Game-Based Learning Outcomes in Economically Disadvantaged Children in India

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Introduction

The concept of using technology in education has been around for a few decades. Exposure to technological devices and technology-enabled sources of knowledge from a young age has proven to be beneficial in terms of preparing children to enter a digital world, and also in terms of enhancing their cognitive development by providing multi-sensory stimuli, thereby enriching their learning environment (Elkind, 1985; Papanastasiou et.al, 2017; Kokkalia et.al, 2017).

Game-Based Learning:

Game-based learning is an increasingly important segment in the overall space of technology-enabled education. The advantages of learning via games are many:

- Games are fun and engaging.
- They make the brain think in new ways and encourage problem solving and creative thinking.
- They can introduce new ideas and complex concepts in a risk-free environment, where the players can learn through trial and error.
- Games can be immersive experiences where people are allowed to explore and build new worlds, and learning is spontaneous.

Studies with young children have shown that game-based learning helps children enhance their cognitive capacities and improve skills while also keeping levels of motivation high. Children involve themselves wholeheartedly in the games, and enjoy the control they have over their learning outcomes (Giannakos et. al, 2012; Sedighian & Sedighian,1996; Tan & Biswas, 2007)

Use of educational technology and game-based learning in economically disadvantaged communities in India:

The use of educational technology and game-based learning has been increasing in the past few years in India, and there are several companies that cater to this growing market. However, most of these companies make content and games that are closely aligned with the existing school curricula and are meant to be used as aids to the formal education system, rather than as a supplement to it, or a replacement of it. Also, these educational games come at a price - mostly accessible to the higher economic classes of Indian society. Access to such resources is

limited amongst the poorer people in both rural and urban communities. Even when such access is available, it is mostly through the formal education system which brings with it its own set of challenges in terms of limited opportunities for exposure, reluctance of teachers to use the games effectively, training required for teachers to use them, etc.

While there has been an acknowledged benefit for using technology and game-based learning in more affluent schools and communities, only a few such studies exist that look at the learning outcomes provided by educational technology in economically disadvantaged children in India.

Sugata Mitra's "Hole in the wall" initiative was a pioneering concept in promoting learning through technology in poorer Indian communities. Computers were set up outdoors in playgrounds creating "learning stations" where children could freely access its educational content. Children would form small groups around these stations and could self-direct their learning experiences. This method of learning was found to be a resounding success and children hugely enjoyed the interactive and collaborative experience (Mitra et.al, 2003).

Two studies by Matthew Kam and his colleagues aimed at improving literacy in rural india using games installed on cell phones to engage children in learning English vocabulary and reading skills (Kam et. al, 2009; Kumar et. al, 2010). The study curriculum included simple English nouns, verbs and sentences. These were converted into interesting, interactive cell phone games, based on traditional Indian village games and game-based learning principles. One study provided children with an unsupervised setting where they were given the devices and had the freedom to choose when and where they played the games. The other study provided a more structured setting, where children had access to the devices for 2 hours a day in an after-school program where they were monitored by the researchers and staff. All the children were ESL learners and showed improvements in their reading and vocabulary after playing with the games. These studies concluded that games can be a useful medium of learning for rural Indian children and that more thorough research into this developing field was required.

Atlas Mission

Storytelling is an immensely powerful instrument of learning. Older than the art of writing, through the ages, people have conveyed information and knowledge to others around them through the medium of stories; and they survive to this date in one form or another. Simply put, people are just better at learning things if they are taught in an engaging manner and if context has been given to what they are learning, both of which storytelling is very good at doing.

The Atlas Mission is a unique educational platform that uses this age-old art of storytelling and combines it with game-based learning to create an immersive learning environment where children are encouraged to learn at their own pace without any risks or pressure from the

outside world. While the Atlas Mission is currently focused on relatively younger children, it will eventually grow to encompass children across the age-range of 2.5 - 16 years.

The Atlas Mission aims at providing a 21st century learning experience to all children irrespective of their socio-economic background, the language they speak or their level of education. It brings together a collection of games covering an array of competencies such as literacy, maths, science, coding, and creativity (with other skills like critical thinking and problem solving to be added in the future), and weaves them into an epic journey driven by an engrossing adventure-based story.

An important part of learning through the Atlas Mission is the ability to instantly receive feedback about one's performance and to be able to continue playing the games until they get the correct answer. This is a hallmark of game-based learning that encourages children to repeatedly try a new skill until they have mastery over it.

The Atlas Mission has been created by a company named Learning Yogi Pte. Ltd. The Learning Yogi Foundation, the publisher of this report, is the non-profit arm of Learning Yogi Pte. Ltd. that takes the Atlas Mission to socio-economically disadvantaged communities around the world.

For the purpose of this study, the Atlas Mission curriculum was restricted to its Literacy component. Altas Mission's literacy curriculum includes 60 levels and 360 words that have been carefully curated to teach a broad range of world families. Beginning with the simplest consonant-vowel-consonant combinations (CVC words), children are slowly taken through important concepts in word building, such as the use of short and long vowels, consonant blends, digraphs and phoneme chunking. They learn a variety of literacy skills, from using letter sounds to help with reading, to tracing out and writing words, and spelling.

Study Objective

The main objective of this study was to introduce the Atlas Mission to children from economically disadvantaged backgrounds, with the purpose of measuring their progress (if any) in various literacy skills. Reading and Vocabulary were the two measures of importance for this study.

Method

Based on our preliminary enquiries, we learnt that all the children in our sample population had access, albeit limited, to sources of knowledge via computers in their schools, or their parents' cell phones at home. Therefore we decided to conduct a pilot study to assess the impact of introducing the Atlas Mission to them.

