Reading TECHniques

How might we improve literacy skills among low-income children in early elementary school?

Final Proposal

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Problem Statement

Problem Background

How might we improve literacy skills among low-income children in early elementary school? The *demographic* that our group is trying to impact is low-income students, since their parents often don't have the resources to send them to preschool or to take extra time out of their day to work with their children on reading and writing. We are influencing *literacy* specifically because it impacts an individual's ability to communicate in all facets of life: social, financial, emergency, and business situations.

While the *geographic* scope of our solution is broad and applicable to any student learning to read, our work is currently focused on and inspired by the Metro-Atlanta area, as we have personally seen great deficits in education here. Our goal is to prove our solution's viability in this environment and to expand it elsewhere following success and refinement. The *timing* of our solution implementation is key; we are focusing on children during their early development because according to the Connecticut State Department of Education, as well as a plethora of other sources, that this is when language and literacy development happens very rapidly and with great fluctuation (Alleyne). As children progress through the primary education system, their literacy skills can fall greatly behind; our intention is to step in at this stage and improve the growth of children that are experiencing deficiency among their peers.

The *why* of our problem is the most significant part. While children will be directly impacted academically through improved literacy skills, they will also benefit from the augmented social and emotional communication skills that have been proved to develop concurrently with language and literacy growth. Improving literacy on the macroscopic level has been a challenge society has faced for centuries, particularly among the demographic of those in poverty. The problem space we are working in manifests itself specifically in low income areas because public schools are not allocated enough resources to properly support their students, and parents often are too busy ensuring economic survival to focus on educating their children. As a result, one of many academic areas that suffers is reading, both in terms of written and oral language development. In fact, the reading abilities of a child in third grade is a strong indicator of whether or not the student will graduate from high school (Sparks, 2011). Our aim is to directly impact the developing children from this demographic, so that we may begin to improve society-wide literacy from a generational level.

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Significance

It is imperative that we strive for success in improving literacy in this target demographic, not only for the obvious individual benefits derived, but also for the potential gains to society that may achieved. In terms of economics, our country incurs enormous costs from the consequences of a portion of the population with poor literacy skills. Children who grow up illiterate are far more likely to be unemployed, commit crime, and struggle with properly accessing healthcare. These realities are estimated to result in over $230 billion in social service costs annually (Adult Literacy Facts). In addition, both state and federal governments spend enormous amounts of money on the public education system. 28% of all government spending (including federal, state, and local spending) goes to education (in 2012); this combined spending is greater than federal government spending in a number of programs, including the military (Ross, 2015). While these costs aren't a direct result of illiteracy, it is clear that such a huge consistent investment by the American public in education warrants higher levels of literacy achievement than what is currently observed.

Potential causes of the problem are strongly linked to poverty. This is because low-income parents often lack the financial capacity to provide educational resources, like books, to their children. In fact, 61% of low-income families have no books for children at home (Fifty Top Literacy Statistics). However, reading is an important part of education since one of the ways children learn is through reading text, whether in a book, on the whiteboard, or on an assignment. Low income parents often do not have the time or energy to read to their children, depriving them of a key way to build foundational language skills that will be need for developing literacy later on. One study claims that only one out of every three parents reads to their children aged below 8 every night, an issue that reaches even beyond our target group of impoverished families (Bayliss, 2013). Without language, children cannot express themselves and because childhood is the prime time to learn, these children often grow up without skills required for jobs or life in general.

Addressing this issue will positively impact the lives of children who would otherwise grow up with poor literacy skills. Effectively doing so could lead to lowered costs for society in several fields, such as social services, medicine, and the justice system, simply by improving literacy (Cardoza, 2013). Society would also directly benefit from the improved national economic growth as a result of greater availability of human capital in the workforce (Hartley and Horne, 2005). For example, one study stated that "a universal prekindergarten program would yield $8.90 in benefits for every dollar invested and $304.7 billion in total benefits" in terms of increased productivity and lowered social service costs (Lynch and Vaghul, 2015). Thus, the challenge of improving literacy development is one that is absolutely valuable to society and worth the investment in addressing.

