The Application of Game-based Phonics Learning Apps in Lower Elementary Teaching

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Abstract. Game-based learning Apps have been flourishing and received much attention from parents who use those Apps as learning tools for children. At the same time, school-adapted learning Apps have received issues around outdated design, inaccessible customer support, and lack of training on how to use them. Since reading is an integral content for lower elementary students, this article discusses if game-based learning Apps can be applied to support school learning. Major problems of school-used reading Apps have been reviewed. Two popular reading Apps, Hooked on Phonics and Duolingguo for public downloading are selected and evaluated from core content, pedagogical methods, and design perspectives. It has been found that those Apps cover limited content that schools teach children, lack pedagogical designs, and do not have core loops in games to keep children's interests. The article points out the potentials and limitations of using those Apps to support school learning, which sheds insight for future research to enhance the effectiveness of reading Apps when they are adopted by schools.

Keywords: Game-based learning; Apps; Lower elementary students; Home; School.

1. Introduction

Smartphones and tablets have become an important part of children's lives as early as newborn to eight years old and appropriate access to and use of mobile and tablet applications is positively associated with young children's language skills [1]. Schools have been adapting to various reading Apps to support students' learning, such as iReady. The App is used both at school and at home. On the one hand, there are few dissertations and no published papers on i-Ready, a widely adapted reading App by schools, but the focus is on its impact on student's reading capability from teachers' perspectives or the targets are middle school students [2, 3, 4]. Whether or not i-Ready is enjoyed by young children and if it helps them to excel in reading receives little attention from academia. On the other hand, young learners grow up in an era of tablets, phones, and digital games. Their expectations towards entertainment have been increasing where more interaction and visual stimulation are needed [5], and this might be why public-facing Apps are popular. The article discusses the potential of using such Apps at school and at home as additional support to assist reading for lower elementary student

2. The Popular Reading Apps for Lower Elementary Students

2.1 The Current Status of Reading Apps in Lower Elementary Classroom

IReady is a tablet-based assessment tool that is widely adopted by students in all 50 states in the United States [6]. The most salient function of iReady lies in its self-adaptive feature that evaluates individual students' reading capability. The school-initiated reading assessment is conducted periodically, and students can complete matching practice at school or home based on the assessment.

Scholars examine the accuracy of iReady assessment, but very little effort is made to find out if school and home practice offered by iReady lead to improvement in students' reading capability and what the beneficial or problematic elements are [7] [8] [9]. Since the popular school-used reading App fails to establish its efficiency, it would be worth exploring other reading Apps' possible adoption to support school learning in the classroom and at home.

2.2 Currently Widely Used Phonics Apps and Platforms in The App Store

The mobile application has distinctive strengths in breaking learning boundaries by making learning accessible anywhere and anytime, forming interactive and integrating trending knowledge in learning content, which is also introduced and applied in classrooms and at home [10]. There is also explosive growth in the number of children who own tablets and apps designed for children have been increasing accordingly [11]. Learning on mobile devices has grown rapidly over the last few years, and is probably the most successful ICT application in education.

Mobile learning can be broadly viewed as learning on all personal, portable, and wireless devices [12], including smartphones and tablets. Nevertheless, since this paper analyzes PA and phonics learning which generally occurs in an age group that has not fully mastered using mobile phones, and it is not practical to offer student smartphone access at school, only the Apps' tablet version will be selected and focused on later discussion.

Considering the general habits of people when they select Apps to download, they tend to look at those that are exposed to them first, reviews of other users, and professionals' advice. Therefore, by simulating the selection path, Hooked on Phonics Learn & Read and Learn to Read - Duolingo ABC were picked for the study. Keywords in the Apps' title descriptions and introductions were reviewed to verify they qualify to be a reading App for lower elementary students. This study selects two apps in the table. 1 as research objects.

Table 1. Popular Apps Selected

Selected Apps	Search Results	Number of Ratings	Editor's Opinions	Keywords
Hooked on Phonics Learn & Read	Appeared the 1st after typing keyword "phonics" in the search box	2.9k, 4.5/5		"Phonics Reading" in title
Learn to Read - Duolingo ABC	Appeared the 2nd after typing keyword "phonics" in the search box	1.7k, 4.3/5	Editor's Choice	

3. Integrate learning Into Apps: The Design and Evaluation Frameworks

To determine whether or not a mobile application can be integrated into school learning, the article evaluates the content, pedagogy, and product design of selected Apps.

