

A Flexible Learning Framework for Kids

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ABSTRACT

Smartphones and their applications are transforming the way we live, work, communicate and navigate the world. This smartphone transformation is also impacting the lives of children across the globe. There is an abundance of various apps in the marketplace specifically targeted for children's learning. However, very few of these apps are customizable either from the instructors' or children's needs. Moreover, they are not always well-tested and validated for effective learning outcomes. In this paper, we propose a mobile application platform for children's education that supports personalized learning through flexible customization of the contents based on learning objectives. The framework provides a web-based interface through which educators and instructors can design instructional materials, test and validate the effectiveness of the materials on children's learning. It also provides an easy, fun and interactive mobile-based interface on a mobile smart device for the children to play and learn educational materials. The framework is fully customizable and provides educators with a platform to conduct research on children's learning and collect useful data.

Keywords

Education App; Mobile Kids App; Learning framework;

1. INTRODUCTION

The proliferation of mobile technologies impacts almost all areas of peoples' lives. Connected mobile devices in particular have become ubiquitous and an integral part of peoples' day-to-day activities. Irrespective of age, profession, and gender, it has changed the way we live, work, communicate, and navigate the world. Today, 85 percent of the world population has access to mobile communications, and by 2020, the expected number of connected devices will reach 50 billion – far more than the total number of people on the earth [7]. This will create a society that is always connected from anywhere in the world and revolutionize the future by unlocking the full potential of learning and innovations. This

mobile revolution coupled with the rise of the networked society that is changing the lives of adults, is now also impacting the lives of children of all ages across the globe. Just as Sesame Street changed TV into a progressive instrument for learning among young kids, four decades ago, advances in mobile technologies are showing enormous undiscovered educational potential for today's generation.

The new generation of mobile devices is making a powerful educational impact broadly including children. The early childhood years, when children are developing new habits for learning and social development, are very crucial and most important determining factors of academic and life success. In this developing period, the role of children's engagement with media is critical – according to the Kaiser Family Foundation and Sesame Workshop studies, 8-year-olds spend far more hours engaging with various screens than they devote to reading and outdoor play [16]. Similarly, a recent Ericsson report [7] points out that “in the age of 15-18, when youngsters are curious and have a lot of interests outside school, a few moments on Facebook can easily turn into minutes and sometimes hours.” Although there are increasing number of concerns among the policymakers, child development experts, and parents about the connection between academic lethargy and media consumption, but for better or worse, digital media stands as a prime pillar of family life and it is here to stay. While the concern about health and safety must be addressed, many child education experts believe that with the help of proper and innovative applications, the connected mobile devices have the potential to accelerate children's learning; especially for children who need intensive support to reach their potential.

The new generation of mobile devices provides unique features such as multi-touch screens, speakers, cameras, location services, and mobile web support, etc., which can be leveraged to produce great learning tools for children of all ages. It provides various opportunities to improve education as well as the learning experience [1, 4]. Despite many positive impacts on children's learning, such as enhanced ways of engaging in collaborative works, developing an effective mobile application for children is challenging. Unlike e-learning solutions, children's mobile apps should be simple, transparent to the technology, intuitive to use, accessible, and most importantly, should contribute towards effective learning experience. Although there is a plethora of applications released every day in the mobile marketplace targeting children's education, very few of them are tested and validated for effective learning outcomes [15, 19, 14, 6, 11, 12, 5]. In addition, off-the-shelf apps are oriented toward commercial

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markets, and not accessible to educators or learners. Hence they do not always provide easy mechanisms for personalization of the contents to a specific target group or knowledge area. For example, instructors of a specific class should be able to customize and select various types of questions that satisfy specific learning objectives. Afterwards, the instructor should be able to validate the learning outcomes with the objectives from the feedback.

To address this issue, in this paper we propose a mobile application framework for children’s education that supports personalized learning through flexible customization of the contents based on learning objectives. In addition, the framework will provide an easy to use platform for the educators and authorities through which they can conduct research and collect insight on the impact of mobile devices on students learning.