Stakeholders

An issue as large and complex as early childhood literacy development encompases a multitude of measurable stakeholders. The first, and primary stakeholder in this area is defined by children themselves who are entering the primary education system (5 and 6 years of age) and younger. These individuals stand to be impacted the most from the introduction of any new product or process that seeks to improve written and oral language skills, as low literacy levels contribute to poor academic success, behavioral issues, and difficulty finding employment in the future (Adult Literacy Facts). Correspondingly, the parents of children affected by our work are also significant stakeholders, as they ultimately exercise the greatest influence in directing the development of their children. While it's obvious that all parents desire their children to grow up as intelligent and literate as possible, their resistance to radical change or being told how to raise their children presents a significant barrier to accomplish this task. Such difficulty is especially true if parents were to feel as though their independence is being threatened by any new solution (Rosenberg, 2009).

School, whether public or private, is the formal environment wherein literacy skills are refined and further developed. As such, academic institutions have considerable control over directing children down the proper path of growth, and also stand to gain significantly if incoming students have improved starting proficiency in a given scholastic area. Early educators such as preschool programs would also fall under this particular stakeholder domain. Important concerns for this group include the relative cost and effectiveness of any new solution, as well as a potential resistance to changing methods among entrenched educators. A final critical category of stakeholder for this complex problem space is that of the future employers of children progressing through the public education system now. It is to the benefit of an employer in any field, and the economy in general, to have a large supply of literate workers with proficiency communicative ability (Engaging Stakeholders, 2009). Thus, it is clear that the professional world is in support of positive change to the development of literacy skills in children, though efforts by this group to provide support tend to vary in scope and effectiveness.

Context and Existing Solutions

Early on in children's lives, development of key skills such as reading and writing that will be essential to their future success. Not only do these skills help deliver a message in an academic setting, but adequate literacy, vocabulary, and understanding of language are all interconnected with a child's ability to communicate thoughts and emotions with other people (Department of Education and Early Development, 2007). However, many factors may impede a child's ability to learn in a traditional school setting, such as a lack of personal interaction with the

students, weak foundation upon entering elementary school, and limited resources for learning to read, especially in low income schools and families. One existing solution to this problem is supplemental learning for these children, specifically a summer camp or after-school program like Horizons at Georgia Tech. They teach primarily through project-based learning, where a combination of research and creative writing may improve different parts of the students' education. We talked to Sirocus Barnes, the director of this program, and we found that the improvement over the course of the camp was inconsistent over the different grades levels and not always proportionate to the duration of the camp (Personal Communication, 2017). The main problem with this solution is that this is a temporary fix; it may catch up the students academically over the summer, but it is not a consistent solution to the problem. Reading improvement programs also can't reach all students in need; there are simply too many children that need assistance and too few programs to enroll them in.

Another typical solution, school-based programs and reforms, have fallen short on helping our target demographic. A clear example is the Social Emotional Learning program adopted by Atlanta Public Schools to improve social behaviors in schools. This is a relatively new program that Jeanne Moore (a local public school teacher) told us she uses in her classroom, where the teacher holds morning meeting and a group discussion for sharing and listening. The data for past implementation of the program shows 9-11% improvement in areas of prosocial behavior, standardized test scores, and reduced emotional distress, in addition to 23% improvement in social and emotional skills (Smith, 2017). The main drawback of this program is the training, time, and resources required to make this program widespread and successful. Also, it is hard to quantify improvement of social skills, which is part of our motivation for focusing on the literacy aspect of the problem as a more universally tested skill. Though these are both moderately successful solutions, neither overcomes the limitation on the amount of teachers or parents available to individually help the students.

Why Is It Still a Problem?

Though the aforementioned solutions have seen some moderate levels of success, there are several fundamental issues that have prevented widespread literacy improvement from taking place. First and foremost, illiteracy is, at its heart, an economic issue. As a result, one of the greatest obstacles in solving this problem is acquiring the resources to make any solution a reality. This is prominent in not only individual homes, but school systems as a whole. Emphasis is typically placed on improving resources already at home, not necessarily purchasing new ones. Any new product or process that may be beneficial to a developing child simply can't be justified as a sensible investment to low income families. Across the education system

itself, drastic changes in widespread trends and techniques rarely occur, likely due to funds required to train teachers and create new programs, even if they improve the ability of students to learn. Although educational apps and computer games exist, not all families have access to a computer or internet, and most existing reading apps are not as interactive as may be necessary to engage a young child. The key to solving this problem is finding a low-cost solution that provides an opportunity for kids to enjoy learning to read.