3.1 The Important Content of Reading Apps for Lower Elementary Students

The nature of students' spelling development has six stages from ages 1 to 18, including prephonemic, early letter name, letter name, word pattern, syllable juncture and derivational constancy [13]. The learning journal is staged, from the non-letter or drawing phase (prephonemic) to letter and sound recognition, and to the combination of letters to make or read words. In this learning path, phonemic awareness (PA) and phonics capability lead to the progress to make a student an independent reader.

PA trains students to handle the single smallest units in spoken language which then combines to form words syllabus and words while the introduction to phonics teaches children to grasp letter-sound correspondences and spelling patterns which are expected to be applied in reading, and both PA and phonics have significant impacts on improving children's ability to read [14]. Lower elementary students are transitioning from drawing and letters to the more advanced level of identifying and manipulating letters and sounds to create meaningful words unit, and strong phonemic awareness (PA) and phonics training are required to ensure a smooth transition. Therefore, it is important to evaluate such phonemic and phonics characteristics in selected Apps, making sure they are offered and made salient, which is also suggested by Hemard in his research about the design of language learning Apps [15].

3.2 Feedback and Assessment

Assessment in technology-supported learning plays an essential role. Formative assessment which is usually conducted in classrooms by teachers, peers, and learners [16] should be considered in mobile apps if learning occurs here. Feedback reveals and reflects performance, and the more effective types of feedback include cues or reinforcement to learners and are in the form of video, audio, or assisted by computers, and the feedback is directly related to learning goals [17]. Thus, a successful mobile app should be able to send out such feedback to users.

3.3 Design Evaluation

The advanced technology makes it possible to support learning through multiple senses, such as visual and audio, and aspects, such as adding VR. Research reveals that students show their attention to pedagogical content presented via various technologies to support comprehension, indicating the significance of mobile apps being able to tailor to users' learning needs [18]. Therefore, an effective reading App should tackle the subject from various technological perspectives.

Chang, Edwards, and Boruta proposed non-functional requirements for language learning apps, including 1) combining open-source and free technologies to ensure low-cost; 2) user-friendly designs in setting up and performing functions; 3) providing scale and reliability; 4) can be integrated into a variety of learning methodologies; 5) be flexible to accommodate users' needs such as single sign-on [19]. It is meaningful to review the performance of the selected Apps regarding the features mentioned above.

In designing and evaluating educational games, what players are pursuing appears to be the most important question. SPAM (Social, Purpose, Autonomy, and Mastery are four main goals motivating players (Motivation in Games-Based Learning, n.d.). From a broader educational game design point of view, the MDA framework offers a solid general base. The framework suggests mechanics defined as a set of game rules, dynamics explained as users' responses to the set of rules, and aesthetics stating the "fun" parts users would like to pursue. Inside the framework, mechanics leads to dynamics which stimulates users' aesthetic feelings [20]. The cohesion of the three makes an educational more playful and effective in achieving learning goals. When assessing the selected Apps, SPAM and MDA analyses will be conducted to predict users' acceptance and likeness of them.

4. Examine Mobile Apps' Usability in The Classroom

Embedding educational games is one of the most salient aspects of popular learning Apps in the App store. How selected Apps perform to deliver fun educational content is evaluated below.

4.1 Hooked on Phonics

4.1.1 Content evaluation

The app divides learning into three categories, pre-reader, learn-to-read, and hooked on spelling. Taking the first level as an example, the pre-reader section introduces letters by alphabet level, they learn to read level explains word families which are popular combinations of letters, and the hooked-on spelling section requires using letters and word families to recognize and spell words. The lesson design covers both the PA and phonics content.

All letters and families are presented in bold and salient. The app allows for multiple attempts to fix errors. Learning materials are shown in cartoons followed by simple assessments, which are expected to improve the player's understanding of the content. Once the player makes a mistake, an audio effect will remind and the player can fix the mistake. Once a module is selected, the player needs to wait for the module lecture to be completed, there is no option to skip. The design cannot adjust to the player's knowledge level and self-paced learning is limited.

