educational settings, particularly in developing countries. In this study, it is investigated how children and parents evaluate the usability of the ALPA Kids British English application usability in the context of the Serbian education landscape.

2.4 Exploring ChatGPT’s Role in Education

ChatGPT has rapidly transformed the global discourse on AI in education [33]. As one of the most accessible and widely used AI tools, ChatGPT has introduced new possibilities for how AI can support teaching and learning [34]. Its application in educational contexts has grown rapidly, with both students and educators exploring its potential to enhance various aspects of the learning experience. Findings from recent studies indicate that the capabilities of Chat-

GPT extend beyond basic information retrieval; they include personalized and adaptive learning, the facilitation of specific teaching and learning tasks, automated assessments, asynchronous communication, and instant feedback. Furthermore, ChatGPT has been used for improving academic writing, simulating personas for training purposes, delegating routine cognitive tasks, and enhancing research efficiency [12].

However, the widespread use of ChatGPT also raises important concerns. While the tool can provide rapid responses, the accuracy and depth of the information it generates can be inconsistent, posing risks if used without critical oversight. In addition, ethical considerations-particularly around data privacy, bias, and transparency in AI decision-making-remain insufficiently addressed in many educational settings. Despite policy initiatives such as the European Union's AI Act, which aims to regulate the use of AI tools in education, ChatGPT remains freely accessible to students worldwide, often without teacher or parental supervision. This has prompted a growing debate on the responsible integration of AI in formal education systems [12].

Since 2025, countries such as China and the United States have begun institutionalizing the use of AI tools in education as part of their national strategies [35]. These developments highlight the urgent need to examine how such technologies are being adopted in developing countries. Investigating the use of AI-driven tools like ChatGPT in these regions is essential for understanding how digital innovation can support equity, accessibility, and educational improvement across diverse educational systems.

While ChatGPT is not a purpose-built EdTech application in the traditional sense, it is increasingly repurposed by students and teachers as an informal learning support tool. In this study, ChatGPT is therefore examined not as a designed EdTech product, but as a general-purpose generative AI system appropriated for educational use. The evaluation thus reflects users' perceptions of its usability and perceived learning support within a specific instructional context, rather than an assessment of a formally engineered educational platform.

3. Methodology

3.1 Usability Platform Test Framework

The UPT was developed as part of the Horizon Europe EdTech Talents project (September 2023 - September 2024) through a collaboration between researchers from Serbia, Austria, and Turkey [14]. The initial conceptual framework was established during the first secondment period in September 2023, when a Serbian researcher visited the EdTech company MatheArena in Austria. During this phase, the core usability dimensions-navigation, user satisfaction, communication, design principles, content relevance, technical quality, motivational elements, and learning progress-were defined based on theoretical models and prior usability research. The UPT uses a seven-point Likert scale ranging from 1 ("Strongly disagree") to 7 ("Strongly agree") for each usability statement. Mean scores were calculated for each dimension, with higher values indicating more positive usability perceptions. In practical terms, mean scores above 5.0 reflect generally positive user experiences, scores around 4.0 indicate neutral or mixed perceptions, and scores below 3.0 suggest substantial usability concerns requiring revision. This interpretative framework enables clearer diagnostic evaluation of EdTech applications across usability dimensions. To validate these dimensions and associated items, structured interviews were conducted with researchers from Turkey between October and December 2023. Simultaneously, a group of students from the University of Novi Sad tested UPT in an experimental environment using the MatheArena app, providing initial feedback on the tool's effectiveness. The findings from this phase informed the refinement of UPT during the second secondment (February 2024), where usability test results were analyzed in collaboration with MatheArena representatives. The revised tool was subsequently tested in a real-world educational setting at the University of Applied Sciences CAMPUS 02 in Graz with master's students. In the third secondment period (September 2024), UPT was further validated with EdTech Austria, but stakeholders identified the need for a market-ready version, as the tool was initially developed as a free survey-based system. To address this, a new grant was secured from the Secretariat for Higher Education and Research Activities of Vojvodina, Serbia (October - December 2024), enabling the engagement of a programming team to develop a fully functional UPT platform with integrated ethical considerations, data security policies, and compliance measures. The final UPT application follows a structured testing process, including account creation, test access, usability testing, and completion, while providing EdTech owners with options for full data access, test creation, response analysis, reporting, comment summarization, and advanced comparison tools. With the involvement

of multiple stakeholders-including universities from Serbia, Austria, and Turkey, EdTech NGOs from Austria and Serbia, representatives from MatheArena, and the government of the Autonomous Province of Vojvodina-UPT reached Technology Readiness Level 9 (TRL-9), making it a fully developed, market-ready solution. As part of this validation process, ALPA Kids, an Estonian EdTech company, sought to test its newly launched English-language application in the Western Balkans region. In collaboration with UPT developers, a tailored usability test was designed for primary schools in Serbia to assess the application's usability, with results presented in the subsequent section