Proposed work

Goal

As is described in our problem statement, at the end of our project we intend to have made a positive impact on the literacy of early elementary-aged children in order to create better lives for these children in terms of job skills, employment, social skills, and general economic well-being. Our specific project goal for achieving this is to improve literacy proficiency among students, specifically low-income, as they progress through early elementary school; the success of our project would be measured by the average improvement in reading levels over the course of the time the solution is implemented.

Solution Concept

Our proposed solution to this problem is a low-cost tablet device that serves as a platform specifically for creating and consuming interactive stories. The tablet, manufactured for this solution specifically, would be smaller and more durable in nature (roughly 5'' x 5'') than other child or adult-oriented devices, and would be loaded with three unique applications for different learning environments. The first mode would be for individual story creation (typically at home). A character would lead the child through a story, speaking out loud and also showing text. Periodically, at a crucial moment in the story, the character would turn to the student for direction: it would explain the situation, and give the child four options for what they wanted the character to do. This way, students will be engaged in the story and will have ownership over it because they created their own story, but will also be practicing reading skills by analyzing the options in a given context. Magnetic contacts could be added to the side of the device so that students could sit side by side and work together to choose the course of a single story. This group mode enables students to engage with one another while they practice fundamental literacy skills, and allows the device to function better in school environments. The idea is to engage the students in storytelling and reading enough so that they could later progress to more complicated picture books, or even chapter books, that could also be loaded onto the device. The device could be provided to every student in a small classroom, with a teacher master device that could push out stories to the smaller devices based on the children's reading levels. This third mode, reading mode, would turn the device into a more traditional e-reader. By delivering story books to students in this way, teachers would have the ability to cater the at-home literacy practice to the skill level of each student, and would not be limited by physical classroom resources. Additionally, this function alone greatly extends the relevant longevity of the device, as a student could theoretically carry this device all the way through the primary education system (K-5), reading increasingly sophisticated content along the way.

While the solution is potentially difficult to create, in terms of software especially, resources like the MIT App Inventor and assistance of software developers will aid us in successfully executing our solution; a choose-your-own-story mode is essential to the interactivity we want to provide, so we will investigate resources to make this happen. This solution provides a focused, compelling set of activities that fosters interest in storybooks through direct ownership in their creation, and capitalizes on this interest by providing actual stories in the same environment for consumption and, critically, literacy practice.

Objective 1: Develop a tool to engage students in literacy development practice

Background

As the fundamental goal for this project is to achieve literacy growth among children, it is important that we conceptualize a novel way to facilitate this process. Our outlined solution, we believe, serves this purpose. By providing an affordable, evolving educational resource in the form of a storybook device, we can enable students to consistently practice reading regardless of their home situation or initial academic level. The device also does not outwardly appear to be oriented for this function, allowing students to focus on having fun and being creative while they are concurrently practicing reading. It is imperative for our approach to confronting our problem space that our solution (in this case, a device) be successfully developed and operate as intended in the real world. Failing to do so compromises our ability to positively impact this problem.

Methods

In order to complete this objective, a functional prototype of our solution will be developed first. The prototype solution would begin with the software functionality of three modes: a solo story-creation mode, a collaborative story-creation mode, and a read-only mode. After successfully developing and demonstrating this portion on an existing electronic device, the standalone hardware platform of the actual solution would then be developed from earlier non-functional mock-ups. Combining the hardware and software components together would yield a full solution prototype for extensive testing and evaluation in the real world.

