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Apps Developed by Academics

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Abstract
In the days of the digital Wild West, developers from all backgrounds have joined in the gold rush trying to profit from the almost unbridled spending of well-to-do parents on educational products. In 2016, the Apple App Store had over 80,000 educational apps. The proliferation of educational apps has happened at a furious pace and more apps are being introduced constantly. Although apps are labeled as educational, they are not held to any science-based standards or subject to any certification (Hirsch-Pasek, et al. 2015). With the boom in new apps introduced every year, there is simply not enough time, money, or resources available to evaluate each app as it enters the market. As a result, "educational" apps are largely unregulated and untested. As a result, app users are misled and are spending money on products which are not actually educational. The real experts – researchers, teachers and educational specialists – need to take over the driver seat in this important and evolving realm of educational apps with the developers playing the supporting role instead of the leading role. With increasingly lowered cost and ease of development to produce an app, academics who do not have vast financial resources or substantial technical knowledge are able to create truly impactful, pedagogically-based apps either by themselves or outsourcing to development services. Although technology promises to be transformative, educational content must remain the main thrust of any educational mobile app development and not technology. Educational apps need to have the experts involved. It is time that education is put back in its rightful, central position.
Keywords: educational apps, ICT, tablet computers, educational content, mobile technology, app development

1. Boom in educational apps

With 700,000 apps listed in the Apple App Store in 2012, there are now over 2 million apps available as of June 2016. Android apps have now reached 2.2 million. Also, since the App Store was launch in 2008, there have been more than 140 billion apps downloaded. The annual revenue for the Apple App Store in 2015 was a staggering US$20 billion (Statista, 2008, 2016, 2013-2015).

In 2016, there are over 80,000 apps in the education category (Apple, 2016) as compared to 20,000 such apps in the App Store in 2012. The preschool/toddler category is the most popular category of apps in the App Store, accounting for 72% of the top paid apps (Shuler, et. al., 2012) and 1.5 million iPads were in use in schools (Rao 2012). Scanlon and Buckingham (2007) posit that in the face of increased educational competition, computers and software have been heavily marketed to parents as a means of ensuring the academic success of their children. Digital literacy is often deemed a competence that contributes significantly to successful learning. As a result, the market for digital learning material for children is and will likely continue to boom into the foreseeable future. One precipitating outcome of this trend is an extension of learning and learning materials into the home. Scanlon and Buckingham call it the pedagogization of leisure time in which parents will become educators and children learners. "The kinds of 'informal' learning that might occur in the home will be increasingly curricularized" (Scanlon & Buckingham, 2007).

2. Over zealous initial embrace of technology

The exuberance surrounding iPads and educational apps, though apparently unique in its stratospheric levels of appeal, is actually reminiscent of the frenzy that accompanied the introduction of several other so-called technological breakthroughs in the past. (Salaberry, 2001) The radio, television, and computers have each significantly revolutionized various aspects of our modern day lives, but Salaberry (2001) states that it is not clear whether they have achieved parallel degrees of pedagogical benefit. He warns that a healthy dose of skepticism about the pedagogical effectiveness of many current technological tools is advisable. An example of technology-driven pedagogy took place in the early Computer Assisted Language Learning programs that reproduced textbook exercises in the form of electronic workbooks. Thrush and Thrush (1984) elaborate that "too often programs are developed from a practical or technical bias and lack sufficient educational planning."

Indeed, smartphone and tablet technology have only really been introduced less than a decade ago, but their rate of proliferation has been staggering. In 2013, just three years after the iPad was introduced on July 26, 2010, Apple proclaimed that iTunes had achieved its 50 billionth download (Apple, 2013). In addition, apps are also generating huge returns. Over $10 billion was spent in the App Store in 2013 and by 2015 it doubled to $20 billion.

The message is not to abandon technology which is not feasible nor sensible, but to change the focus.

Bax (2003) ascribed two common fallacies (a) the belief that a new technology can do more than it actually can; and (b) the belief that the existence of new technologies is the only relevant factor leading to its success.