The pilot study was divided into 2 phases. Phase 1 was conducted with children from an economically disadvantaged community within the city of Bangalore, India. Based on the learnings from Phase 1, Phase 2 was then conducted in a supplementary school program with children from a government run school in Bangalore. Both phases of the pilot were aimed at collecting data on children's interaction with the Atlas Mission and assessing their learning outcomes after 1 month of playing with it.

Phase 1: Community Pilot

Participants:

In Phase 1, we reached out to a small, low-income community within the city of Bangalore, India, recruiting willing families having children of the appropriate ages and English abilities to be able to play the Atlas Mission. Parents were briefed about the goals of the study and based on parental consent, children were included in the study after taking a pre-test (baseline) to assess their English vocabulary and reading abilities. Initially 8 children were enrolled in the study; however, after the pre-test was administered, 4 of them subsequently dropped out of the study for various reasons.

The remaining 4 children (2 boys and 2 girls) were between the ages of 4 years and 8 months (youngest) and 6 years (oldest). They all attended affordable private schools where the medium of instruction was in English. However, their exposure to the language outside of their schools was minimal, and English remained as a poorly used second language. As with many schools in the affordable range of the lower economic strata of Indian society, English was mainly taught by rote - children were made to memorise words and spellings by constant repetition rather than by more intuitive and pedagogically sound learning methods. All the children had basic exposure to hand-held technological devices, especially cell phones.

Phase 2: School Pilot

Participants:

Since the attrition rate was very high in the community pilot, it was decided to use a somewhat different approach for Phase 2 of the program. In this phase, we collaborated with a well-known Non-Profit organisation (Whitefield Ready) whose volunteers taught in several local government run schools in the Mahadevpura district of Bangalore. One of the schools under the NGO was chosen for our pilot study - Ramagondanahalli Primary School. Appropriate consent was taken from the school authorities for the Atlas Mission to be introduced to the participants.

The Whitefield Ready volunteers agreed to include the Atlas Mission as part of their 40 minute daily sessions with the children and to monitor the children's use of the tablets, only to the

extent where they were certain that the children were using the platform by themselves and not passing the tablet to their friends, or playing in groups. They were specifically asked not to give any feedback or help to the children playing with the Atlas Mission.

Government schools in India are typically run by the state and cater to children from economically impoverished families. Ramagondanahalli Primary School is in the state of Karnataka and is a Kannada medium school. Children are taught the rudiments of English only from Grade 2 onward, as a second language. Therefore, we decided to enroll Grade 3 students into our study as they met the criteria for inclusion - they had a basic knowledge of English, and they knew the alphabet. A total of 12 children (8 girls and 4 boys) took part in the study. Since they only started learning English as a second language at a later stage, the youngest child in this group was 8 years old and the oldest child was 11 years old. Children are grouped by ability level rather than by age in government schools, hence the wide age range within our participant set. The children had almost no exposure to English in their homes or amongst their peers. All the children were quite familiar with hand-held technological devices.

Design and Testing Procedures:

The study was set-up in the following manner:

Only the literacy games in the Atlas Mission were provided to the children to limit the data collected to a specific learning domain. Two hallmarks of literacy, vocabulary and reading, were the focus of the present study.

The Atlas Mission was modified to allow control over the presentation of the curriculum in such a way as to measure learning outcomes across a relatively short period of time. Instead of the full 60 level literacy curriculum, only 11 levels were included in the study. These levels were pre-selected to reflect a gradual increase in the difficulty of the curriculum words and word families, both in terms of vocabulary and reading. Nine literacy games within the platform were made available to the children, so that they had exposure to different aspects of literacy - the way words are written, the sounds of the words, the phoneme breakdown, spelling and also whole word learning. This ensured that all the children went through a "crash course" of basic English literacy within the period of a month. It is to be noted that the Atlas Mission was set to the British (UK) Accent as this was found to be the closest approximation to the Indian English accent that the children were familiar with.

The tests and the Atlas Mission were installed on several Android tablets. The researchers went to the children's houses/school and conducted preliminary tests to assess their initial vocabulary and reading abilities. The children were then given tablets preloaded with the Atlas Mission. The researchers monitored the children as they played the first level of the Atlas Mission, providing help only when absolutely necessary (for instance, if the child was facing some technical problems with the tablet)). No feedback was given regarding correct or incorrect answers. The

tablets were left with the children, either in their homes or in school, where they had daily access to them. Parents and volunteers were asked to monitor screen time, and to allow a child to play continuously for a maximum of 30 minutes per game session. After a month, the tablets were collected from the children and the researchers administered another test of the children's vocabulary and reading abilities. They also made observations on children's screen literacy and proficiency with the game. A month after this "post-test", the researchers once again administered the same literacy tests to the children (a delayed retention test). This was done to provide information on how well the children remembered the words they had learnt while playing with the Atlas Mission.

The tests conducted in the study fell into two broad categories:

1. Objective tests, wherein specific numerical data was collected that reflected a child's vocabulary and reading abilities before and after playing the Atlas Mission.

a) *Baseline Test:* At the very beginning of the study, a pre-test was administered by the researchers, where children were required to recognise and name (in English) a set of 20 pictures shown to them on a tablet. They were then asked to read out the same 20 words when presented with the written graphemes via a tablet. This established a baseline for each child's vocabulary and reading abilities. The 20 words used in this test were all taken from those included in the Atlas Mission curriculum for this study. This list of words comprised of mainly easy and medium words (3 and 4 letters) and a few hard words (5 letters and above).

