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RESEARCH ARTICLE

Evaluation of Google Play educational apps for early childhood education

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Abstract: In the global retail market, there is a plethora of educational software: smartphone applications, computer programs, and websites with engaging educational activities that can be used at all levels of education: preschool, primary, secondary, tertiary, and especially in educational robotics and STEM education. However, a teacher or a parent faces a dilemma today: Which is the most educational and appropriate app for children to choose and use? This article aims to help parents, teachers, and other stakeholders in the education community. It has a double purpose: on the one hand, to present an evaluation rubric for educational apps, and on the other hand, to make use of it by offering the vital characteristics and the evaluation of well-known educational apps (n = 50) which can be downloaded from Google Play Store (https://play.google.com). App selection was based on the following criteria: a) to be suitable for early childhood education (kindergarten), b) to cover a wide range of learning objectives (*e.g.* maths, music, visual arts, language, science, programming, history, and environment) and, c) to be free to download. The educational rubric used was a modified version adopted by literature research.

Keywords: educational apps, educational software, preschool education, Google Play

1 Introduction

Numerous education experts, scholars, and decision-makers concur that technology can substantially contribute to the efficiency of a superior early childhood education program (Antoniadi, 2023; Chatzopoulos et al., 2020; Kalogiannakis et al., 2020; McManis & Parks, 2011). Well-designed educational technology, such as STEM, Educational Robotics, and smart mobile technology, has unlocked unparalleled prospects for learning experiences for young kids that deliver beneficial outcomes in cognitive and socio-emotional growth (Chatzopoulos et al., 2019, 2021; Xezonaki, 2023). Paying close attention to the function of technology in education is crucial to guaranteeing that young learners have supreme experiences while engaging with technology as a component of the exceptional education that we all aspire to deliver (Sunar et al., 2022; McManis & Parks, 2011; Papadakis et al., 2021). Over the past ten years, smart mobile technology has gained popularity among young children, with more than 50% of the educational apps available aimed at preschoolers (Vaiopoulou et al., 2023), as a consequence of the worldwide increased access to smart mobile devices, such as smartphones and tablets (Papadakis, 2020).

Smart mobile devices are a new type of small-sized, handheld, portable computer equipped with touch-screen features (Susilawati & Supriyatno, 2023) that gained popularity among the educational community despite their concerns about implications for learning (Ok et al., 2016). These devices are running software called applications (or briefly "apps") that can be easily downloaded from well-known app stores such as Google's Play or Apple's App Store.

Educational apps are interactive programs facilitating learning on a smart mobile device (smartphone or tablet) (Ali Ahmad, 2023). This software technology is widespread in home and school learning environments (Lee & Cherner, 2015; Outhwaite et al., 2023), promoting children's active participation by incorporating educational ideas into game-like activities (Chatzopoulos et al., 2020). Additionally, they can assist in guiding children's learning through adaptive learning technology, offer feedback and incentives through gameplay, and encourage the repeated practice of fundamental skills (Mercan et al., 2022; Vaiopoulou et al., 2023). In addition, many studies (Kalogiannakis et al., 2020) advocate their effectiveness and their increased role in learning capabilities with possible educational goals, including (McManis & Parks, 2011):

i) Enhanced learning approaches (*i.e.* creativity, curiosity, persistence, flexible thinking),

ii) Enhanced cognitive development (*i.e.* science, mathematics, literacy, language, social studies),

iii) Enhanced social-emotional skills (*i.e.* collaboration, cooperation, and emotional intelligence).

As well, the use of smartphones and tablets offers several advantages in the classroom (Kalogiannakis et al., 2020; Pearson et al., 2020; Share, 2023):

i) It is a comfortable way for students to learn.

ii) Smart mobile devices can quickly provide answers to students.

iii) Smart mobile devices can be used as collaboration tools allowing students' social learning.

iv) They are interactive and fun devices, enriched with multimedia capabilities, and can be used as a traditional notepad pen.

v) They provide access to a wide variety and quantity of educational apps in various subjects and for all kinds of learners.