4.1.2 Pedagogy evaluation

Feedback is provided by audio effects or a reward box. For example, a sound will play to alert the player of the mistake. Upon completion of a task, it will play a complementary sentence to praise the player. The player can choose to open a reward box when finishing a module. Following each cartoon lecture, the player will have a chance to work on activities to test her understanding of the content. This part is optional and can also be skipped. Additionally, the app provides books that the player can choose to read, which serves as another self-assessment source.

4.2 Duolingguo

4.2.1 Content evaluation

Taking level 1 of the App is chosen to begin the evaluation. The app presents the alphabet as the beginning of the learning journey. At this level, there is a whole section of rhyming which levels up the learning and touches on PA content, but the coverage is not sufficient compared to other similar apps. For example, a simple combination of sounds could have been included to raise students' awareness of PA.

The app does not provide salient knowledge on phonics to emphasize sounds, writing, and spelling. The App includes a library where users listen to or read books. This is an opportunity for players to solidify their comprehension of the knowledge, however, the library does not categorize books into different levels, which could cause learning confusion if a mismatched book is chosen. One advantage of this app comparing Hooked on Phonics is that the game allows players to select their activities within a content range, which provides more flexibility and the possibility for players to make find the best level that fits them.

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The App asks users to record letter sounds; however, it cannot signal players if their recorded sounds are wrong. The feedback element is ineffective in this case. Users need to rely on their correction ability or support from adults to realize and correct wrong understandings. The game uses a "ladder" to represent each step players will be taking, and this image visually shows players' progress, serving as feedback on users' progress and is positive reinforcement. The game includes confirmation feedback to tell the players if their choices are correct. To back up the confirmation feedback with more information, the game also has corrective feedback where an audio sound would play if the wrong answer is selected or a warning color will be triggered to indicate mistakes.

4.3 Design Evaluation of Selected Apps

From downloading to registering, Hooked on Phonics and Duolingguo present a straightforward path for users. Both Apps use video and audio-embedded cartoons, which is rather traditional and does not utilize technology potential as much. The main motivations of the game are purpose and mastery. Playing the game has an obvious purpose, which is to master phonics. Players may be attracted by the pretty design and enjoy the relaxation the game offers. The app's core loop is also straightforward - watch the lecture cartoons, finish assessments, read leveled books, and play other games to reinforce the knowledge obtained. Because the rules are simple, players are not under too much pressure and the game does not have features to trigger addiction and too much excitement. The players receive age-appropriate stimulation to focus on educational content.

5. Examine Mobile Apps' Usability in The Classroom

5.1 The Lack of Connections between Teaching Content and App Content

The Apps use a set of screening questions to divert users, and the major determinant is age. However, during students' early reading years, age does not indicate the correct reading qualifications. Some readers are even several grades up. The Apps fail to match students with their reading levels. Additionally, schools may not implement personalized teaching at students' early ages. Students will still be given the same knowledge in the classroom. There is an inconsistency in App content and classroom content. For example, many students learn the sound of a, m, and t at school to avoid confusion, and they learn how to write l, t, i, u, and j first because they are easy [21] [22] while the Apps use the alphabetical order when teaching their users. In summary, Apps cannot offer thorough assessments like schools to recognize the correct reading levels. And Apps do not follow the same teaching path as the schools. Therefore, it is difficult to introduce the Apps to schools as a supplementing resource to be used for classroom and home learning.

5.2 Limited Exploration of Technologies to be Integrated into Apps

Students need various types of stimulation to grasp the knowledge, making the entire reply on apps and games an impossible decision. As mentioned earlier, the selected Apps use videos and cartoons to deliver content. Due to cognitive development and security concerns, Apps targeting children need to go through strict scrutiny limiting the content that can be included in Apps for older users. If App designers do not consider other options to make their products more fun and attractive, such as applying newer technologies, they will not attract young users and even the learning outcomes will be damaged.

5.3 Insufficient Forms of Feedback and Assessment

The games being evaluated cannot replicate or replace feedback students may receive from teachers. It is also hard for teachers to ensure that students understand feedback provided by apps and give effective reflections in future studies of the content. In addition, only limited types are seen in the apps being assessed. For example, there is no sign of diagnostic feedback which can tell why incorrect responses have been chosen by students. The lack of such information prevents teachers from understanding students' thought processes which is valuable information for teachers to modify teaching pedagogy or adjust the difficulty level of subject levels.