3.2 Case Study I: Implementation of the ALPA Kids Application in a Serbian Primary School

The first case study was conducted between January and February 2025 and focused on the implementation of the ALPA Kids language learning application, developed in Estonia, with students in a Serbian primary school. The participants were children aged 7 to 9, enrolled in private English language lessons. The learning environment was structured in two phases. Initially, students were introduced to the ALPA Kids app during guided sessions with their English teacher. Following this, the children continued using the app at home under the supervision of their parents. This pilot took place during a temporary school closure period in Serbia, which provided a unique opportunity for extended engagement with the application. With schools closed, parents were able to dedicate more time to supporting their children's language learning and monitoring their interaction with the app. This situation allowed for a natural integration of digital learning at home and offered insights into the role of parental involvement in EdTech-supported early language acquisition. After the usage period, a team of researchers from the University of Novi Sad engaged with the parents to conduct a usability evaluation. Parents were instructed on how to use the UPT to assess the application alongside their children. A total of 20 children and 20 parents participated in the usability testing process. To ensure privacy and ethical compliance, all responses were collected anonymously. The testing sessions were jointly facilitated by university researchers and parents, enabling a collaborative and child-centered evaluation of the ALPA Kids application.

3.3 Case Study II: Evaluating ChatGPT Use Among Talented Secondary School Students in Vojvodina

The second case study aimed to evaluate the use of ChatGPT among selected secondary school students, aged 18, who had been identified by their schools as academically talented. The study was conducted during a two-day educational workshop held at the Science and Technology Park in Novi Sad. The workshop, organized and facilitated by faculty from the University of Novi Sad, focused on the responsible and effective use of AI tools in education, with a particular emphasis on ChatGPT. A total of 60 students from six different secondary schools across the Vojvodina region in northern Serbia participated in the workshop. The event workshop was designed as a practical extension of the academic collaboration between the University of Novi Sad and Tallinn University of Technology, developed during the Estonian Doctoral Schools initiative in December 2024. The sessions covered key aspects of AI in education, including how to properly integrate ChatGPT into learning processes, critical evaluation of AI-generated content, and ethical considerations in the use of generative AI tools. During the workshop, students used ChatGPT primarily for academic support tasks including essay structuring, explanation of mathematical and scientific concepts, language reformulation, and reference generation exercises. Students were first guided through structured prompt examples provided by instructors, after which they engaged in independent exploration using self-formulated prompts related to their school subjects. Interaction was individual and device-based, with real-time supervision and discussion. This mixed structured–open interaction model allowed participants to experience both guided and autonomous AI-supported learning prior to completing the UPT evaluation. Unlike ALPA Kids, which was designed as a structured educational application, ChatGPT was evaluated as a general-purpose AI system repurposed within a pedagogically guided workshop setting. Following the instructional component, students were invited to engage with ChatGPT based on the skills and knowledge acquired during the workshop. They then participated in a structured evaluation process using the UPT, which allowed them to provide feedback on their experience with the tool. This approach enabled the researchers to assess not only the functional usability of ChatGPT in a real educational setting but also the students' perceptions of its effectiveness, accuracy, and relevance to their academic needs.

It should be noted that the sample sizes in both case studies were relatively small and uneven (n = 40 in Case Study I and n = 60 in Case Study II), reflecting the exploratory nature of the research design. The study was not intended to produce statistically generalizable conclusions, but rather to examine the applicability of the UPT framework across different educational levels and technological formats within a real-world context. Given the descriptive and diagnostic purpose of the study, inferential statistical tests were not applied. Instead, the analysis focused on comparative descriptive statistics and qualitative feedback to identify usability patterns and perceived learning support across user groups. In the present study, reliability checks were performed to verify internal consistency patterns across the UPT dimensions, and the observed results were broadly consistent with prior validations reported in [14], indicating strong psychometric reliability. In the present study, reliability analysis further supports the stability of the instrument when applied in a developing-country K–12 context. The ChatGPT dataset demonstrated high internal consistency across core dimensions, confirming that the UPT performs robustly with older student populations. While slightly lower coefficients were observed in the ALPA Kids pilot sample, this pattern is consistent with established research indicating that younger respondents tend to exhibit greater response variability in Likert-based instruments. Importantly, the overall reliability structure of the UPT remained stable across both educational levels, reinforcing its suitability as a multidimensional usability assessment framework applicable across diverse age groups and technological formats.