b) *Post - Test:* After the month long exposure to the Atlas Mission, the children were given another test of vocabulary and reading. The original 20 words used in the baseline were presented again, both as pictures and written words, and the children were asked to name and read them aloud in English. As the children would have encountered these words within the Atlas Mission, they were now expected to be familiar with them. Additionally, another set of 20 words, also taken from the Atlas Mission curriculum for this study, were given to the children to identify from pictures, and to read aloud from written graphemes. This provided a measure of the learning of new words from the platform. This list of words comprised of a few easy words (3 letters) and mainly medium and hard words (4-5 letters and above). Finally, the children were given a set of 20 unfamiliar written words, taken from the broader Atlas Mission curriculum, but not present within the curriculum for this study, and were asked to read them aloud. This allowed us to measure the ability of children to use the concepts of letter sounds and phoneme blends that they had learned while playing the Atlas Mission to help them read novel words.

c) *Delayed Retention Test:* This test is used as a measure of long term memory stores - how well do children pick up information from the Atlas Mission and for how long after they play with it can this information be retained and recalled? A four week gap was

given between the post-test and the delayed retention test. The retention testing followed the exact same procedure as the post-test, using all the same words. In total, children were asked to name 40 familiar pictures, and read 40 familiar and 20 unfamiliar words.

2. Subjective tests, wherein researchers observed the children as they played with the Atlas Mission and also while they answered the tests. We were interested in recording the methods and strategies employed by children to learn new words and read them aloud. We were also interested in assessing overall screen literacy and how well children were able to understand the gameplay and functions after a certain period of exposure to the game.

Data Analysis and Results

Quantitative Analysis:

Phase 1: Community Pilot

Children's performance on the baseline, post test and retention conditions were plotted as frequency histograms. From this data, observable differences were noticed, where children showed apparent improvements in their vocabulary and reading after playing the Atlas Mission. To quantify these observations, analyses were conducted to measure any significant differences between children's performance before and after playing with the game. It is to be noted that for the purpose of clarity in evaluation, the means have been reported as whole numbers, rounded up or down from the nearest decimal point, as knowing half a word is not possible.
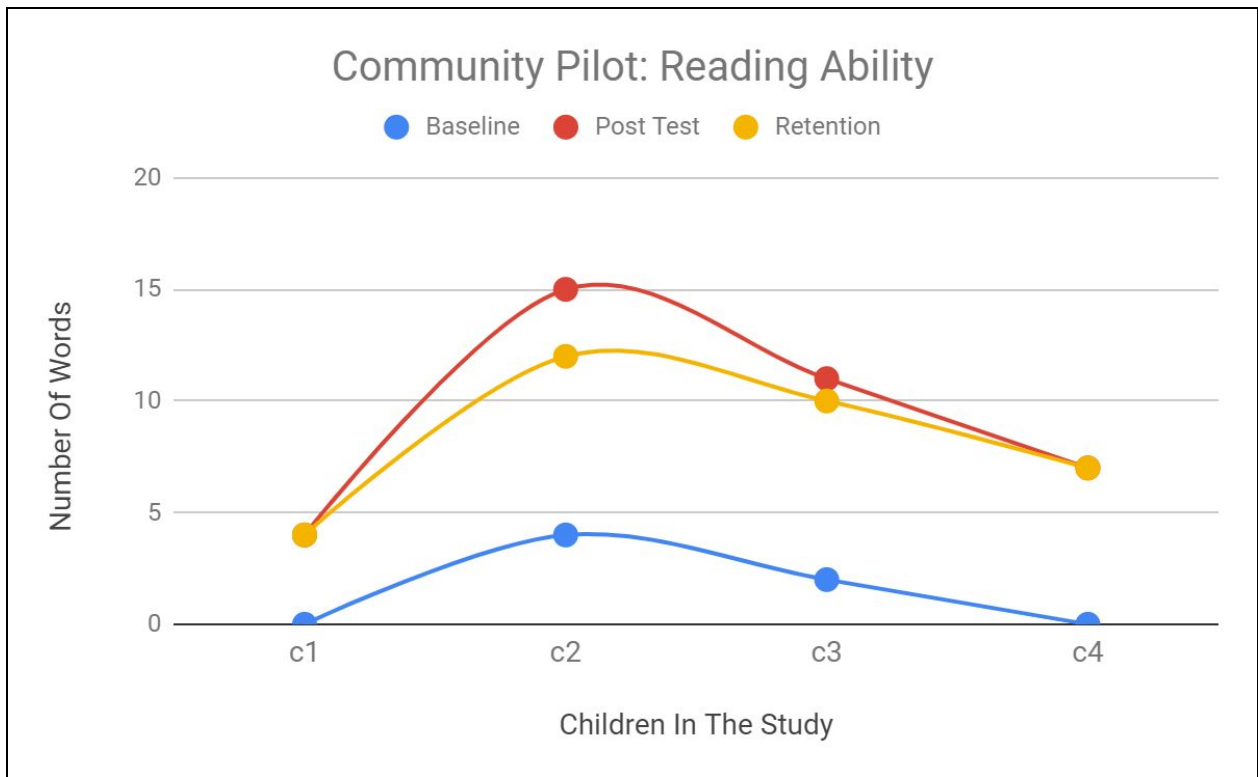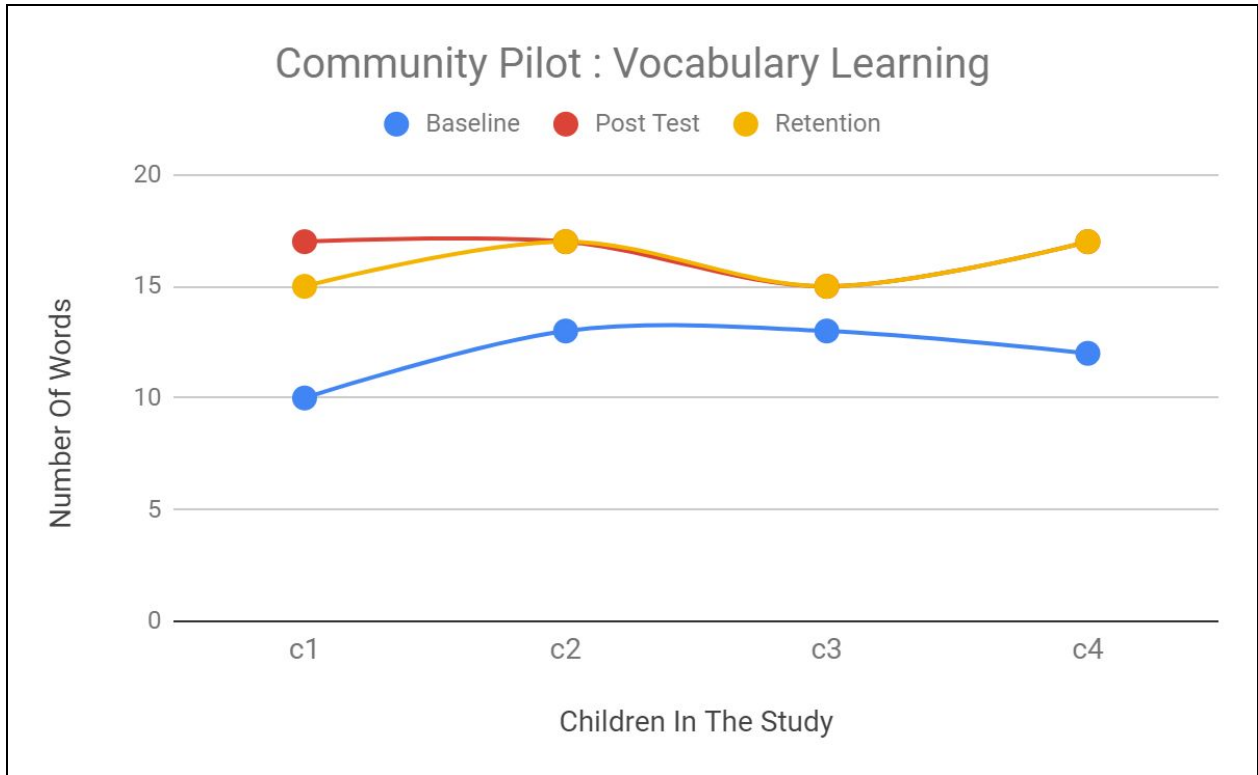
Fig 1.1: Frequency histograms showing individual children's performances on the baseline, post test and retention conditions for vocabulary and reading.