Despite their proven usability in learning, their vast quantity is separate from a corresponding increased quality (Uğraş et al., 2023). Choosing the most qualitative ones remains a challenge for a teacher or parent (Outhwaite et al., 2023).

2 Background: Review of educational software evaluation

Today the main question has shifted from whether a teacher should use smart devices for education to which apps are the most educational and suitable (Papadakis et al., 2022). For this reason, an app evaluation tool is a necessity. Many previous research had faced the same challenge. For example, in her research, Melissougraki presents and evaluates various educational applications for smart devices designed to teach physics concepts to preschool children aged 3 to 5 (Melissourgaki, 2022). She wanted to investigate whether the apps that were receiving the same user ratings (in a standard app rating system) were related to a subjective rating system for the apps in the sample and whether these apps could be considered appropriate and effective for which they were designed based on their ratings (Melissourgaki, 2022). Her evaluation was based on the *REVEAC application tool*, which evaluates the app's design, functionality, educational content, and other technical characteristics (Melissourgaki, 2022). In the same vein, Strataki investigated a variety of educational applications (for iOS and Android operating systems) and their quality (Strataki, 2022). These apps were suitable for children aged 3 to 5 years (preschool).

For this reason, she used two research evaluation tools: the rubrics published by Papadakis et al. (2017) and Lee & Cherner (2015). In their recent research, Meyer and colleagues (Meyer et al., 2021) endeavoured to establish a dependable coding scheme for operationalizing the *Four Pillars of Learning*, as proposed by Hirsh-Pasek, Zosh, and their associates (Hirsh-Pasek et al., 2015). Meyer and colleagues study aimed to evaluate the efficacy of commercially available educational apps by assessing the quality of learning outcomes using the Four mentioned *above Pillars* (*i.e.*, Active Learning, Engagement in the Learning Process, Meaningful Learning, and Social Interaction). The study examined a sample of 100 educational apps that garnered the highest downloads from both Google Play and Apple app stores. A total of 24 preschool-age children commonly engaged in using these applications were tracked longitudinally throughout the study. They revealed that most of the children's educational applications that were most popularly downloaded from Google Play and Apple, and the cohort sampled in the study exhibited a lower propensity to adhere to the Four Pillars principles, irrespective of their payment status (Meyer et al., 2021). Kevin Larkin conducted a study in which he presented the findings of an evaluation involving 142 applications, a minor part of a larger group of applications selected based on various search criteria (Larkin, 2013). The author thoroughly analyzed relevant topics from the existing literature and explained the underlying research methodology used to test the effectiveness of the applications. His article details the significant results of a qualitative analysis of mathematics applications concerning the Australian curriculum. In addition, he presented a list of 34 high-quality mathematics applications suitable for further evaluation. These evaluations were conducted using learning principles used for video games and software evaluation tools to meet the requirements of use by both primary teachers and students (Larkin, 2013).