4. Results and Discussion

4.1 Radar Diagram Analysis

The following results should be interpreted as exploratory and descriptive, aimed at identifying comparative usability tendencies rather than establishing statistically generalizable differences. In response to the research questions "how students from developing countries respond to the integration of modern EdTech tools in their learning environments" and "what are the similarities and differences in perceived learning support and usability dimensions between the ALPA Kids language learning application and the AI-based ChatGPT tutoring tool when applied in developing countries", Figure 1 presents a radar diagram comparing the usability evaluations of the ALPA Kids application and ChatGPT.

Figure 1 presents a radar chart comparing the results of the UPT conducted in two distinct educational contexts: the use of the ALPA Kids application by primary school students and the use of ChatGPT by secondary school students. The evaluation focused on eight dimensions of usability. The results reveal notable differences in usability perceptions between the two tools. Overall, the ALPA Kids app demonstrated higher average scores across nearly all dimensions. Specifically, ALPA Kids outperformed ChatGPT in Content Analysis (5.45 vs. 4.20), Learning Progress (5.35 vs. 4.64), Motivational Aspects (5.14 vs. 4.55), Navigation Information (5.29 vs. 4.54), Technical Quality (5.59 vs. 4.67), Usage of Design Principles (5.49 vs. 3.47), and User Satisfaction (5.63 vs. 4.34). The only dimension in which ChatGPT

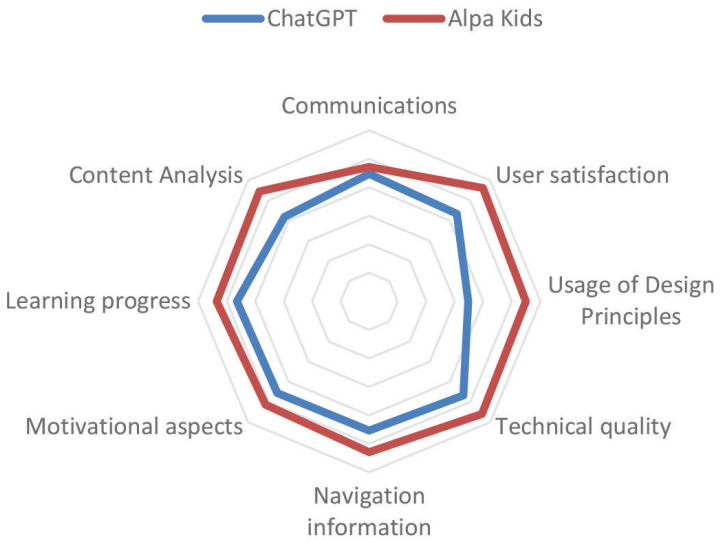


Figure 1. Comparative UPT Profiles of ALPA Kids and ChatGPT

scored closely was Communications (4.47 vs. 4.72), indicating its effectiveness in dialog-based interaction, a core feature of AI-powered conversational tools. Beyond individual dimension scores, three dominant contrasts emerge, directly linked to age group, tool type, and implementation context. First, ALPA Kids demonstrates stronger "product-oriented" usability (design, navigation, technical quality), which aligns with its gamified structure and its use by younger primary-school learners (7–9 years) in a guided home–school setting supported by parents. Second, ChatGPT's comparative strength lies in communication, reflecting the affordances of a conversational GenAI tool used by older secondary-school students (~18 years) in a structured workshop environment; however, this same tool type generates higher expectations regarding clarity, reliability, and transparency, contributing to lower evaluations in interface structure and support. Third, the findings suggest a contextual-fit effect: ALPA Kids performs best when learning is scaffolded and age-calibrated, whereas ChatGPT's perceived learning value depends heavily on students' critical literacy, responsible-use framing, and digital maturity factors that are particularly salient in developing-country educational settings. To gain a deeper understanding of how students from developing regions perceive and accept the use of the ALPA Kids and ChatGPT applications, qualitative feedback was collected from all respondents who rated any item with a score of 3 or below on the UPT. Table 1 summarizes the main themes that emerged from the comments, highlighting key usability and pedagogical concerns related to each tool.