Vocabulary Testing: A one way ANOVA was carried out to compare children's performance on the baseline test versus the post test and the delayed retention test using the same words across all 3 testing paradigms. Pictures were presented to the children and they had to name each word in English. The ANOVA was statistically significant, $F(2,9) = 16.85$, $p < .01$; suggesting that there was a measurable difference between children's performance on the different tests. A further pair-wise analysis revealed that the baseline test scores (*Mean* = 12, *SD* = 1.4) were significantly less than both the post test (*Mean* = 17, *SD* = 1) and the delayed retention test (*Mean* = 16, *SD* = 1.2) scores; $p < .01$. However, no measurable difference was observed between the scores on the post test and the delayed retention test.
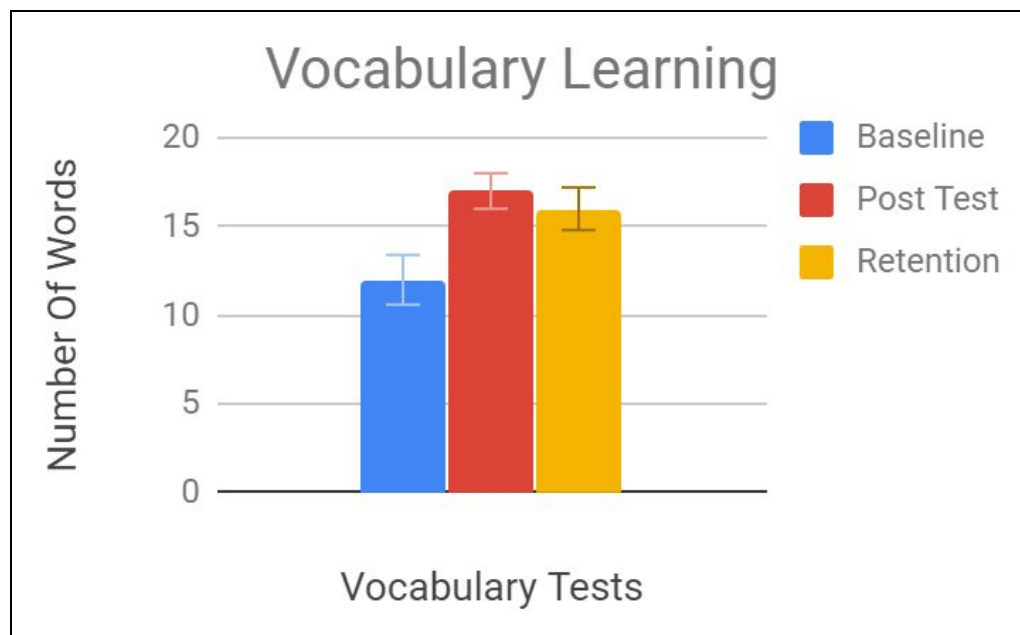

Fig 1.2: Community Pilot - Comparison of baseline, post test and retention conditions for picture - word naming.

The findings indicate that children improved their vocabulary after playing with the Atlas Mission and that this improvement was sustained even a month after they stopped playing with it.