3 In search of an educational software evaluation rubric

Over time, there have been numerous endeavours to assess the appropriateness of educational software intended for early childhood learners. Haugland's software evaluation scale for preschool children is a prevalent assessment tool (Haugland, 2000). The *Haugland Developmental Software Scale* encompasses 38 closed-ended true/false inquiries distributed across 11 thematic domains. These inquiries aim to evaluate a range of parameters, including (Haugland, 2000): i) the applicability of the software to a target age group, ii) the learner's capacity to independently regulate the pace of their learning, iii) the clarity of the instructional materials, iv) the presence of ascending levels of complexity, v) the potential for unsupervised individual work, vi) the contextual relevance of the software to the real world, vii) its technical functionality, and viii) the extent of the educational progress made in terms of cognitive development. This scale emphasizes the design component, specifically the utilization of graphic elements. However, it needs to consider the extent to which personalized learning is facilitated and its compatibility with the curriculum (Haugland, 2000). McManis and Parks developed an evaluative instrument, known as the *Early Childhood Educational Technology Evaluation Toolkit*, to communicate the tenets of technological incorporation in early childhood education, as outlined in the joint declaration of the National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center (McManis & Parks, 2011). To ascertain the educational value, appropriateness, child-friendliness, user enjoyment, provision of student progress tracking, facilitation of personalized learning, and integration into instructional practices of an application, a rating scale consisting of 20 items on a four-point Likert scale was developed (McManis & Parks, 2011). The McManis and Parks scale is intended to evaluate the suitability of content without considering design features, such as incorporating visual and auditory elements to facilitate learning (McManis & Parks, 2011). Chau (2014) has identified that while the two ratings mentioned above scales are intended to evaluate the suitability of mobile applications in an educational setting, they fall short in providing the requisite level of detail necessary for a comprehensive analysis of individual technological products, such as tablets. Chau devised an evaluation scale, the *Developmentally Appropriate App Design Evaluation Form*, drawing on various studies to establish a framework for mobile app design practices that cater to the developmental needs of preschoolers. The presented framework is characterized by four crucial design principles: interactive design, visual design, auditory design, and instructional design (Chau, 2014). In their study, Shoukry, Sturm, and Galal-Edeen (Shoukry et al., 2015) endeavoured to construct an assessment framework through an inquiry into the appropriateness of educational games. The formulation of an appraisal framework by the authors encompasses fifteen distinct categories. The categories include screen design, navigation and control of the application, ease of use, responsiveness, game design, learnability, availability of instructions, feedback, level of difficulty, content distribution and presentation, availability of a pedagogical agent, degree of customization, security, accessibility, and acquisition value. Pilar Rodríguez-Arancón, Arús, and Calle (Pilar et al., 2013) developed an assessment tool that integrates cognitive, pedagogical, and technical criteria with equal emphasis. The cognitive value and pedagogical coherence, the quality of content, the capacity for learning support, interactivity and adaptability, and motivation for learning are some of the pedagogical criteria included in the assessment scale. The evaluation tool also incorporates technical criteria such as format and layout, usability, accessibility, visual layout, and compatibility (Pilar et al., 2013). The rubric developed by Walker (Walker, 2011) has gained extensive recognition and facilitated the development of subsequent evaluation scales by other researchers. As a trailblazer in the sphere of mobile applications assessment, he integrated six criteria into his evaluation scale: curriculum relevance, authenticity, feedback, level of differentiation, user-friendliness, and motivation. Walker asserts that his devised rubric, intended mainly for assessing applications designed for mobile devices akin to iPod, can ascertain whether an app relates to a particular skill or concept outlined in the curriculum (Walker, 2011). Lee and Cherner (Lee & Cherner, 2015) constructed an extensive rubric comprised of 24 evaluative dimensions. This rubric was developed to assess the instructional potential of educational applications by utilizing previously published research. The 24 dimensions have been classified into three domains: Instruction, Design, and Engagement. This rubric is fortified to encompass many criteria but is not immune to circumscription. In our scholarly perspective, a significant constraint pertains to the requirement for individuals to categorize applications according to their respective skill-based, content-based, or function-based nature since the evaluative rubric's scoring criteria for educational applications will vary depending on their design (Lee & Cherner, 2015). Last but not least, Papadakis, Kalogiannakis, and Zaranis (Papadakis et al., 2017) developed a novel assessment instrument that distinguishes itself from extant scales by its comprehensive evaluation of portable applications, attending to both technological attributes and product features beyond the purview of individual companies. As such, this evaluation tool accounts for the distinct properties of the technological ecosystem within which portable applications operate. The rubric they created assesses applications in four key domains: i) the *Educational Content* category with eleven questions, which evaluates the educational adequacy of the app; ii) the *Design* category with six questions, which evaluates the child-centred design of the app; iii) the *Application Functionality* category with seven questions, which evaluates the usability of the app, and finally iv) the *Technical Features* category with three questions, which evaluates the app based on its compatibility with the electronic devices it runs on (Papadakis et al., 2017).