Outcomes

The measurable outcome of this portion of the project would be the delivery of a functional prototype for testing. Evaluation of the prototype software would assess how intuitive and interesting it is in practice among the targeted users, as well as the perceived academic improvement noticeable among early testers in the short term. Unfortunately, such assessment at this portion would be very qualitative in nature, but

would serve as a preliminary proof of concept indicating the potential for success or failure in the future. Following hardware development, assessment of the device's longevity and sustained usage could be determined in extended testing. This period of testing also could be used to gauge how much students improved in literary capacity following consistent usage, using quantitative assessments. Relative success or failure of the final prototype would be dependent upon this later stage evaluation.

Anticipated Problems

Since our objective is to improve literacy growth, one of the potential problems is if children do not actively engage with the story, and randomly pick choices or simply not pay attention. Since the student is actively participating in the story creation mode, and it isn't immediately recognizable as academic work, students may not realize they are actually reading and learning. If this is overcome, there is also the potential that students will shy away from the traditional reading mode all the time, in contrast to our belief they will take an active interest in reading stories after building their own. In addition, our target demographic is very young and potentially poor children, so we would need to make the device virtually indestructible, while affordable. While not impossible, this will lengthen the hardware design process.

Objective 2: Gain approval to be used in a classroom setting and set a standard for widespread use.

Background

A major obstacle in the implementation of a solution of this nature would be marketing or making the target audience aware of its availability, as well as gaining its acceptance and employment among the educational community as a valuable tool in learning. Many children that are behind in reading may be lacking in the additional resources need to keep them up to the level of their peers. If parents do not already show the initiative to provide their children with these resources, we cannot assume that their motivation with change with using or investing in this device. As a result, we must find alternate means to encourage children to use our solution. This is in part accomplished by the idea of playing a game while reading (story creation mode). In this sense, the children will want to play the game while also learning valuable reading skills. However, the game must first be introduced to them and consistently encouraged to be used. Without any push for the children to begin playing the game and continue using it, the entire device will go unused, and the children will continue to be without supplemental resources necessary to expand their vocabulary and reading skills.

Methods

We can begin implementing our solution in classrooms first, since that is most likely the easiest place to reach, and then encourage its independent use in the home. To accomplish this, we will target smaller and more non-traditional schools first, as they are more likely to be experimental with new learning tools. Children's success measured by a change in lexile score (or other assessments) will validate our solution to more traditional public schools. Our task then will be to convince these institutions to invest in our solution on a larger scale, and systematically encourage teachers to actively use its capabilities to their advantage in the classroom. Demonstrating the device's success in schools can also convince parents to purchase them individually for their child (if their school does not provide devices, for example). Based on the results of these various processes, we will reevaluate how effective our solution is and address areas that need work. A key part of our solution is affecting as many families as possible, so marketing would also be a key step in accomplishing what we want; again this would be especially effective if backed by the child's school.

Outcomes

The ideal outcome of this objective would be to have this device used in the Atlanta Public Schools system in the long term. In the short term, this can be accomplished by implementing the use of the device in a Pre-K to second grade classroom for testing, either public or private. This outcome's success will be determined, in part, by the sheer volume of adoption we are able to obtain without initial market success (though we will have validation from the prototyping stage). Teacher enthusiasm and frequency in employing our solution in class will be another key measure of how effectively we are able to define a new standard in literacy education. Finally, parental approval and the amount of independent use allowed at home to children will determine the success of our solution in promoting literacy education at home, regardless of environment. All of these outcomes will be measured quantitatively, through a baseline for success versus failure will be difficult to define, as the intention of our solution is very unique among typical educational products. One metric would be to compare our device against other devices similar in intention among the same target demographic (young students with tablets in general, for example).

Anticipated Problems

One major problem we face in trying to achieve this objective is for the schools to have the financial resources to acquire the technology to provide the game to each student, assuming they do not have it already. The same issue applies to the parents

trying to provide devices to their children. The relevance of this issue can be lessened by minimizing the cost required to create the device. Additionally, we would have to explore other options for advertising the game, which could also be potentially costly. Ideally, success of the game will help it gain popularity and encourage its widespread adoption and use.

Project Team

Our current project team is small (4 members), and we don't anticipate this changing over the course of our project. Our intended role assignments for carrying out the project is divided into 3 main roles: hardware/software development, content acquisition, and solution advocacy. All project members will be responsible for project documentation, as well as potential key presentations or meetings with outside parties. We will hold each other accountable to coming to meetings regularly outside of class.