Reading Ability: A one way ANOVA comparing children's reading ability across baseline, post test and retention paradigms, using the same written words found a significant difference; $F(2,9) = 5.49$, $p = .027$; indicating that a measurable difference exists between the 3 conditions. Pair-wise comparisons showed that reading scores for the baseline test (*Mean* = 2, *SD* = 1.9) were significantly lower than those for the post test (*Mean* = 9, *SD* = 4.8) and retention test (*Mean* = 8, *SD* = 3.6) conditions; $p < .05$. No statistical difference was observed between the post test and retention test scores.
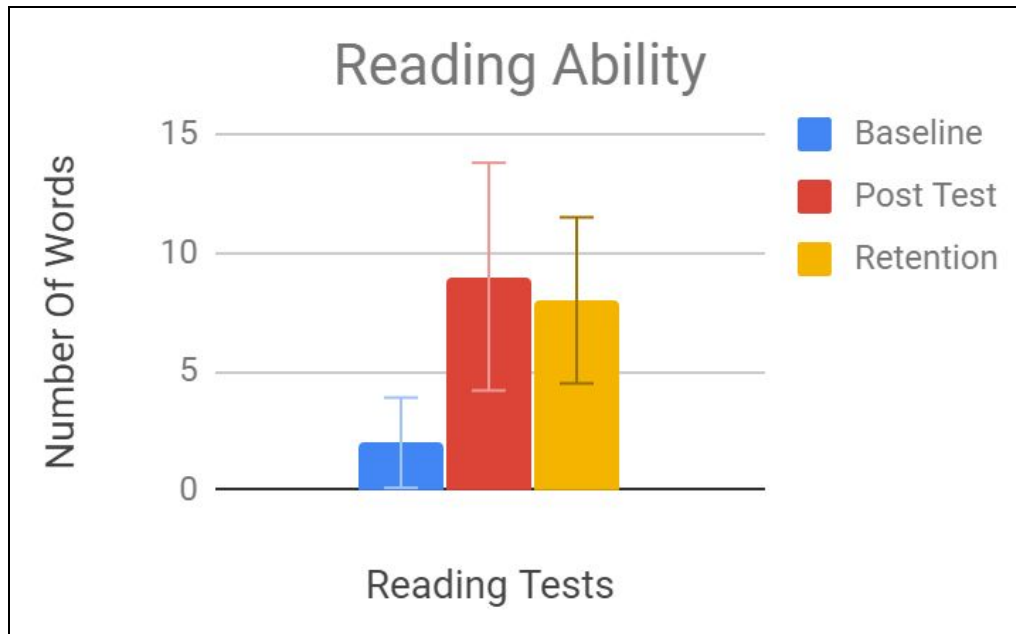
Fig 1.3: Community Pilot - Comparison between baseline, post test and retention for reading ability.

These findings suggest that children's ability to read written words improved significantly from the time they were first tested before engaging with the Atlas Mission, to the time they were tested after a month-long exposure to it. Moreover, children showed the ability to retain this reading skill even a month after they no longer had access to the Atlas Mission.

Learning and Remembering New Words:

A one tailed, paired sample t - test was conducted comparing children's performance on 20 additional post test words and their repeat tests in the delayed retention condition, for both vocabulary and reading abilities respectively. These were words that were part of the study, but were excluded from the baseline test. No significant difference was found between the 2 conditions for vocabulary learning; $t(6) = 0.61$, $p > .05$; (*Post Test Mean* = 13, *SD* = 2.4 and *Retention Mean* = 12, *SD* = 2.2). This indicates that children were able to learn new vocabulary and retain this information over an extended period of time. Similarly, there was no significant difference found between post test (*Mean* = 8, *SD* = 3.6) and retention (*Mean* = 8, *SD* = 3) scores for reading ability, $t(6) = 0.21$, $p > .05$, indicating that children were able to read new words after playing with the Atlas Mission and also remember how to read these words at a later date.
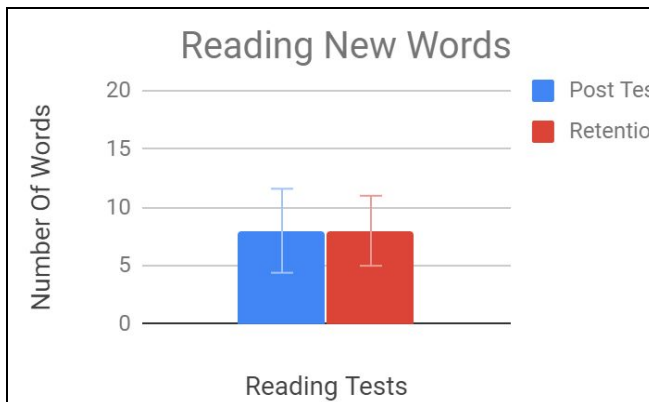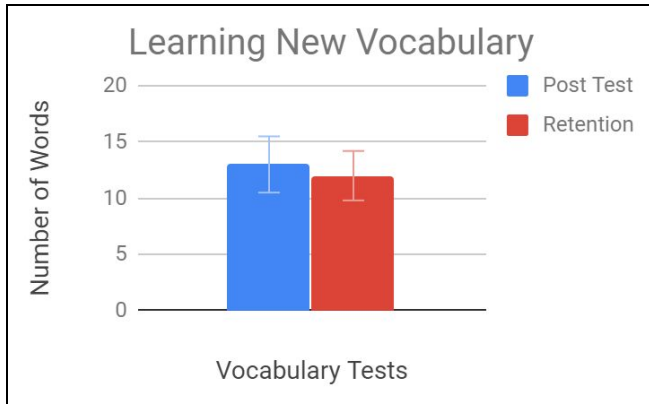
Fig 1.4: Children's performance on vocabulary and reading tests for 20 additional post test words immediately after playing with the Atlas Mission compared with a four week delay after playing with it.