In response to the first research question, the findings from Serbia highlight both the opportunities and challenges of integrating modern EdTech tools in a developing-country context. As shown in Figure 1, participants rated ALPA Kids higher than ChatGPT across nearly all usability dimensions. Primary-school users perceived ALPA Kids as visually appealing and easy to use, but qualitative feedback consistently indicated a mismatch between task difficulty and learners' level. In particular, children reported low challenge and limited progression options, suggesting that the app would benefit from adjustable difficulty levels to better fit diverse educational contexts. Parents largely confirmed the positive usability experience but also pointed to practical barriers related to access and reliability (e.g., account creation and occasional loading issues), indicating room for improvement in onboarding and backend stability.

In contrast, secondary-school students evaluated ChatGPT more critically. While the tool's dialog-based interaction supported communication-related use cases, students reported lower satisfaction with interface clarity, navigation, and availability of guidance or support. Importantly, concerns about trust and data privacy emerged as salient themes, alongside doubts about response reliability for schoolwork, particularly in tasks that require accuracy and verifiable outputs (e.g., academic references). Overall, the comparison suggests that students in devel-

Table 1. User-Reported Usability Improvement Themes for ALPA Kids and ChatGPT

Dimension	ALPA Kids	ChatGPT
User Motivation & Engagement	Reward system not engaging enough; needs more stimulating elements.	Boring interface and tone; lacks emotional engagement or incentive to continue learning.
Account & Support Access	Account creation was unclear; contact/help info hard to find.	Users struggled to find help or online support; no clear guidance for assistance.
Navigation & Interface	Navigation structure unclear; users want option to select difficulty levels.	App perceived as unintuitive; difficult to navigate and locate relevant content.
Content Relevance & Challenge	Tasks were too easy for older children (7–9 years); no adjustable difficulty.	Repetition of tasks and lack of depth; content sometimes irrelevant or not educational.
Learning & Feedback	Content not perceived as educational; limited memory support or reinforcement.	Inaccurate or vague responses; lack of explainability; hallucinations noted.
Technical Performance	Some tasks didn't load properly (blank screens).	Delayed responses, failed prompts, and unstable multimedia features (e.g., AI image).
Design & Aesthetics	Desire for more engaging visual design and structured layout.	Minimalist design disliked; poor color schemes and boring interface; "too plain."
Audio & Voice	Voice sometimes unclear; laughter effects distracting.	Voice rated very poorly; often confusing or unpleasant; users request better voice design.

oping educational settings are willing to engage with EdTech, but sustained adoption depends on context-fit: age-appropriate challenge and stable usability for younger learners, and clear guidance, transparency, and reliability assurances for general-purpose AI tools re-purposed for learning.

4.2 Theoretical Implications

In response to the second research question "how effective is the UPT in assessing the adaptability of EdTech applications across different educational contexts", the findings of this study confirm previous results on the effectiveness of the UPT, which had been successfully applied in advanced countries such as Austria. This study extends its validation by including data from both primary and secondary school students in Serbia, as well as their parents, thereby incorporating diverse stakeholder perspectives from the EdTech ecosystem [14]. The results highlight the UPT's capacity to offer multidimensional insights through its combination of quantitative scores and qualitative comments. It enables clear visualization and comparative analysis of each usability dimension, supporting both macro-level evaluations and micro-level diagnostics of specific features. This dual approach strengthens the UPT's value not only as a measurement tool but also as a formative assessment framework that guides EdTech developers in adapting applications to the needs of different user groups and educational environments. Importantly, the inclusion of users from a developing country context reveals that while students and parents show strong interest in modern EdTech tools, the design and functionality must be aligned with their specific learning needs and perceived learning support, digital literacy levels, and contextual constraints. These findings underscore the broader potential of UPT to facilitate cross-national collaborations and policy development by identifying common usability barriers and informing inclusive EdTech design. Therefore, this research supports the idea of joint initiatives across Europe aimed at developing a shared understanding of quality standards and fostering the co-creation of adaptable, learner-centred digital education systems.