3. Educational Apps - not really educational

In line with Salaberry's caution about jumping in too rapidly in adopting new technologies as the magic bullet to education's problems, the authors in the Hirsch-Pasek, et al. (2015) study likewise warn that many apps, which are labeled as educational, are in fact not held to any science-based standards or subject to any certification. A study by Takeuchi and Vaala (2014) reveals that 80% of teachers who use games in their classrooms have difficulty finding curriculum-aligned games, whereas just 39% believe that a sufficient variety of such games even exist.

Murray and Olcese (2011) stated that current advances in tablet technology are underused and not aligned with developmental theories and are of little use to educators. Their study concluded that the majority of apps appropriate for young children lack collaboration capabilities and do not promote creation or problem-solving skills.

But, parents have embraced educational apps despite its unregulated status. In 2013, 58% of parents in the United States reported that they had downloaded apps for their children (Common Sense Media, 2013).The same report showed that in 2013, 72% of children age 8 and under have used a mobile device as compared to 38% in 2011.

Without any current standards for what can be qualified as educational apps, Hirsch-Pasek, et al. (2015) state that only a handful of apps are designed with an eye toward how children actually learn. They describe that only a small number of developers at both small start-ups and bigger toy/media companies have used research-based approaches with preliminary results of research. For example, they refer to a study which found that interacting with a vocabulary-focused app increased young low-income children's vocabulary by up to 31% in just a 2-week period. While this result may sound encouraging, they described the study design as not being robustly investigated, making it difficult to evaluate the apps' scientific impact.

Having established that the current validity of educational apps is often questionable, the authors raise the next logical question of what qualifies an app to be deemed as educational. Hirsch-Pasek, et al. propose using four pillars based on the Science of Learning theory to guide the design of appropriate apps that will offer a greater likelihood of producing educational benefits. Although the Science of Learning is helpful for enhancing the learning content of apps, we believe that a serious discussion about pedagogical guidelines specific to individual subject matter must come first and that educational content is what truly defines an app as educational or not. Our premise is that without specific and high quality subject matter content, an app simply cannot be called truly educational. Furthermore, it is insufficient merely to have a certain amount of learning content padded by a lot of filler or worse yet distractors. A suitable analogy may be the definition of fruit juice. Whereas many drinks contain only 10% fruit juice, they are nonetheless still labeled as juice. Indeed, this kind of misleading labeling could lead to detrimental health effects since the consumer may be ingesting primarily unhealthy sugar water instead of nutritious juice. Mislabeling is just as serious when it comes to education. To mislead parents or teachers that learning has taken place while a learning opportunity is actually being forfeited by an educationally weak app can cause long-term ramifications for a child's development relative to another child who is actually receiving a true educational input. If the child is from a low social-economic background and is getting the educational "lite" version, then the child will be put at an unfortunate disadvantage which could affect his/her future chances for success.

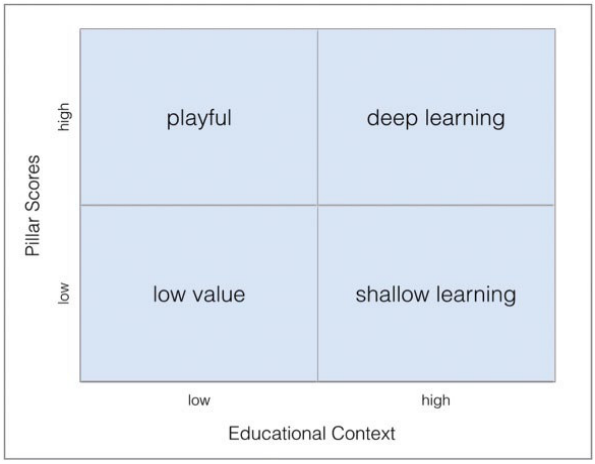

Figure 1. A grid for determining the pedigree of an app excerpted from Hirsh-Pasek et. al. (2015)

In their article, Hirsch-Pasek, et. al. (2015) outlined a 2 X 2 matrix (Fig. 1) positioning their pillar

scores against educational content. When the pillar scores ranked high but the learning goals were low, then the researchers acknowledged that the app was nothing more than a "pure entertainment app". The popular "educational app", Toca Hair Salon Me, mentioned in the article was described as an example of an app that fits into this quadrant. Even though the pillar scores were high, the researchers classified the app as largely "noneducational". Even the CEO, Björn Jeffrey, declared that Toca Boca was not an educational company. In Banville (2014), Jeffrey states:

> My argument would be: Education is great and it has its place, but there are other things we can do for children other than just educate them. Just looking at learning from a broader sense, there are things you can learn . . . that are not from a strict curriculum perspective—things like collaborating or using your imagination or being creative. There's a place for that in an educational context, but they are also things that can be just learned from doing completely different things. . . . I don't see us as an educational company. I see us as a company that makes apps for children or digital toys for children or, more simply, products for children, but it is about the children first. If they can be used in an educational context, great, but that's not the intent.

Hence, if high pillar scores with low learning goals results in a pure entertainment app, then it would follow that the pillar scores cannot be deemed the foundation for determining the true basis of educational value as was suggested in the conclusion of the Hirsch-Pasek et. al. (2015) article. In comparison, in the bottom right quadrant of their 2X2 grid, where the pillar scores were low but the learning goals were high, the researchers reasoned that the learning will be shallow. Under such a circumstance, it is possible that traditional learning methods could outperform the new mobile technology format (Salaberry, 2001). The key point to underscore here was that the app at least had reasonable grounds to still be considered an educational app despite the fact that it did not align well with the Science of Learning pillars. But, Hirsch-Pasek et. al. (2015) implied that such apps do not prompt "true learning". They assert, "Looking at the bottom right quadrant in comparison to the top right quadrant, we can now plainly see a difference in what might be a true educational app and one that simply bears that name" (page 25). We believe that this statement is misleading given that they themselves have categorized the apps as having high educational content.

The authors suggest that the Hirsch-Pasek, et. al, (2015) study has placed the cart before the horse and emphasized the importance of the pillars before the problem of weak educational content and missing pedagogical principles has been properly addressed. Our position is that the discussion about putting education into educational apps must first and foremost be focused on whether it can pass muster in terms of an overall pedagogically sound approach to the specific educational content being taught. That determination can only be made by the experts in the specific field. It is not enough even to seek the approval of a general educator. Without sound pedagogy, a discussion about the pillars or even about mobile technology does not make sense. Of course, the coveted space on the Hirsch-Pasek, et. al., (2015) 2 X 2 matrix is in the top right quadrant where an app possesses high learning goals and high pillar scores. Indeed, we concur that such an app would have a higher chance of promoting deeper learning.

4. Pedagogy before technology

Despite the shortcomings of present day educational apps, it would be imprudent to disregard them as illegitimate for educational purposes. Instead, we believe that the true potential of such apps has not been properly harnessed because educational experts have not been actively involved. According to Salaberry (2011) new technologies should only be applied to the extent that they serve a pedagogical purpose. In reference to the hyped up hopes of iPads in education, Hirsch-Pasek, et. al. (2015) report that a large number of schools throughout the United States have integrated the use of tablets into their curriculum despite the absence of research to support its benefits.

The understanding of pedagogy and how to apply technology in the most optimal way is not a simple matter. Such competencies cannot be easily developed over night. Educators and academics dedicate years to develop the understanding and expertise in their respective fields. Given that apps are typically developed over a period of about 18 weeks (Rice, 2015), it is implausible that app developers, who do not have the educational expertise, will be able to translate a pedagogically solid curriculum into an effective educational mobile app during that short amount of time. Apps created in such a manner can only be expected realistically to offer basic educational content at best and misguided teaching in the worst case scenario. Educators need to be involved in the educational app development process and to protect the potential learners from false claims. According to Peng, Su, Chou & Tsai (2009), "Educators should take a proactive stance towards emerging technology and become integrally involved in the development, as well as the evaluation, of pedagogically sound educational tools. A partnership should be established among schools, corporations, universities, and professional organisations. By becoming involved early in the process, there is a greater chance that hardware and software may meaningfully improve teaching and learning."