Phase 2: School Pilot

Performance on the baseline, post test and retention conditions were plotted as frequency histograms. Observable differences were noticed, where children showed apparent improvements in their vocabulary and reading after playing the Atlas Mission. Analyses were then conducted to measure any significant differences between children's performance before and after playing with the game. It is to be noted that for the purpose of clarity in evaluation, the means have been reported as whole numbers, rounded up or down from the nearest decimal point, as knowing half a word is not possible.
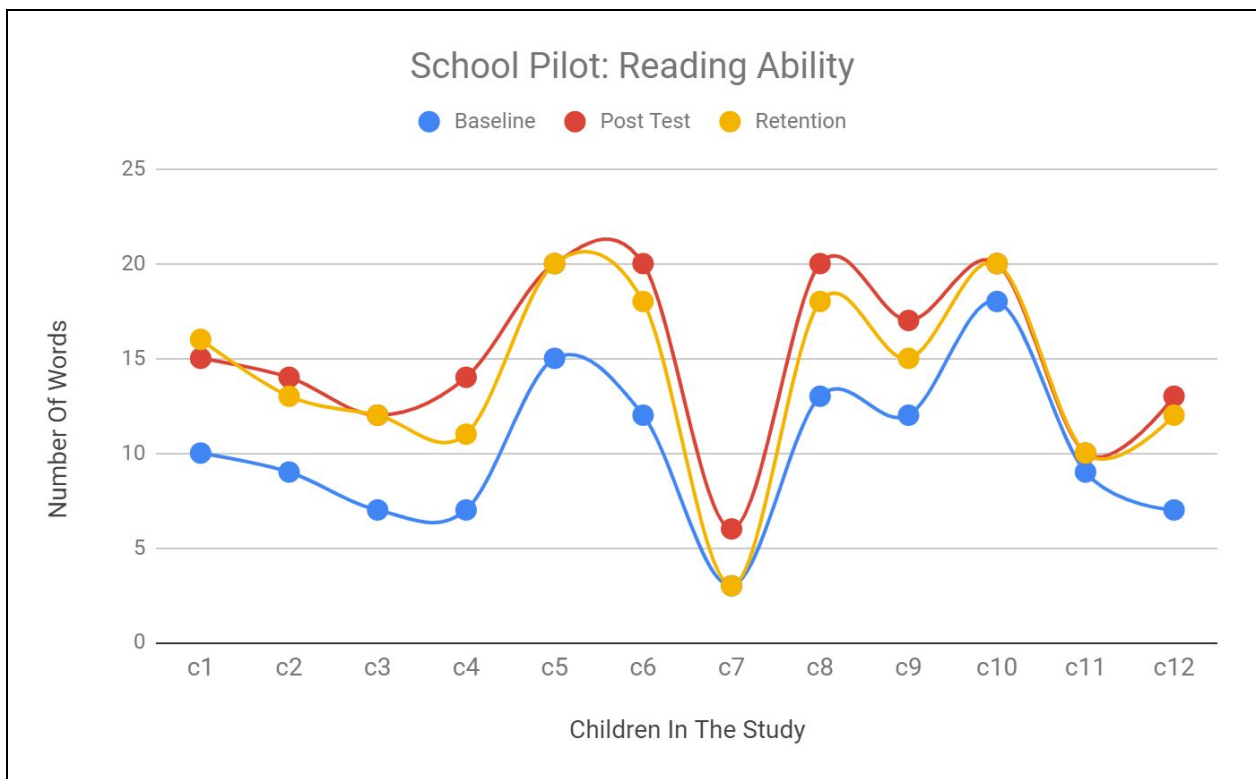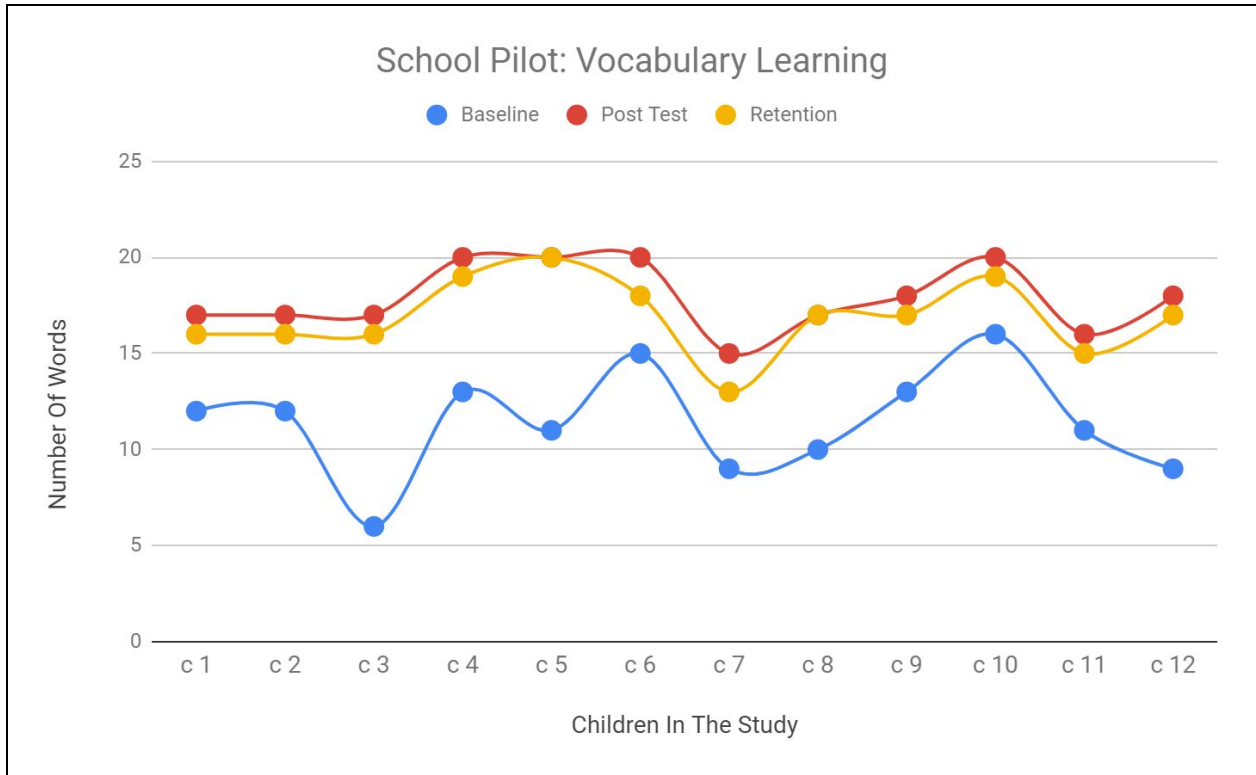
Fig 2.1: Frequency histograms showing individual children's performances on the baseline, post test and retention conditions for vocabulary and reading.