Beyond confirming the applicability of the UPT framework, this study makes a distinct theoretical contribution by advancing the comparative evaluation of educational technologies across different pedagogical and technological paradigms. Recent scholarship has emphasized that the effectiveness of digital learning tools depends not only on technical performance, but also on their pedagogical fit, contextual adaptability, and alignment with user needs across educational settings [36]. At the same time, emerging research on generative AI in education has shown that general-purpose systems such as ChatGPT introduce new forms of interaction and support, but also raise specific challenges related to trust, interpretability, and instructional integration [38]. In contrast to prior studies that typically examine either purpose-built educational applications or AI tools in isolation, the present study evaluates both within a single usability framework, thereby enabling a more rigorous comparison of how learner age, tool architecture, and implementation context shape perceived learning support. This is particularly important in light of recent calls for more context-sensitive and educator-centred approaches to digital transformation in education [39]. Furthermore, by applying UPT across primary and secondary educational levels in a developing-country context, the study extends current debates on digital ecosystem maturity and the uneven transferability of EdTech solutions across national and institutional settings [37]. The findings therefore demonstrate that structured multidimensional usability assessment can reveal hidden barriers to adoption, support, and trust that are often overlooked in broader technology acceptance discussions, while also contributing to ongoing conversations about responsible AI integration and digital pedagogy in contemporary education systems [40].

Taken together, the findings highlight the importance of evaluating emerging educational technologies through structured and context-sensitive usability frameworks rather than relying solely on adoption or performance metrics. By comparing a purpose-built educational application with a repurposed generative AI system within the same evaluation framework, this study demonstrates how differences in tool architecture, learner maturity, and instructional context shape perceived learning support. The results therefore contribute to the broader discussion on responsible integration of AI and digital learning tools in educational ecosystems undergoing digital transformation, particularly in contexts where technological innovation often precedes pedagogical adaptation [38].

4.3 Practical Implications

From a practical perspective, the findings of this study provide several valuable insights. Most notably, the results highlight the growing interest among students in developing regions in engaging with EdTech applications. The use of the ALPA Kids app during a period of school closure in Serbia demonstrated the

potential for parents to take an active role in sustaining children's learning outside of formal classroom settings. This case illustrates how EdTech tools can be effectively integrated during moments of disruption, offering flexible and accessible alternatives for continued education. On the other hand, the use of AI tools-particularly ChatGPT-among secondary school students revealed important insights into how young people perceive and adopt AI in education. In our sample, students expressed interest but reported uncertainty about effective academic use, indicating a need for structured guidance and AI literacy support. Although they express interest, many lack a clear understanding of how to effectively use these tools in an educational context. Therefore, the practical implementation of AI in education in developing countries must be supported by clear pedagogical frameworks that define the appropriate use of AI, focusing on learning outcomes, teacher roles, and ethical considerations. This research highlights the need for international cooperation between developing and advanced educational systems to share best practices and co-create scalable solutions. Additionally, the findings raise new questions that could inform future European initiatives, including Horizon Europe proposals, aimed at establishing a pan-European alliance for AI in education. Such collaborations could foster inclusive digital transformation and ensure that AI adoption in schools is equitable, purposeful, and pedagogically sound.

The findings also provide several practical implications for EdTech developers, educators, and policymakers seeking to implement digital learning technologies in emerging educational ecosystems. First, developers should prioritize contextual adaptability when designing educational applications intended for international deployment. Tools developed in digitally mature ecosystems may require adjustments in interface clarity, difficulty calibration, onboarding processes, and culturally aligned content before being introduced into new educational systems. Second, the results highlight the importance of pedagogical mediation when integrating general-purpose AI tools such as ChatGPT into formal learning environments. While students demonstrated interest in using generative AI for academic support, their feedback revealed uncertainty regarding reliability, navigation, and appropriate usage for school-related tasks. This suggests that AI adoption in education should not be treated solely as a technological implementation, but as a pedagogically guided process supported by AI literacy initiatives, teacher training, and institutional guidelines. Finally, the study underscores the importance of conducting structured usability diagnostics before large-scale EdTech deployment. Evaluation frameworks such as the UPT can help educational institutions and technology providers identify usability barriers, trust concerns, and contextual misalignments early in the adoption process, thereby supporting more effective and responsible integration of digital learning technologies across diverse educational contexts.