5. Apps Developed by educational experts

Fortunately, it is easier than ever for academics to create their own apps and to genuinely participate in transforming learning for the twenty-first century. Upon conducting a Google search for - apps developed by educators, apps developed by academics, apps developed by researchers, apps developed by teachers, teachers creating app, apps developed by universities or professors creating apps - the authors were surprised to discover that only a handful of applicable entries were retrieved. Nonetheless, some exemplary apps have been produced by pioneering educators and we hope that this article will encourage others to realize their potential in producing educational apps as well. The search for apps developed by researchers yielded the most entries, but the results for these apps were primarily related to apps which help researchers with their research topics. For the scope of this article, we are also not focusing on apps that have translated or used research to produce a new product or service.

The target of our research was educational apps developed by an educational expert in their specific area of training for teaching and learning purposes. We have outlined the significant findings in this article to document the state of app development by educators at this point in time. Assuming the premise that a researcher/educator/teacher would choose to highlight his or her educational qualification in producing the app in order to lend credibility to the app's content and that mention of these qualifications would be captured by a Google search, the number of apps that have been developed by educational experts relative to the sheer number of available apps is truly very few. We will spend the next section summarizing some of the examples of apps developed by educators.

5.1 Michele Neumann – Griffith University

Dr. Michelle Neumann, a lecturer from Griffith University in Australia, created an Emergent Literacy Assessment app to assess children's literacy. "I developed it as a digital assessment tool for children I am working with in my research," she said. The app emails a summary of the child's aptitude in letter name recognition, sound skills and knowledge of words and numbers. The results highlight which skills the child needs further help with and the assessment can be repeated to follow the child's emergent literacy growth. A highlight of the app is that parent and teacher tips are provided to help support the child's learning.

In a media interview, Dr. Neumann expressed, "Effective learning apps need educators, researchers, and app developers involved in their production. Parents often don't have the skills to understand the difference between what is working and what just looks great. We need to be fostering the right skills and gathering the right information and assisting parents with this."

"A lot of [apps] have been developed by just the app developer without consultation with educators and researchers," she said. "We put a lot of thought and research-based evidence into the app." (New app, 2016)

Dr. Neumann highlighted in her research that aspects of emergent literacy skills may develop via children's early use of touch screen tablets and their apps (Neumann, 2013). Furthermore, Dr. Neumann said a week-long trial of her app among 20 students at a local childcare center showed most of the class averaged 80 per cent on tests after using the app for a week. She said another class of 30 students in Tasmania showed similar results. (New app, 2016)

5.2 Vikram Kapila – Professor from NYU Polytechnic

Professor Vikram Kapila of the Department of Mechanical and Aerospace Engineering at the NYU Polytechnic School of Engineering in New York, developed a series of mobile applications that allow students to remotely interact with real data and equipment in real laboratories (Baulkman, 2015). The app can serve as an interactive learning aid. By allowing multiple students to simultaneously connect to the experiment, the apps afforded deeper engagement and learning.

5.3 Anant Sundaram-Tuck School of Business & Aswath Damodaran-Stern School of Business

The motivation for creating a mobile app geared for business students arose for Anant Sundaram, a professor at Dartmouth College's Tuck School of Business, who collaborated with Aswath Damodaran, a professor at New York University's Stern School of Business, when they considered writing a textbook. "We looked at the textbook landscape and said, 'Who needs another textbook about valuation?'" Sundaram says. "In this day and age, one of my biggest disappointments is how textbook companies have been slow to adjust to changes in the industry." (Lytle, 2012)

Drs. Sundaram and Damodaran both teach valuation and corporate finance classes to MBAs and executives. The corporate valuation app, uValue, which the two professors created is available for free and helps to supplement their in-class instruction. The software was coded by students from the Department of Computer Science at Dartmouth College. They have produced a dedicated website which offers more information about the app and also how to use it. (http://pages.stern.nyu.edu/~adamodar/New_Home_Page/uValue.html)