For hardware and software development, two of the more technically-skilled project members will work on the actual device driving our proposed solution. These individuals will need to research and acquire the necessary programming tools and methodologies to effectively develop a proof-of-concept application demonstrating the solution. While some of the more advanced software components may be contracted with a professional developer (see budget for more details), the bulk of conceptualizing, designing, integrating, and testing the overall application will fall on these individuals. It is important to stress that the initial goal of this project group is to develop baseline applications that can be tested in the real world with our target users. Improvements, both cosmetic and functional, will be made with time. It is also important to note that the original "proof-of-concept" for this solution will probably be in the form of applications running on existing mobile hard (iPods or iPads), with a standalone device being delivered later on.
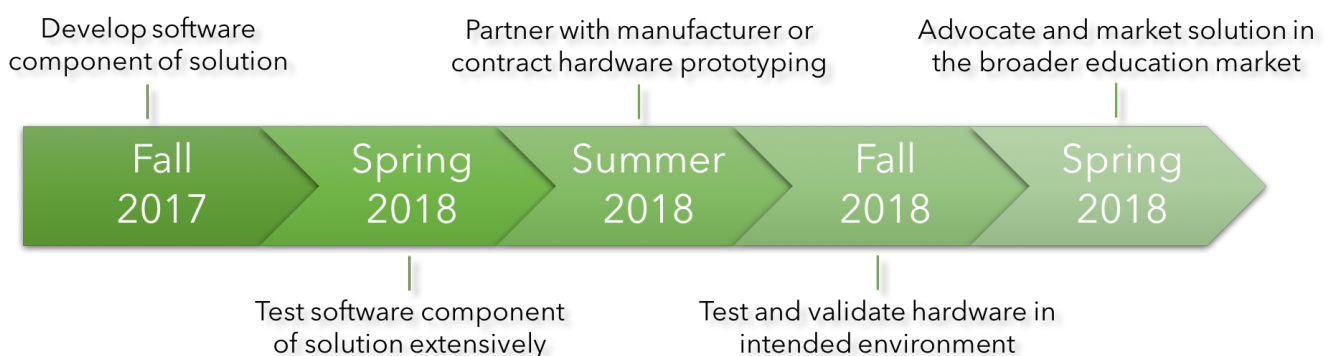
The second project task, content acquisition, revolves around obtaining access to non-original literature so that it may be distributed legally within our solution. Unfortunately, the reading feature of our solution is dependent on the ability to provide children with published media materials that are not our own. As a result, a project member must be dedicated to working with content publishers (large or small) to enable our application to access stories and characters well-known to the public. Given our group's small size and lack of industry recognition, this may be very difficult to do. Therefore, this individual's efforts will most likely be directed towards legal means of hosting electronic books that are already published for sale, or directly licensing books from publishers. In addition, it is possible that we would be able to construct simple storylines ourselves, but this would likely only be the case if we were having trouble acquiring non-original content rights.

In regards to the final task, solution advocacy, one project member will be wholly devoted to forming relationships with governmental organizations, literacy

advocacy groups, and local educational institutions to encourage the rapid trial and acceptance of our solution in the real world. For example, this individual may reach out to a local private school to advocate and negotiate the terms of deploying prototype devices into classes. In addition to this "salesperson" role, the individual will also provide technical support to initial users of our solution, and will be responsible for observing, gathering, and summarizing feedback for solution improvement to the hardware development group. Eventually, this individual will work towards getting our solution into homeless shelters, houses, and schools and beginning to affect our target demographic.This role really is primarily about bridging the gap between the technical work within our project group with the concerns and effects from real world users of our solution.