4 Methodology

4.1 Research sample

The sample (Figure 1) used in this research consisted of 50 applications (apps) for the Android operating system, selected by the following criteria: i) the apps should be relevant to the age (3-5) and learning objectives of preschool and primary education children, ii) should belong to one of these educational subjects: Maths, Science (including Physics and Chemistry), Environment, Programming, History, English, Visual Arts, and Music., and iii) should be hosted into the official Google's Play Store (https://play.google.com).

Figure 1 Some educational apps evaluated by the researchers

4.2 Research tools

The evaluation of the following educational apps was based on the Papadakis, Kalogiannakis & Zaranis rubric (Papadakis et al., 2017). This rubric perfectly meets the needs of this research, as it assesses each application in the following four key domains (Figure 2): i) the *Educational Content*, ii) the *Design* category, iii) the *Application Functionality,* and iv) the *Technical Features*. This rubric consists of 27 questions (Table 1), which evaluates the app based on its compatibility with the electronic devices it runs on (Papadakis et al., 2017). In addition, the results of the rubric's evaluation were compared with the "5-star system" subjective evaluation taken from Google's App Store, which is based on the users' comments. Last but not least, ethical principles relating to basic individual protection requirements were met with regard to the information, informed consent, confidentiality, and use of data (Petousi & Sifaki, 2021).

The rubric used the same questions and categories as that of Papadakis and colleagues, with two key differences: the "Do not Know" (D/N) option was removed because it was not meaningful since all criteria were checked by the researchers on all applications, leaving only the remaining three options ("0 - Not at all". "1 - A little", and "2 - Very"). Secondly, the rubric's scoring had changed to obtain the total score on a five-point scale. This change was necessary to compare the results with the corresponding reviews of Google Play users. Thus, the "Very" response is weighted to two points, the "A little" response is weighted to one point, and the "Not at all" response gives zero points. The final score is obtained by calculating the total number of points scored by the application in each of the four categories and then adding

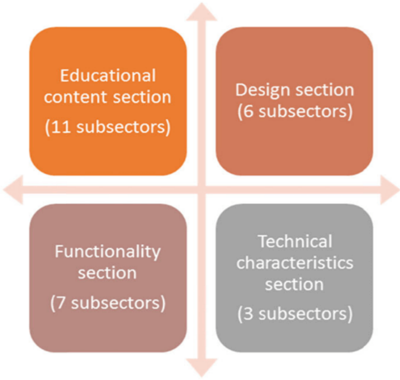

Figure 2 The four domains of the Papadakis, Kalogiannakis & Zaranis rubric (Papadakis et al., 2017)

Table 1 The selected rubric for the educational apps evaluation (Papadakis et al., 2017)

Educational content (can the child learn through this app?) (0 - Not at all, 1 - A little, 2 - Very)	**Score**
1.1 The app is suitable for the age and knowledge of the child.	
1.2 The app is error-free (*e.g.*, mathematics, language).	
1.3 It helps the child learn through multiple activities, not just mnemonically.	
1.4 Emphasizes problem-solving rather than passive viewing of pictures, videos, *etc*.	
1.5 It has different levels of difficulty	
1.6 Provides the child with information in various ways (visual, auditory, *etc*.).	
1.7 Motivates the toddler to engage with it	
1.8 Provides an update on the toddler's performance.	
1.9 Rewards the toddler frequently, and punishments of any kind are absent.	
1.10 Monitors and analyses the toddler's progress.	
1.11 Contains no gender stereotypes or other forms of prejudice (*e.g.* ethnicity).	
Design (is the app designed with the child in mind?) (0 - Not at all, 1 - A little, 2 - Very)	**Score**
2.1 It has excellent image quality.	
2.2 It has pleasant, legible text, graphics, and background.	
2.3 It has excellent sound quality.	
2.4 Through the correct use of sounds, images, and video helps the child to learn	
2.5 The layout arrangement of the elements is clear, logical & intelligent.	
2.6 The menu design is correct and facilitates the handling of the application.	
Application functionality (Can the child use it quickly and without problems?) (0 - Not at all, 1 - A little, 2 - Very)	**Score**
3.1 It has increased interactivity, *e.g.*, allows colouring-designing, moving objects, *etc*.	
3.2 It gives the infant a sense of control and ease of use after the first time.	
3.3 It has simple and complete instructions.	
3.4 Provides reconfigurability (*e.g.* mute sound).	
3.5 It is easy to learn and easy to use.	
3.6 It has no advertising.	
3.7 Do Not encourage the child to engage in any form of online transaction.	
Technical characteristics (The application does not require special knowledge) (0 - Not at all, 1 - A little, 2 - Very)	**Score**
4.1 It loads and executes quickly. It is reliable.	
4.2 It has frequent & automatic updates without requiring user intervention.	
4.3 "runs" on old and new devices.	
App evaluation	