5.4 Elliott Visconsi–University of Notre Dame & Katherine Rowe–Bryn Mawr College

Elliott Visconsi, a professor at the University of Notre Dame collaborated with Katherine Rowe, a professor at Bryn Mawr College, to create the app, Shakespeare's The Tempest for iPad. The app costs $4.99 and allows students to listen to audio performances or lectures about the play, to take and share notes with classmates, and to annotate passages from the play. The app is designed to accommodate any Shakespeare-literacy level, with the option to learn from the world's leading Shakespeare scholars or simply to be introduced to a lively description of the play. (University of Notre Dame, 2012) Visconsi says the app helps accelerate student learning. "Students and teachers get further into the play faster, with deeper comprehension than by solitary reading. Along the lines of the flipped classroom metaphor, we have seen students working at a higher level in class, demonstrating deeper interpretive sophistication, and handling textual details with much more ease. They are prepared to get into complex philosophical issues sooner. They come to class better prepared, asking more strenuous questions. By getting deeper into the play and sharing notes and reading together, students are more confident. And they feel they can look to their peers in moments when they need guidance. So the app is expanding the footprint of the class. The classroom is becoming ubiquitous. Meaningful conversation can happen anytime." (Levasseur, 2012)

In regard to developing the app, Visconsi comments, "The nice thing about developing mobile apps is that you can push out new small features [and] you can make changes or corrections if you discover you've made a mistake. It allows for us to be really flexible and responsive to what student needs look like, and it allows us to continually improve the experience." (Lytle, 2012)

Indeed, the development of mobile apps can be very expensive and time consuming for professors, but Visconsi says he believes that mobile technology will have an even stronger influence on learning going forward. "We're at a very exciting moment in the transformation of higher ed," he says. "And I think the mobile app is going to become the dominant platform for the consumption of educational content." (Lytle, 2012)

Visconsi and Rowe, with the support of Notre Dame and a team of investors, have created a startup company called, Luminary Digital Media LLC. Luminary aims to develop many more applications around core humanities texts (University of Notre Dame, 2012). Currently, there are 8 iPad apps by Luminary listed on the Apple App Store.

5.5 David Johnston - Duke University

David Johnston, a professor at Duke University, created the free digital textbook app, Cachalot, for his marine megafauna course. With a dedicated website (http://superpod.ml.duke.edu/cachalot/), Johnston's stated goal for the app is to help people "learn about the biggest and most compelling creatures of the sea from the expert scientists who study them." (Cachalot, n.d.) It is crowdsourced with contributions by a global network of marine scientists. The app incorporates a messaging system for students to collaborate about the course and an interface for Wolfram Alpha's computational knowledge-engine. (Cachalot, n.d.)

"If we were to assign textbooks for this class, we'd have to assign five textbooks and students would end up using 10 to 15 percent of each textbook," Johnston described. "We wanted to create a textbook that would allow us to … facilitate learning, but we also wanted to reduce the cost for students." (Lytle, 2012)

Development of Cachalot is currently funded by the Duke Center for Instructional Technology, Duke Marine Lab and the Nicholas School of the Environment at Duke University in collaboration with the Woods Hole Oceanographic Institution's Computerized Scanning and Imaging Facility, National Geographic and the Society for Marine Mammalogy. (Cachalot, n.d.)

5.6 Esa Helttula – University of Tampere in Finland

As a researcher of algorithm visualization, Helttula makes learning apps for children to facilitate their conceptual understanding of math. With 24 iPhone apps, the reviews of Helttula's apps have been very positive, including several endorsements from elementary school teachers.

5.7 Rob Frank – Hartford Community College

Prof. Frank produced a series of video demonstrations for how he learned to program using Android including links to the various development websites. He developed several apps with the most popular one being a resume tips app for Android which has been downloaded over 50,000 times (Frank, 2012).

5.8 Deborah Lupton – University of Canberra

The only other educational app developed by a university academic, which appeared in the Google search, was from Professor Deborah Lupton, from the University of Canberra in Australia. In an article entitled "Why aren't more academics making their own apps and getting digitally savvy?" (Sweet, 2012) Dr. Lupton was interviewed about how she decided to make her own medical sociology app. She described that she treated it as an experiment to see how difficult it would be for someone who is self-prescribed as not very computer-savvy, to

make an app which explains key concepts in medical sociology, a field which she had been writing about for many years. The app lists each key concept and a brief explanation as a resource for students studying this topic.