6. How to increase the Usability in The Classroom

6.1 Improve PA and Phonics Content based on a Better Understanding of Target Users' Capability

The evaluation results reveal that some of the phonics does not cover the necessary content that will support students learning. Additionally, it indicates inconsistency between the App content and the schools' curriculum. A more comprehensive content design based on a thorough review of linguistics and curriculum requirements should be incorporated.

6.2 Explore New Technologies to be Included in App Design

AR is defined as "using the existing real-world environment and putting virtual information on top of it to create a sort of mixed reality" [23]. An interesting application of AR in education is Catchy Words, an AR-based App to help with spelling. Users can walk around the environment and catch letters with the mobile device they use. Then they can make words using the letters. This application combines letters with a physical environment and offers more experience and fun for learning. AR could add value to the selected Apps.

VR is another emerging technology that has big potential to be used in educational apps. It creates a simulated environment for users that they are able to view the object or scene from all angles, giving people an immersive experience [24]. Google's VR zoo during the pandemic provided unexpected and appreciated fun for children who were forced to stay at home. Well-designed VR effects may be welcomed by students and more effectively deliver learning content.

6.3 Add Different Types of Feedback and Assessment to Support Learning

It has also been noticed that the apps can integrate assessment and feedback features for self-evaluation and self-correction; however, it is even more important for young learners to understand why their answers are wrong, and what the correct answers are and why. Therefore, to apply phonics apps at school, the apps should include explanatory feedback to educate players on how the right answers are results.

Apps that are evaluated in this paper do not have per-assessment players' capability and start them with content that matches their level. One game asks for the player's age and generates a set of modules, which are too generalized. Moreover, the preview of the content map is not available, making it impossible for teachers to help find appropriate content for their students. Adding those features can be challenging if the developer companies do not view school use as the main purpose of their app.

6.4 Teachers' and Parents' Readiness to Support Technology Integration

As mentioned by Goodwin, teachers are at the front line to deal with technology upgrades in the classroom [25]. Also, although tablets have become very popular at home and school and young learners may have operated on them, teachers should still be prepared with handling students' anxiety to help them adapt to learning on tablets. To better fulfill the technical support role, teachers should be trained to obtain experience and knowledge.

Since we expect that the Apps can be used as a home practice to support classroom learning. Schools are responsible to prepare parents about the tools that the schools adopt. Some sample aspects that need to cover include, 1) The technology tools that will be used at home; 2) The platforms that host the tools; 3) Access information to the tools; 4) The learning content the Apps cover and how it is connected with the curriculum; 5) Where to get support if students struggle at home.

7. Conclusion

It has been detected that some school-adapted reading Apps may not have the expected benefits and parents encounter struggles and inconsistency when using the practice resources embedded in the Apps at home. Two top reading Apps available in the App Store are selected and evaluated to explore their potential to be used in the classroom and at home to support school learning.

Findings show that the Apps cover a substantial amount of appropriate content, and include some level of feedback and assessment that are widely used in to simulate classroom learning; however, there are flaws in content, pedagogical methods, and even the technology applied. First of all, the content cannot match a student's reading level and is different from the school's curriculum. Secondly, effective assessment and feedback are very limited and misleading. Thirdly, the design itself fails to stimulate more learning interests.

It proves that adopting popular App Store reading Apps as classroom and home practice is not practical. The Apps need considerable improvement in content, pedagogy, and design to make them adequate supplements to school learning. With the improvements made to enhance the reading App's content covered, pedagogical methods to further evaluate and offer feedback to students' performance, and various but adequate fun in design will offer students more resources to learn. The combination of technology and learning is significant to children growing up with technology

References

[1] Booton, S. A., Hodgkiss, A., & Murphy, V. A. The impact of mobile application features on children's language and literacy learning: a systematic review. Computer Assisted Language Learning, 2021, 1-30.

[2] Torres, Ricardo A. The Effect of the I-ready Reading Program on Student Scores on the Northwest Evaluation Association (NWEA®) Measures of Academic Progress (MAP) Reading Assessment. PhD diss., Cleveland State University, 2019.

[3] Aguilar RE. Predictive validity of i-Ready diagnostic scores for high-stakes test outcomes with middle school students: A program evaluation. State University of New York at Albany, 2019.

[4] Coleman-Void, D. A. Teacher Perceptions of the Impact of the iReady Reading Software: A Phenomenological Study, Northcentral University, 2022.

[5] Peirce, N. Digital game-based learning for early childhood. A state-of-the-art report, 2013, 1-42.