the points from all categories together to get the total score on a five-point scale. Thus, the formula used for each category is:

$$S_{category} = 2 \times X + 1 \times Y + 0 \times Z \tag{1}$$

Furthermore, the formula for the overall score is:

$$S_{overall} = (S1 + S2 + S3 + S4) \times 5/54 \tag{2}$$

Where X, Y, and Z are the total number of “Very”, “A little”, and “Not at all” responses, respectively, and S1, S2, S3, and S4, is the total score in “Educational content” “Design”, “Application functionality”, “Technical features” category respectively, $S_{category}$ and $S_{overall}$ is the score per category and the overall score respectively.

In equation (2), the multiplication by the term “5/54” was chosen to equate the app’s final score on the 5-point rating scale used by Google Play. This way, the two independent final scores (research and users’ ratings) can be easily compared.

5 Results and discussion

Table 2 presents all the selected educational apps, sorted by educational subject, and from the highest overall score to the lowest (on a five-point scale). It is important to note that no children played these games and their subsequent learning. This content analysis is based solely on the researchers’ judgment, utilizing pre-existing research on teaching practices for these ages. Based on Table 2, some crucial statistics can be obtained. 18% of the applications (9 applications in total) in the *Educational Content* category, 36% of the applications (18 applications in total) in the *Design* category, 16% of the applications (8 applications in total) in the *Application Functionality* category and 90% of the applications (45 applications in total) in the *Technical Features* category have scored more than 4 (on the 5-point rating scale). On the other hand, in the *Educational Content* category, 34% of the applications (17 applications in total); in the *Design* category, 20% of the applications (10 applications in total). In the *Application Functionality* category, 18% of the applications (9 applications in total) have collected a score of less than 2.5 out of 5. There was no application with such a score in the Technical Features category. Furthermore, 48% of the apps (24 out of 50) have done well to reasonably well in terms of educational adequacy, while 44% of the apps (22 out of 50) have done well to reasonably well in terms of child-centred design. A further 66% of the apps (33 apps out of 50) have done well to reasonably well in terms of how child-friendly the app is, and lastly, only 10% of the apps (5 apps out of 50) have some “minor issues” in terms of mobile phone compatibility.

5.1 Searching for a “good” educational app

Based on Table 2, the final evaluation can be made to present the best applications per educational subject and highlight the best applications with the highest score per category and the best of all applications with the highest score overall from all four categories together. In particular, the two best applications per educational objective were selected, and the five best applications per category. It is worth noting that if two or more applications in a category have scored the same points, they will be compared based on their overall score, which is the same, and then they will all be listed. The best apps by educational objective are shown in Table 3.

This research showed that almost every app scored differently based on the rubric’s overall score and the Google Play user rating score. This can be explained concerning technical aspects (related to different smart devices’ brands, versions of the operating system, and customization) that users face and affect their judgment and rating. However, the average app’s score difference was relatively low (-4,6%), and only in rare cases there were some outliers, *e.g.* “The History of Everything” app had a -28% difference. Similar researchers exported different results. For example, Strataki’s evaluation of educational apps for preschool-age children research showed that in the most proclaimed educational apps, the pedagogical value was omitted (Strataki, 2022). She rated the educational apps on the best scores based on two rubrics. She concluded that they must be improved in all areas: educational content, design, application functionality, and technical features. In the same vein, Melissourgaki, in her research, evaluated a variety of smart devices and apps designed to teach physics concepts to preschoolers (Melissourgaki, 2022). She used the *REVEAC application evaluation tool* to evaluate the educational apps (N = 15) on the four domains: educational content, design, functionality, and technical characteristics. She observed that most of them scored lower than the average rubric score, and only four (26.6%) scored higher but had below-average scores in error correction/feedback and learning provision (Melissourgaki, 2022). On the other hand, Vaiopoulou’s research evidence that the analyzed educational apps -using the valid five-dimensional instrument ETEA-2- prepared children to