Vocabulary Testing: A one way ANOVA comparing children's performance on the baseline test, post test and the delayed retention test using the same picture - word matches across all 3 testing paradigms was statistically significant; $F(2,33) = 30.95$, $p < 0.01$. This suggested that there was a measurable difference between children's ability to name the pictures across the different tests. Pair-wise analysis showed that the baseline test scores (*Mean* = 11, *SD* = 2.8) were significantly less than both the post test (*Mean* = 18, *SD* = 1.7) and the delayed retention test (*Mean* = 17, *SD* = 1.9) scores; $p < 0.01$. However, no significant difference was observed between the scores on the post test and the delayed retention test.
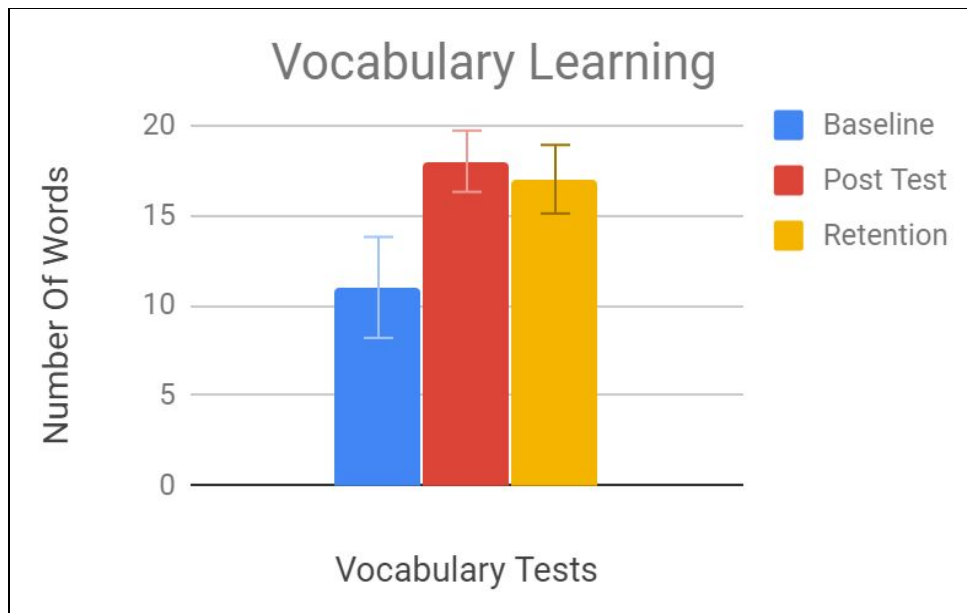

Fig 2.2: School Pilot - Comparison of baseline, post test and retention conditions for picture - word naming.

Reading Ability: A one way ANOVA was used to compare children's reading ability across baseline, post test and retention paradigms, using the same written words. There was a significant difference; $F(2,33) = 3.93$, $p = 0.029$; indicative of a difference in performance between the 3 conditions. Pair-wise comparisons showed that reading scores for the baseline test (*Mean* = 10, *SD* = 4.1) were lower than those for the post test (*Mean* = 15, *SD* = 4.5) and retention test (*Mean* = 14, *SD* = 4.9) conditions; $p < 0.05$. No statistical difference was observed between the post test and retention test scores.
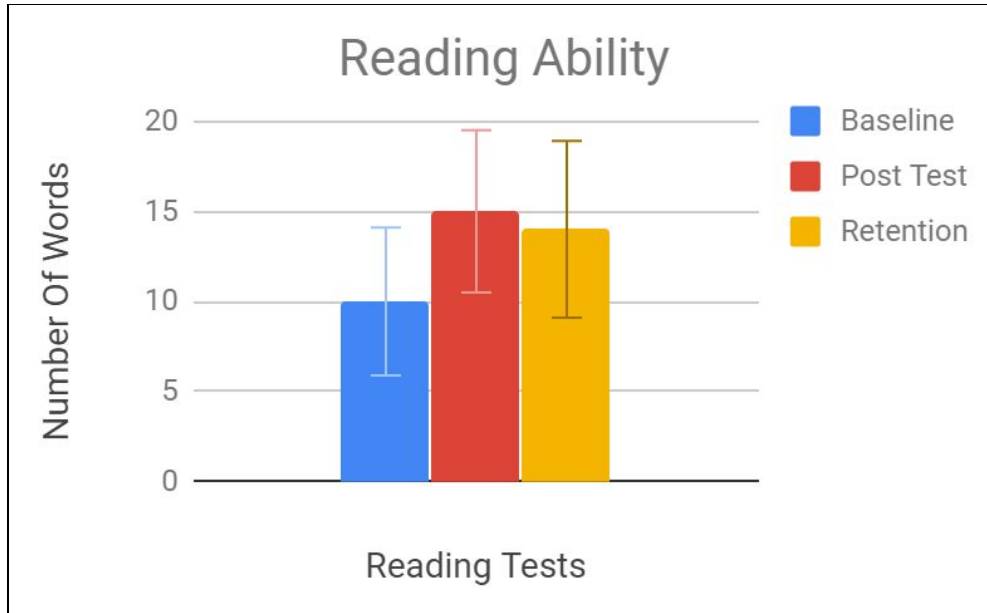
Fig 2.3: School Pilot - Comparison between baseline, post test and retention for reading ability.