[6] Fixler, C. Curriculum Associates' i-Ready® Helps Close the Achievement Gap for Students in the Nation's Largest Urban School Districts. Press Release Curriculum Associates I-ready helps close achievement gap students in nation largest urban school districts. Retrieved October 12, 2022, from https://www2.curriculumassociates.com/aboutus/Press-Release-Curriculum-Associates-i-Ready-Helps-Close-Achievement-Gap-Students-in-Nation-Largest-Urban-School-Districts.aspx#:~:text=In%20addition%20to%20its%20wide,students%20across%20all%2050%20states. n.d.

[7] Silva, T. B. The effects of the i-Ready computer assisted instruction program on the reading and fluency achievement of first graders (Doctoral dissertation). California State University, Stanislaus, 2016.

[8] Costa, J. The effects of using iReady reading as a reading intervention program on reading achievement for second grade students, California State University, Stanislaus, 2018.

[9] Jones, T. A. Predicting Proficiency on the Ohio Achievement Assessments Using I-Ready Diagnostic. Huntington, Marshall University, 2013.

[10] Yahaya, N. S., & Salam, S. N. A. Mobile learning application for children: Belajar bersama Dino. Procedia-Social and Behavioral Sciences, 2014, 155, 398-404.

[11] Ackermann, L., Lo, C. H., Mani, N., & Mayor, J. Word learning from a tablet app: Toddlers perform better in a passive context. PloS one, 2020. 15(12), e0240519.

[12] Gangaiamaran, R., & Pasupathi, M. Review on use of mobile apps for language learning. International Journal of Applied Engineering Research, 2017, 12(21), 11242-11251.

[13] Templeton, S. Explorations in developmental spelling: Foundations for learning and teaching phonics, spelling, and vocabulary. The Reading Teacher, 1998, 52(3): 222-242.

[14] National Reading Panel (US). National Reading Panel: Teaching Children to Read: an Evidence-based Assessment of the Scientific Research Literature on Reading and Its Implications for Reading Instruction. National Institute of Child Health and Human Development, National Institutes of Health, 2000.

[15] Hemard, D. P. Design principles and guidelines for authoring hypermedia language learning applications. System, 1997, 25(1), 9-27. http://dx.doi.org/10.1016/S0346-251X(96)00057-7.

[16] Black, P., & Wiliam, D. Developing the theory of formative assessment. Educational Assessment, Evaluation and Accountability (formerly: Journal of Personnel Evaluation in Education), 2009, 21(1), 5-31.

[17] Hattie, J., & Timperley, H. The power of feedback. Review of educational research, 2007, 77(1), 81-112.

[18] Nami, F. Towards more effective app-assisted language learning: The essential content and design features of educational applications. Issues in Language Teaching, 2020, 9(1), 245-278.

[19] Guetl, C., Chang, V., Edwards, A., & Boruta, S. Flexible and affordable foreign language learning environment based on Web 2.0 technologies. International Journal of Emerging Technologies in Learning, 2013, 8(2), 16-28.

[20] Hunicke, R., LeBlanc, M., & Zubek, R. MDA: A formal approach to game design and game research. In Proceedings of the AAAI Workshop on Challenges in Game AI. 2004, 4(1).

[21] Light, J., & McNaughton, D. Letter-sound correspondences. Letter-Sound Correspondences: Literacy Instruction for Individuals with Autism, Cerebral Palsy, Down Syndrome, and Other Disabilities. 2019, Retrieved October 12, 2022, from https://aacliteracy.psu.edu/index.php/page/show/id/6/index.htm.

[22] Children's Community Occupational Therapy. Oxford Health NHS. (n.d.). Retrieved October 12, 2022, from https://www.oxfordhealth.nhs.uk/wp-content/uploads/2014/05/Handwriting-Letter-formation.docx

[23] Gillis, A. S. What is augmented reality (AR)? WhatIs.com. 2002, Retrieved October 12, 2022, from https://www.techtarget.com/whatis/definition/augmented-reality-AR.

[24] Virtual reality in the classroom: What is Vr? Research guides. 2021, Retrieved October 12, 2022, from https://guides.library.utoronto.ca/c.php?g=607624&p=4938314.

[25] Goodwin, K. Use of tablet technology in the classroom. NSW Department of Education and Communities, 2012, 6-93.