Table 2 Classified evaluation of educational apps sorted by educational subject

Educational App's Name	App's Educational objective	P1 Educational content (max 22)	P2 App Design (max 12)	P3 Application functionality (max 14)	P4 Technical features (max 6)	App's overall score in points (max 54)	App's Overall score in 5-star scale (max 5.0)
Math Games: Math for Kids	Mathematics	20	12	13	6	51	4.7 ★
Math games, Mathematics	Mathematics	20	12	10	6	48	4.4 ★
Learn Math & Math problems	Mathematics	18	11	12	6	47	4.4 ★
Math Kids: Math Games For Kids	Mathematics	16	11	13	6	46	4.3 ★
Math Land: Addition Games	Mathematics	18	10	11	6	45	4.2 ★
Math Games - Brain Training	Mathematics	15	9	6	6	36	3.3 ★
The Fun Way to Learn Algebra	Mathematics	13	8	8	6	35	3.2 ★
Math All Levels Quiz Game	Mathematics	14	8	5	5	32	3.0 ★
Algorithm City: Coding Game	Programming	20	12	10	5	47	4.4 ★
Code Karts Pre-coding for kids	Programming	19	11	11	5	46	4.3 ★
Tynker - Learn to Code	Programming	12	6	5	5	29	2.7 ★
Alchemy Merge - Puzzle Game	Science	15	10	10	6	41	3.8 ★
Little Alchemy 2	Science	13	11	11	5	40	3.7 ★
Lingokids - Play and Learn	Science	15	10	8	4	37	3.4 ★
Fun with Physics Experiments	Science	15	6	9	5	35	3.2 ★
Little Alchemy	Science	10	4	12	5	31	2.9 ★
School Science Experiment Lab	Science	11	6	9	5	31	2.9 ★
Chemistry Quiz Science Game	Science	7	8	8	5	28	2.6 ★
Kid Science Learning Worksheet	Science	10	6	6	5	27	2.5 ★
Science Experiment Physics Lab	Science	9	5	7	5	26	2.4 ★
Kids Learn Science Experiments	Science	11	2	7	5	25	2.3 ★
Kiddopia	Environment	15	12	10	5	42	3.9 ★
My City Cleaning Waste Recycle	Environment	13	7	11	5	36	3.3 ★
Sustainable Shaun	Environment	12	7	10	5	34	3.1 ★
Animals for Kids	Environment	12	8	7	6	33	3.1 ★
Clean my Beach	Environment	10	5	10	5	30	2.8 ★
Applaydu family games	Environment	13	5	8	3	29	2.7 ★
Animal Games for Kids	Environment	10	3	6	6	25	2.3 ★
Green Rank: Green Our Home	Environment	8	4	8	5	25	2.3 ★
Green Rank: Save Our Oceans	Environment	8	4	8	5	25	2.3 ★
Spelling & Phonics: Kids' Games	Language	20	12	14	6	52	4.8 ★
Learn English - 11,000 Words	Language	18	10	12	6	46	4.3 ★
English for kids	Language	21	10	6	6	43	4.0 ★
Kids Games to Learn English	Language	12	9	9	6	36	3.3 ★
English for Kids: Learn & Play	Language	11	9	8	5	33	3.1 ★
Coloring Games: Color & Paint	Visual Arts	14	12	14	3	43	4.0 ★
Bini Drawing for kids games	Visual Arts	13	10	10	4	37	3.4 ★
Kids Doodle - Color & Draw	Visual Arts	14	7	8	5	34	3.1 ★
Coloring book - games for kids	Visual Arts	9	9	9	6	33	3.1 ★
Easy coloring pages for kids	Visual Arts	8	6	7	5	26	2.4 ★
Piano Kids - Music & Songs	Music	16	12	10	6	44	4.1 ★
Musical Game for Kids	Music	16	10	9	5	40	3.7 ★
Piano Game: Kids Music Game	Music	13	7	7	5	32	3.0 ★
Kids Instruments	Music	7	6	6	6	25	2.3 ★
123 Kids Fun Music Games	Music	9	5	5	5	24	2.2 ★
Famous People - History Quiz	History	9	9	8	6	32	3.0 ★
The History of Everything	History	7	9	8	5	29	2.7 ★
History of Art	History	5	8	8	5	26	2.4 ★
Historical Calendar	History	7	6	6	6	25	2.3 ★
Learn World History (Free)	History	5	5	10	4	24	2.2 ★