Lupton encouraged other academics to think about how they could be making apps to help students. She highlights that academics or universities developing their own apps are able to tailor the content to their own specific needs and purposes. She commented that some universities, including those in Australia, have begun to provide apps that provide information about the university. Yet she echoed the authors' findings that that very few universities have developed more specific subject-based content for apps. (Sweet, 2012)

5.9 Frederick Feraco – Secondary School Science Teacher

High school science teacher at Columbia Secondary School for Science, Math and Engineering in New York City, Frederick Feraco, spent 6 months to develop apps that help his students to hone study skills to prepare them for the New York Regents exams. Feraco said in an interview, "All teachers are judged on how well their students do on Regents and there's pressure on students having to perform well. I thought it would be great if I could take all of the useful teaching tools I use in the classroom—or I wish I could use in the classroom—and put it on one app." (Fortson, 2012) Since then, Feraco has published over 30 apps under his BuddyApp development company and has even expanded into helping others with creating apps (http://buddyappdevelopment.com/).

5.10 Jeff Scheur – High School English teacher

The second example of a high school teacher developing an app is Jeff Scheur, who was an English teacher at Whitney Young Magnet High School in Chicago. Scheur hired a developer to create the web-based application NoRedInk, which Scheur used to quiz students on common mistakes in sentence mechanics and grammar. Launched in February 2012, NoRedInk allows teachers to personalize lessons, track students' progression through their assignments, and provide instant feedback so they can quickly see areas of strengths and weaknesses for both individuals and an entire class. Millions of students have now used the online drills (NoRedInk, 2015). As a teacher, Scheur noticed that students would often feel overwhelmed by red marks. Instead of learning from the feedback about their writing mistakes, they would often toss the paper in the trash. He said the experience prompted him to create a coding system for grammar rules so that students could more easily see when they made the same error multiple times (NoRedInk, 2015). In an interview, Scheur attributes his years of teaching to the success of NoRedInk, and he encourages other educators to create apps that match the needs of students. "I wish there were more teacher-entrepreneurs informing the discourse of education. It takes a lot of experience to really understand kids' central motivations." (Herron, 2012)

5.11 Justin Holladay- math teacher

Holladay created several math apps and subsequently put together an online course, www.teachercreatedapps.com, to share with other teachers how they too can create their own educational apps. The course walks through the design process as well as how to hire a developer and designer. Holladay is also creating a social network for those who have produced apps using his course to help with feedback and advice.

The Next Generation Preschool Math (NGPM)

NGPM is a collaboration between researchers at the Stanford Research Institute (SRI) and media to develop a preschool math curriculum supplement that combines digital and non-digital activities. The impetus for developing the apps came from the premise that most preschool teachers are not trained to teach mathematics and are thus unable to provide rich mathematics learning opportunities for young children (Zanchi, Presser, & Vahey, 2013). Gracie and Friends Birthday Café was their first app launched in October 2014. The team created a suite of 8 apps after engaging in three years of product iterations and tests. The NGPM project exemplifies a good model for how high quality educational apps can be produced in collaboration between educators and developers. Many lessons can be gleaned for other academic app developers by their example. The NGPM team offers seven principles for effective design-based research.

1) Blueprint learning goals with content experts.
2) Do prototypes relentlessly. NGPM prototyped 50 digital interactives and over 100 hands-on activities before ending with 8 apps and 46 hands-on-activities.
3) When conducting pilot/user testing, focus on what works and what needs to be improved, not on how to distribute the product. Make it ongoing formative testing which improves the product and helps build the foundation for the field of learning with technology.
4) Teachers can profoundly influence the product in not only exposing flaws but also in mediating learning with technology.
5) The learning blueprint is the anchor for design but it is just as critical to let a game be a game which is what keeps children playing.

6) Collaborative learning with technology does not always yield perfect outcomes but that is part of the learning process for all involved.
7) Know your target audience and establish an ongoing relationship.

The NGPM team asserts that educational app development must begin with the learning blueprint and that this blueprint anchors everything else and must be re-visited throughout the development process.

6. Educators as entrepreneurs

This next section highlights three companies started by educational experts who produced apps that have been extremely well received in the market.