The rest of the paper is structured as follows: in section 2 we briefly overview some of the off-the-shelf app in the marketplace related to children’s education and some of the previous education related works. Our main contribution is the presented in section 3 where we describe our flexible learning framework design and architecture for kids. In section 4 we discuss some of the salient points related to our proposed framework. We finally conclude in section 5.

2. LITERATURE SURVEY

Mobile technologies are already widespread among children [16]. Due to the unique capabilities of mobile smart devices, such as mobility, multi-touch screen, location services, and advanced sensors, many believe that rather than seeing them as disruptive devices, educators should seek to exploit the potential of the technologies and find ways to put them into good use for the benefit of learning practice [3, 8, 9, 2].

The recent Horizon report points out that mobile devices – specially smartphone, and tablet – are among one of the six emerging technologies that is likely to have a large impact on teaching, learning, research, or creative expression [10]. Once the mobile devices become pervasive in schools, apps will have an entryway to many more children. It is predicted that mobile app revenue is expected to generate more than \$38 billion by 2018 [18]. While apps are fun and entertaining, many believe they have the significant potential in supporting children learning [8, 9, 2]. The children’s apps are growing, almost half of the apps in the Education category of the iTunes APP Store targeted for children [17]. However, the field is emerging so quickly that studies on the effectiveness of apps for learning have lagged behind, and learning apps for the mobile devices have become a much debated educational technology topic [18].

Numerous developers are investing significant funds and development efforts on building educational apps [15, 19, 14, 6, 11, 12, 5], yet there is a lack of available market information. Although there are many anecdotal descriptions of what is available for children, none has undertaken a careful analysis based on learning outcomes. In addition, many apps miss an important element – flexibility of customizing pedagogical contents by an educator based on learning outcomes, which is an essential factor for determining the success of children’s learning. In [18], authors have conducted a survey on 196 educational apps in the iTunes APP Store, surprisingly very few apps (such as Stack the States, Toontastic, Star Walk, Interactive Astronomy Guide, Graphic

Calculator, iStudiez Pro) are targeted for the school usage and aligned to standards. In addition, none of these apps are exclusively targeted for the school market. This is because currently the independent developers are not seeing a high commercial value of the app when it is exclusively targeted to school and the devices (and iTunes) are primarily consumer based, not instructional focused. In the Table 2 we provide a comparison of most popular educational applications for kids that are freely available in the app market. These apps run on a variety of platforms and provide interactive learning experiences for children. However, most of these apps either lack content customization or do not provide feedback on learning outcomes.

Therefore, there is a need for a platform designed specifically to address the educators need, which will support personalized learning through flexible customization of the contents based on learning objectives.

3. PROPOSED FRAMEWORK

In this section, we present our interactive mobile learning application platform for children’s education that supports personalized learning through flexible customization of the contents based on learning objectives. Using this framework, educators can design instructional materials, test and validate the effectiveness of the materials on children’s learning and then share the materials with other instructors. Although the framework is designed for child’s education in mind, but it can be extended to use in other educational settings, such as high school, college, and university settings. The application framework is composed of two major phases: the *setup phase* and the *play phase*.

3.1 Setup Phase

The setup phase is a web-based module for the instructors or educators to set up and initiate an assessment for a specific group of students or class. In this phase, the instructors or educators first selects an assessment theme or storyline for the assessment. The storyline specifies how the assessment should progress through various interactions with the kids. For example, a storyline may compose of a maze with specific checkpoints. Kids need to travel through the maze and explore the checkpoints. The checkpoints are small interactive quizzes on specific learning objectives. For each checkpoint, instructors decide the learning objectives and the system automatically selects and presents a set of questions from a question bank that satisfies the learning outcomes. At this point, the instructors have the option to change or modify any question that they feel necessary. In addition, the instructors can also choose types of quizzes for the checkpoints. For example, the quiz type could be a simple multiple-choice, or fill in the gap or even be a memory game where kids need to match the similar picture or figure. Once the storyline and quizzes are set for each checkpoint, the setup phase is complete and the assessment is ready to publish. Figure 1 shows the process and interactions of different entities in the setup phase using a use case diagram. These assessments are stored in the database for later use. It is also possible to share the existing assessments with other instructors and educators.