5. Conclusions

This study examined the usability and perceived learning support of two digital tools ALPA Kids and ChatGPT within a developing-country educational context. The findings indicate that while students across age groups are open to engaging with EdTech, sustained adoption depends on contextual alignment. ALPA Kids was positively evaluated for design clarity and technical stability but required better calibration of difficulty levels to match learners' competencies. ChatGPT demonstrated strengths in communication-based interaction, yet raised concerns related to interface clarity, response reliability, and data trust. Across both cases, the most significant barrier was not access to technology, but the degree of pedagogical and cultural fit within the local educational environment.

The primary contribution of this research lies in extending and validating the UPT within K–12 contexts in a developing-country setting. The results demonstrate that UPT functions as a multidimensional diagnostic framework capable of identifying age-specific usability patterns and adaptation needs across different technological formats. Beyond comparing two tools, the study highlights the importance of structured usability assessment as a prerequisite for meaningful and equitable EdTech integration.

While this study offers valuable insights into the usability and adaptability of EdTech applications in developing educational contexts, several limitations should be acknowledged. The most significant limitation concerns the relatively small and uneven sample sizes and the geographic confinement to a single national context, which limits statistical generalizability. Although the research included both primary and secondary school students, as well as two distinct types of EdTech tools-a gamified language learning app (ALPA Kids) and an AI-based tutoring system (ChatGPT)-the total sample of 100 participants was confined to a single country, Serbia. This limited scope may affect the generalizability of the findings,

especially considering the cultural, infrastructural, and educational diversity that exists across other developing regions. Moreover, the dual focus on both age groups and tool types, while ambitious, may have constrained the depth of analysis for each subgroup. The study should thus be viewed as a pilot exploration, laying the groundwork for a more expansive research agenda.

Future studies should aim to include a broader range of EdTech applications, covering additional functionalities and subject domains, and should be conducted across multiple countries and educational systems. Comparative studies involving different cultural and institutional settings would help validate the UPT further and provide a more comprehensive understanding of how EdTech tools can be successfully adapted to meet the needs of diverse learners. Longitudinal research is also recommended to examine how sustained use of these tools impacts learning outcomes, digital competence, and student motivation over time.

Funding

This research was funded by the European Commission under the Horizon Europe call HORIZON-WIDERA-2022-TALENTS-03, project "EdTech Talents" (grant agreement number 101119689).

References

[1] S. Rakic, N. Tasic, U. Marjanovic, S. Softic, E. Lüftenegger, and I. Turcin, "Student performance on an e-learning platform: Mixed method approach," Int. J. Emerg. Technol. Learn., vol. 15, no. 2, p. 187, 2020, doi: 10.3991/ijet.v15i02.11646.

[2] H. G. Van De Werfhorst, E. Kessenich, and S. Geven, "The digital divide in online education: Inequality in digital readiness of students and schools," Comput. Educ. Open, vol. 3, Art. no. 100100, 2022, doi: 10.1016/j.caeo.2022.100100.

[3] F. Kilipiris, S. Avdimiotis, E. Christou, A. Tragouda, and I. Konstantinidis, "Bloom's taxonomy student persona responses to blended learning methods employing the metaverse and flipped classroom tools," Educ. Sci., vol. 14, no. 4, Art. no. 418, 2024, doi: 10.3390/educsci14040418.

[4] R. Cobo-Rendón, C. Bruna Jofre, K. Lobos, N. Cisternas San Martin, and E. Guzman, "Return to university classrooms with blended learning: A possible post-pandemic COVID-19 scenario," Front. Educ., vol. 7, Art. no. 957175, 2022, doi: 10.3389/feduc.2022.957175.

[5] V. Arioli et al., "Digital servitization business typologies in the manufacturing sector," Int. J. Ind. Eng. Manag., vol. 16, no. 1, pp. 1–23, 2025, doi: 10.24867/IJIEM-378.

[6] S. K. Howard and A. Mozejko, "Considering the history of digital technologies in education," in Teaching and Digital Technologies, 1st ed., M. Henderson and G. Romeo, Eds. Cambridge, U.K.: Cambridge Univ. Press, 2015, pp. 157–168, doi: 10.1017/CBO9781316091968.017.

[7] O. Zawacki-Richter, V. I. Marín, M. Bond, and F. Gouverneur, "Systematic review of research on artificial intelligence applications in higher education—Where are the educators?," Int. J. Educ. Technol. High. Educ., vol. 16, no. 1, Art. no. 39, 2019, doi: 10.1186/s41239-019-0171-0.