In addition to the active group members, our project's success will also be dependent upon external mentors in varying fields. The first of these is Sirocus Barnes, the director of the Horizons at Georgia Tech summer reading program. We first made contact with Mr. Barnes earlier this year while conducting expert interviews, and he indicated clearly that his relationships with area schools would allow us to more easily gain access to classrooms for potential testing of our solution. Another mentor of this nature is Andy Tucker, a program director at the City of Refuge shelter we visited during a team field observation trip. Both of this individuals, despite differing educational and professional backgrounds, have years of experience in working our target demographic and related groups (parents, teachers, etc.). As such, both can provide meaningful feedback on the viability and approach to implementing our solution as it develops. The final possible mentor we currently have in mind is a Jeanne Moore, a first grade teacher at a more advanced public school in the Buckhead area. We feel she would be extremely beneficial in enabling us to assess solution impact among demographics beyond our target (wealthy, non-urban students).

Timeline

Develop software component of solution		Partner with manufacturer or contract hardware prototyping		Advocate and market solution in the broader education market
Fall 2017	Spring 2018	Summer 2018	Fall 2018	Spring 2018
	Test software component of solution extensively		Test and validate hardware in intended environment	

Budget

Materials and Supplies

In order to implement our solution, we would need access to Xcode, which is an iOS app development environment. Using the iOS development platform, we would first develop and test the software portion of our solution on iPads, a capable platform similar in form to our intended hardware solution. The cost of Xcode subscriptions (for iOS development) would be $400 total. Two iPads for testing purposes would be an additional cost of roughly $1000. Our proposed hardware platform would not be produced independently, so it is not included in these costs.

Equipment

For the software development stage of our project, we don't believe there is any large industrial equipment to be purchased. For hardware development, it is more realistic to partner with a professional manufacturer rather than try to build an consumer electronics device on our own. As such, we don't have any planned equipment expenses.

Services

Though we plan to develop the software independently, if we find that we do not have the skills to develop the app fully, we will enlist the help of an app developer to finish the job. Our goal is to learn enough through self-teaching and free programs that we will not have to resort to this. Our hardware prototyping process, however, is more complex. We may utilize an existing electronics manufacturer or prototyping group, which would require outside corporate sponsorship or investment to provide us with the necessary resources for realizing our solution. This would be far to0 resource-intensive to ask of Grand Challenges. However, if we were to patent a hardware design and license our product instead to a manufacturer, Grand Challenges could provide the resources for that approach. This cost would be between $2000-3000.

Travel

We don't anticipate any significant travel costs at this time. As we move into the hardware development stage, however, it may be necessary to meet with a prototyping or manufacturing partner in person. The location and number of such trips can't be accurately estimated currently. Advocating the adoption of our solution will also require travel, though this would be local driving for our initial target area of Atlanta.

Expected outcomes and future directions

Improving literacy skills for low-income children is an ongoing process that depends on how well the product is developed and whether or not parents and schools take the initiative to get kids using it, so the project is essentially over once when kids playing the game show increased social confidence and improved reading abilities. If we are still passionate about our project, we can continue to develop new iterations of our product with more features so that a greater age and ability range of children is included and supported. In the end, we expect to have provided a product that is effective in engaging children and promoting literacy skills and has become a staple in classrooms and homes, at least in the metro Atlanta area. Ideally, we will finish this project and have a small system that manufactures and distributes devices to intended customers. The best case scenario would be the establishment of a non-profit or LLC.

Ideally, the project will span four years. This year revolved around coming up with a solution for a problem. Year two would be the developing stage of the project, so we would be making the prototype. After this, we would use year 3 to continue to develop it, test it out and work out bugs and by year four, it would be ready for implementation.

In order to keep the project going, we could collaborate with successful educational-toy developers, such as LeapFrog Enterprises. LeapFrog Enterprises currently has games that children can play in order to learn how to read and write, but none of these games allow the children to create stories together. They might be interested in our idea and willing to partner with us, especially if we emphasize we are not looking to make money. However, it is probably better for us to partner with a non-profit organization since companies like LeapFrog are usually looking for a profit. The Southern Education Foundation is located right here in Atlanta, Georgia and would be a good organization to look into, as it seeks to promote early learning opportunities and advance public education. Such organizations might be able to provide us money to purchase tablets for the children ("Mission And Vision "). The mentors that we indicated above will be essential assets to our project; Sirocus Barnes specifically is a successful professional within our problem space, and is likely to have a wealth of knowledge and advice.

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