3.2 Play Phase

The *play* phase takes place in an app running on a smartphone or a tablet. We name this phase as the play phase

Table 1: Comparison of Popular Free Educational Apps Available in the Market

Application Name	Description	Platform	Benefits	Limitations
Prodigy [13]	Web-based Math game that follows Ontario standards for mathematics. Uses game first model, education is done via <i>ingame</i> combat.	Web-based	<ul style="list-style-type: none"> • Entertaining, engaging. • Provides feedback for teachers. • Customization of game avatars. • Uses Ontario math curriculum. 	<ul style="list-style-type: none"> • Lack of content customization. • Limited contents. • Need to pay for additional features.
Duolingo [6]	Language learning application.	Web/iOS/Android	<ul style="list-style-type: none"> • Utilizes speaking, listening and spelling to teach language. • Earns and uses <i>Lingots</i> to purchase in game items. • Can challenge friends/family. • Can see progress of friends/family. 	<ul style="list-style-type: none"> • Lack of content customization. • Need to pay for additional features.
Toca Lab [11]	An application for learning basics of chemistry.	iOS/Android	<ul style="list-style-type: none"> • Uses graphics to explain concepts of chemistry and the periodic table. • User engagement using graphics and game-play. 	<ul style="list-style-type: none"> • Lack of content customization. • Need to pay for additional features. • Lack of feedback or option to save.
Motion Math [12]	An application for learning basics of mathematical. Mainly targeted for kids of age 3 to 4 years.	iOS/Android	<ul style="list-style-type: none"> • Uses graphics and animation to explain simple addition, subtraction, etc. • Adaptive user engagement using graphics and game-play that gets harder as player progresses. 	<ul style="list-style-type: none"> • Lack of content customization. • No ability to change animation or avatars. • Lack of feedback or option to save.
Sago Mini Trucks and Diggers [5]	Building game where one uses construction vehicles. Play with trucks and diggers and build homes.	iOS	<ul style="list-style-type: none"> • Uses graphics and animation. • Fast and easy to play. 	<ul style="list-style-type: none"> • Limited use of pedagogy; mainly focused on playing. • Fixed and limited contents. • Lack of feedback or option to save.

because at this phase, a student (could be a child) would play an interactive game and learn through playing. To start playing, a student first logs in to the mobile app using a *username* and *password*. The mobile app then connects to the server and downloads the available assessments created for the user. Before starting the game, the mobile app presents the student with a choice of *avatar* characters that will interact with him/her throughout the learning exercise and the character will help students by providing clues whenever he/she will face difficulty in overcoming a challenge. For example, in the case of maze traversing exercise, the avatar character may provide useful clues on how to find an exit quickly. In case the student is frustrated, it may even reveal the answers to the student.

During the play phase, there are several checkpoints that students need to pass to complete a game or a task. To cross a checkpoint, the students must provide answers to a quiz (designed and set by the instructor). While completing the quiz, the app records several aspects of the student's responses, such as the time they take to answer a question, how many mistakes they have made, how often they change their minds, or even a small video recording of the student's attentiveness during the quiz, etc. These recorded data are

then sent back to the server for analysis and assessment purposes. Whenever a student successfully completes a quiz, a digital sticker is presented as a reward and to motivate the student. At the end of the play phase, the scores of the assessment are displayed and a personalized certificate is presented to the student as a recognition of his/her effort. Figure 2 provides a use case diagram of the entire process. One important aspect of the app is that a student can leave a game at any time and resume it from the same place at a later time. This provides flexibility and support for personalized self-paced study.

4. DISCUSSION

The proposed system is unique of its kind. The main novelty of the proposed system is the customizability of the contents based on the learning outcomes and personalized feedback that reflects the learning outcomes. In this section, we highlight some of the salient features of our proposed framework:

Wide accessibility: Since our framework is mobile and web based, kids can access the app from anywhere through the mobile devices to accomplish their home works and revise class works.