[8] Y. I. Alzoubi and A. Topcu, "Generative artificial intelligence technology for systems engineering research: Contribution and challenges," Int. J. Ind. Eng. Manag., vol. 15, no. 2, pp. 169–179, 2024, doi: 10.24867/IJIEM-2024-2-355.

[9] M. Kelley and T. Wenzel, "Advancing artificial intelligence literacy in teacher education through professional partnership inquiry," Educ. Sci., vol. 15, no. 6, Art. no. 659, 2025, doi: 10.3390/educsci15060659.

[10] C.-C. Lin, A. Y. Q. Huang, and O. H. T. Lu, "Artificial intelligence in intelligent tutoring systems toward sustainable education: A systematic review," Smart Learn. Environ., vol. 10, no. 1, Art. no. 41, 2023, doi: 10.1186/s40561-023-00260-y.

[11] F. Panagopoulou, C. Parpoula, and K. Karpouzis, "Legal and ethical considerations regarding the use of ChatGPT in education," SocArXiv, 2023, doi: 10.31235/osf.io/c5hf3.

[12] B. Memarian and T. Doleck, "ChatGPT in education: Methods, potentials, and limitations," Comput. Hum. Behav. Artif. Hum., vol. 1, no. 2, Art. no. 100022, 2023, doi: 10.1016/j.chbah.2023.100022.

[13] D. Hadar Shoval, "Artificial intelligence in higher education: Bridging or widening the gap for diverse student populations?," Educ. Sci., vol. 15, no. 5, Art. no. 637, 2025, doi: 10.3390/educsci15050637.

[14] S. Rakic, S. Softic, Y. Andriichenko, I. Turcin, B. Markoski, and J. Leoste, "Usability platform test: Evaluating the effectiveness of educational technology applications," in Futureproofing Engineering Education for Global Responsibility, M. E. Auer and T. Rüütmann, Eds., Lecture Notes in Networks and Systems, vol. 1280. Cham, Switzerland: Springer Nature Switzerland, 2025, pp. 250–258, doi: 10.1007/978-3-031-83523-0_23.

[15] D. Rodriguez-Segura, "EdTech in developing countries: A review of the evidence," World Bank Res. Obs., vol. 37, no. 2, 2022, doi: 10.1093/wbro/lkab011.

[16] A. Norman, "Educational technology for reading instruction in developing countries: A systematic literature review," Rev. Educ., vol. 11, no. 3, 2023, doi: 10.1002/rev3.3423.

[17] P. Lynch, N. Singal, and G. A. Francis, "Educational technology for learners with disabilities in primary school settings in low- and middle-income countries: A systematic literature review," Educ. Rev., vol. 76, no. 2, 2024, doi: 10.1080/00131911.2022.2035685.

[18] A. Bozkurt, "Educational technology research patterns in the realm of the digital knowledge age," J. Interact. Media Educ., vol. 2020, no. 1, Art. no. 1, 2020, doi: 10.5334/jime.570.

[19] B. D. Nye, "Intelligent tutoring systems by and for the developing world: A review of trends and approaches for educational technology in a global context," Int. J. Artif. Intell. Educ., vol. 25, no. 2, 2015, doi: 10.1007/s40593-014-0028-6.

[20] P. Goswami and V. Parekh, "The impact of screen time on child and adolescent development: A review," Int. J. Contemp. Pediatr., vol. 10, no. 7, 2023, doi: 10.18203/2349-3291.ijcp20231865.

[21] J. Cullen et al., "Impacts of digital technologies on child and adolescent health: Recommendations for safer screen use in educational settings," N. Z. Med. J., vol. 137, no. 1598, 2024, doi: 10.26635/6965.6565.

[22] D. R. Wulan, D. M. Nainggolan, Y. Hidayat, T. Rohman, and A. Y. Fiyul, "Exploring the benefits and challenges of gamification in enhancing student learning outcomes,"

Glob. Int. J. Innov. Res., vol. 2, no. 7, 2024, doi: 10.59613/global.v2i7.238.

[23] K. E. Gael and D. S. Elmiana, "Mobile-assisted language learning (MALL) in English language acquisition: A critical literature review," J. Engl. Lang. Teach. Innov. Mater., vol. 3, no. 2, 2021, doi: 10.26418/jeltim.v3i2.49813.