6.1 Duolingo

In 2009, Carnegie Mellon University (CMU) professor Luis von Ahn, creator of reCAPTCHA, and his graduate student Severin Hacker, conceived of Duolingo by asking the question how to get people around the world to translate the Internet into different languages for free. The solution they came up with was to have people translate while they are learning a language. Some of the sentences that are being used as exercises are those actually found on the Internet that need to be translated. As the millions of Duolingo users are translating various sentences as part of their language learning, the algorithm behind Duolingo is fine tuning the answers, resulting in a translation that is equal to that of a professional translator. The company was spun off from CMU in 2011. As of 2016, Duolingo had over 120 million users who completed over 6 billion exercises each month. It was the most downloaded app in the education category in Google Play in 2014 (Ghoshal, 2014). As of 2015, the company was valued at USD $470 million with a total funding of USD $83.3 million (Lardinois, 2015)

6.2 Kidaptive

Kidaptive was founded by Dr. Dylan Arena, who holds a Ph.D. in Learning Sciences and Technology Design from Stanford University. Other researchers on the team include Dr. Clement Chau, who is a child psychologist with a background in early childhood education, educational technology, and child development, Dr. Webb Phillips, who specializes in speech recognition, and has a background in software engineering, psycholinguistics, and cognitive developmental psychology, and Dr. David Hatfield, who is a learning scientist with a background in science education, video game design, and assessment.

Kidaptive created Leo's Pad Enrichment Program for Preschoolers which is an award-winning adaptive-learning series. The games in Leo's Pad address over 25 skills essential to early learning and adjust to each child's skill level as they play. Embedded assessments across 75+ dimensions of learning are used to customize game-play, support metacognitive development, and provide parents with actionable intelligence (Kidaptive, n.d.) Core subjects include physics, math, logic, letters and art while the activities also help to develop executive function and impulse control skills. In 2014, they produced an app designed for parents called Learner Mosaic, which offers personalized insights into the child's progress. The intention is to engage parents in their child's learning, offering tips and activities for parents so that they can help their child learn better. In 2014, Kidaptive had about 1 million users (Perez, 2014).

6.3 Motion Math

Stanford University School of Education graduates, Gabriel Adauto and Jacob Klein, developed Motion Math to teach fractions conceptually in multiple forms. Since 2010, Motion Math has released nine math games which have been downloaded over four million times. In a study conducted with 122 participants, students' fractions test scores improved an average of over 15% after playing Motion Math for 20 minutes daily over a 5-day period, representing a significant increase compared to a control group. In addition, children's liking of fractions, each improved an average of 10% (Riconscente, 2013). This study thus offers evidence that Motion Math successfully integrates learning and entertainment, and in the process boosts players' attitudes toward fractions.

7. Conclusion

Over 80,000 apps are labeled as educational in the Apple App Store but many of them are indeed not educational. Education and the effective delivery of education is a field of expertise and educational products should be made by the experts in education. So far, mostly untrained app developers have been flooding the market with so-called educational apps. Not until educators rally to get involved in the app development process will the situation change radically. Apps produced or designed by educators have the potential to translate decades of research and experience into a mobile learning platform that could be distributed globally. The goal should be to deploy high quality mobile apps wherever they are needed, offering knowledge and learning to anyone who yearns for it and especially meeting the needs of those who lack access to a good education. Proposed future research would be to investigate the effectiveness of the apps which have been developed by academics and potentially using the findings to suggest improvements for the next version of the app in a continuous design

based research process. As mentioned, research has been conducted in regard to the impact that Motion Math has had on a student's fractions knowledge. Similar research for other apps would also prove beneficial to a better understanding of what constitutes a truly effective educational app. The hope in profiling the current set of apps developed by academics is to inspire many more educators to join in the effort to help meaningfully transform education for the twenty-first century. Additional future research will be required to assess the effectiveness of pedagogical delivery for each subject area since the learning methods and approaches are intrinsically unique. The world needs many more high quality educational apps in many more subject areas and for many different age groups. Only by joining in the app development process can educators remedy the serious problem of not having enough real educational apps.

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