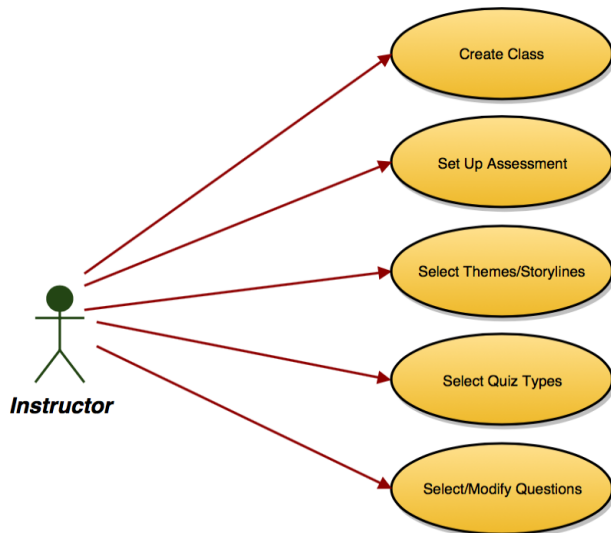


Figure 1: Use case diagram of setup phase of the framework

High customizability: Off-the-shelf apps do not always provide customizable contents through which educator or instructor can measure the learning outcomes. In other words, they do not always provide easy mechanisms for personalization of the contents to a specific target group. Our framework is fully customizable and provides feedback on the learning of individual students. In addition, the framework can be easily extended to provide support for other educational settings, for instance, in the high school, college or university educational settings.

Research platform for educators: Unlike any other off-the-shelf apps, our framework can be used as a tool that educators or researchers can use for designing instructional materials, test and validate the effectiveness of the materials on children's learning.

Interactive and engaging interface: The framework provides an interactive mobile interface that is fun and easy to navigate by the kids of different ages.

Collaborative framework: The framework provides a common and collaborative platform for the teachers and educators to share existing materials. For example, an experienced educator may create an effective assessment module for a specific knowledge area and share the module with multiple instructors teaching in the same area.

Support for inquiry-based learning: Our framework could easily be used to facilitate inquiry-based learning. In this setting, a student in a class can create contents, questions, or scenarios and challenge other peer groups in the class. Furthermore, the instructor who acts as the facilitator of the inquiry based learning, can also use the framework as a technological assistant to deliver any content they feel is relevant.

High extensibility: Although the platform is mainly proposed for the elementary to junior high students, it can easily be extended to the other educational target groups such as high school, college, and university students.

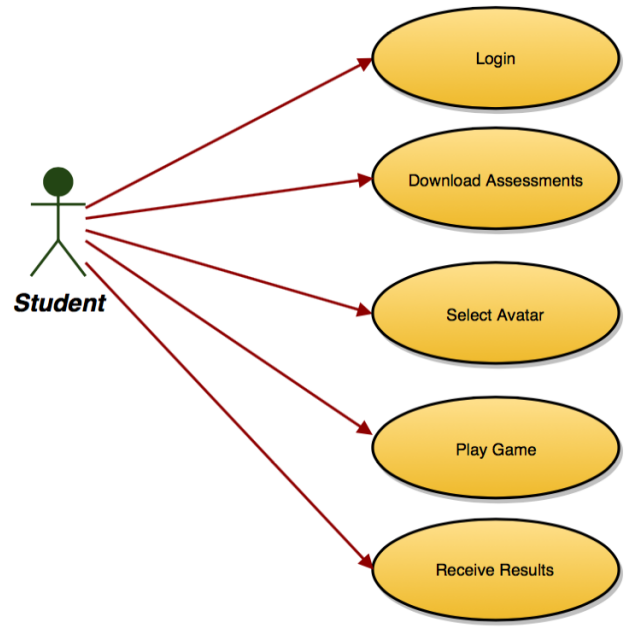


Figure 2: Use case diagram of play phase of the framework.

5. CONCLUSIONS

Today kids are fascinated with mobile technology. A sheer amount of their free time is spent on mobile devices. Hence, there is a huge potential to use this technology for educational and learning purposes. Although, several educational and learning applications for the kids are out there in the marketplace, but they are hard to customize and do not satisfy specific needs of educators or teachers. In this paper, we proposed a flexible framework that gives teachers the ability to customize the content. In addition, the framework can be used for inquiry based learning and enables students to create their own content to teach themselves and their peers.

While the paper considered the design aspect of the framework, the practical implementation and evaluation of its impact on students learning are left for a future work.

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