[24] C. Kalyan Chakravarthy and V. Sunitha, "The use of mobile apps to enhance reading skills of language learners: A review," J. Hum. Res. Rehabil., vol. 13, no. 1, 2023, doi: 10.21554/hrr.042303.

[25] M. D. Tadjiyeva, "The use of educational apps as didactic tools in teaching English as a second language," Eur. J. High. Educ. Acad. Adv., vol. 1, no. 1, 2023, doi: 10.61796/ejheaa.v1i1.184.

[26] S. A. Booton, A. Hodgkiss, and V. A. Murphy, "The impact of mobile application features on children's language and literacy learning: A systematic review," Comput. Assist. Lang. Learn., vol. 36, no. 3, 2023, doi: 10.1080/09588221.2021.1930057.

[27] S. S. Sukor and Z. Ali, "Smartphone applications for young English language learners," J. Phys. Conf. Ser., vol. 1529, no. 5, Art. no. 052079, 2020, doi: 10.1088/1742-6596/1529/5/052079.

[28] A. Megahed, "Impact of language learning games for preschool children based on the case study of Alpa Kids application," Master's thesis, Tallinn Univ., Tallinn, Estonia, 2021.

[29] E.-M. Kippar, "Personalized learning in early childhood education in Estonia and opportunities to support it through technology: Using ALPA Kids application," Master's thesis, Tallinn Univ., Tallinn, Estonia, 2022. [Online]. Available: https://www.etera.ee/zoom/198893/view?page=1&p=separate&search=alpa&tool=search&view=807,1087,1320,560. [Accessed: Oct. 12, 2024].

[30] H. Yaremenko, "The uncertainties of digital learning games use in teaching young children (by the immersion method): The case of ALPA Kids," Master's thesis, Univ. Tartu, Tartu, Estonia, 2023.

[31] L. Ints, "Ukraina sõjapõgenike laste eesti keele õppimise toetamine ALPA Kids hariduslike mängude keskkonna kaudu," Master's thesis, Tallinn Univ., Tallinn, Estonia, 2024. [Online]. Available: https://www.etera.ee/zoom/201297/view?page=1&p=separate&search=alpa&tool=search&view=0,992,2176,2516. [Accessed: Oct. 12, 2024].

[32] M. Kummer, "Eestikeelsete ekraanipõhiste haridusrakenduste kasutamise võimalused lasteaias," Master's thesis, Tallinn Univ., Tallinn, Estonia, 2024.

[33] Y. Albadarin, M. Saqr, N. Pope, and M. Tukiainen, "A systematic literature review of empirical research on ChatGPT in education," Discov. Educ., vol. 3, no. 1, Art. no. 60, 2024, doi: 10.1007/s44217-024-00138-2.

[34] N. Nainggolan, B. Mahmoud AlWadi, M. Kosov, and W. Putra, "Advancements in optimization for automotive manufacturing: Hybrid approaches and machine learning," Int. J. Ind. Eng. Manag., vol. 15, no. 3, pp. 254–263, 2024, doi: 10.24867/IJIEM-2024-3-361.

[35] A. Maynard, "AI in education: Comparing China and U.S. strategies," Future of Being Human Initiative, Arizona State Univ., 2025.

[36] W. Holmes, M. Bialik, and C. Fadel, Artificial Intelligence in Education: Promise and Implications for Teaching and Learning. Boston, MA, USA: Center for Curriculum Redesign, 2019.

[37] R. Luckin, W. Holmes, M. Griffiths, and L. B. Forcier, Intelligence Unleashed: An Argument for AI in Education. London, U.K.: Pearson Education, 2016.

[38] E. Kasneci et al., "ChatGPT for good? On opportunities and challenges of large language models for education," Learn. Individ. Differ., vol. 103, Art. no. 102274, 2023, doi: 10.1016/j.lindif.2023.102274.

[39] V. M. Freires, A. M. Lucas, R. H. P. da Silva, and E. S. de Almeida, "Development of a didactic solution for teaching concepts related to digital twins using educational robot," Int. J. Ind. Eng. Manag., vol. 16, no. 4, pp. 444–458, 2025, doi: 10.24867/IJIEM-398.

[40] M. Bond, S. Bedenlier, V. I. Marín, and M. Händel, "Emergency remote teaching in higher education: Mapping the first global online semester," Int. J. Educ. Technol. High. Educ., vol. 18, no. 1, Art. no. 50, 2021, doi: 10.1186/s41239-021-00282-x.