Table 3 The best-rated educational apps per category

Educational App's Name	App's Educational objective	App's overall score Total score in points (max 54)	App's overall Score Total score in 5-star scale (max 5.0)	App's Google's Play Score Based on User Ratings on a 5-star scale (max 5.0)	App's Score Difference Overall vs Google's Play on 5-star scale and %
Math Games: Math for Kids	Mathematics	51	4.7 ★	4.4 ★	0.3 ★ / 6%
Math games, Mathematics	Mathematics	48	4.4 ★	4.5 ★	- 0.2 ★ / - 2%
Algorithm City: Coding Game	Programming	47	4.4 ★	5.0 ★	0.7 ★ / 14%
Code Karts Pre-coding for kids	Programming	46	4.3 ★	3.6 ★	0.7 ★ / 14%
Alchemy Merge - Puzzle Game	Science	41	3.8 ★	4.6 ★	- 0.8 ★ / - 16%
Little Alchemy 2	Science	40	3.7 ★	4.1 ★	- 0.4 ★ / - 8%
Kiddopia	Environment	42	3.9 ★	4.1 ★	- 0.2 ★ / - 4%
My City Cleaning Waste Recycle	Environment	36	3.3 ★	3.8 ★	- 0.5 ★ / - 10%
Spelling & Phonics: Kids Games	Language	52	4.8 ★	4.7 ★	0.1 ★ / 2%
Learn English - 11,000 Words	Language	46	4.3 ★	4.6 ★	- 0.3 ★ / - 6%
Coloring Games: Color & Paint	Visual Arts	43	4.0 ★	4.0 ★	0 ★ / 0%
Bini Drawing for kids games	Visual Arts	37	3.4 ★	4.0 ★	- 0.6 ★ / - 12%
Piano Kids - Music & Songs	Music	44	4.1 ★	4.4 ★	- 0.3 ★ / - 6%
Musical Game for Kids	Music	40	3.7 ★	3.7 ★	0 ★ / 0%
Famous People - History Quiz	History	32	3.0 ★	3.9 ★	- 0.9 ★ / - 18%
The History of Everything	History	29	2.7 ★	4.1 ★	- 1.4 ★ / - 28%

have some rudimentary bases in specific areas (reading, writing, arithmetic, music, *etc.*), proving their usefulness in classroom and at home. However, her findings signify security issues and suggest more safety considerations in designing educational apps (Vaiopoulou et al., 2021).

6 Conclusion

Previous research evidence that preschool children easily handle smart devices and adapt well to digital learning (Strataki, 2022). This research indicates that most of the selected education apps evaluated are at an above-to-average rubric score level so that children can use and exploit them to improve their learning background and develop further critical thinking on topics that concern them. However, there is a need for a systematic educational apps evaluation across the App Stores that preschool children use to ensure that they will not be harmed in any way by their use of them, as it is impossible to insulate them from technology (Papadakis et al., 2017). This research could be a guide or incentive for teachers and parents to use, test, and choose the appropriate educational apps for their children. Furthermore, app developers may utilize this research to test, compare and/or improve their educational software products.

Conflicts of interest

The authors declare that they have no conflict of interest.

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