The findings from these comparisons indicated that children learnt both vocabulary and reading skills while playing the Atlas Mission and that they were able to retain this knowledge over a period of time after they had stopped playing with it.

Learning and Remembering New Words:

A one tailed, paired sample t - test was conducted comparing children's performance on 20 additional post test words and their repeat tests in the delayed retention condition, for both vocabulary and reading abilities respectively. These were words that were part of the study, but were excluded from the baseline test. No significant difference was found between the 2 conditions for vocabulary learning; $t(22) = 1.12$, $p > .05$; (*Post Test Mean* = 14, *SD* = 2.8 and *Retention Mean* = 13, *SD* = 2.7). This indicates that children were able to learn new vocabulary and retain this information over an extended period of time. Similarly, there was no significant difference found between post test (*Mean* = 12, *SD* = 3.9) and retention (*Mean* = 11, *SD* = 4.5) scores for reading ability, $t(22) = 0.44$, $p > .05$, indicating that children were able to read new words after playing with the Atlas Mission and also remember how to read these words at a later date.
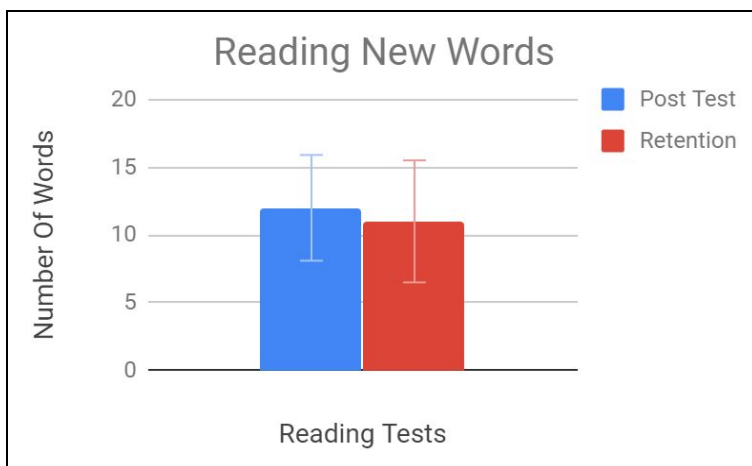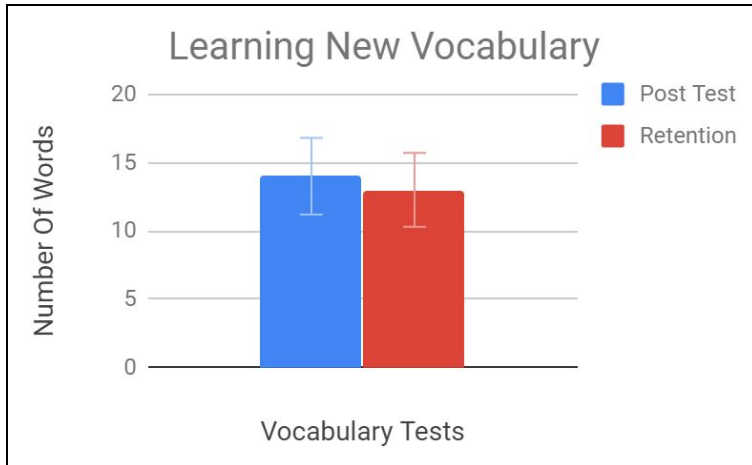
Fig 2.4: Children's performance on vocabulary and reading tests for 20 additional post test words, immediately after playing with the Atlas Mission compared with a four week delay after playing with it.

Qualitative Analysis:

Screen Literacy:

Baseline and Post Test screen literacy was assessed by observing children's initial and final game play sessions.

Initial observations showed that children were often hesitant to actively interact with the screen and waited until they saw a visual prompt indicating the next step in the game play. In the absence of such visual cues, they looked towards the researcher for guidance. Once they figured out the game play however, they were able to keep playing with minimal difficulty. *Tap, swipe* and *drag* interactions were easily learned. They did not understand the English language audio scaffolding and dialogues within the games and completely ignored these cues.

Final observations of children's game play sessions showed that they were very confident with the entire platform, and freely explored the interactive elements inside the Atlas Mission (not curriculum related). Their familiarity with the game play was evident as they were able to navigate through the platform smoothly. No feedback or help was required at any point in time, and the researchers merely passively observed them as they played. They still ignored all the audio cues provided within the games.

Learning Outcomes:

Initial observations were recorded during the pre-test phase of baseline testing. Most children were able to name at least some of the pictures, indicating a basic ability to remember labels for objects, animals etc. (whole word learning). All children tested were familiar with the letters of the English alphabet. However, very few children knew the sounds corresponding to the letters. Their reading ability was restricted to whole word learning, presumably learned through rote in school. If they could not recognise the word as a whole, they were only able to read out the individual letters, but were unable to put them together to form the word.

Final observations were noted during the post test and delayed retention testing phases. Children showed a noticeable improvement in vocabulary, as they were able to name many more pictures that were shown to them (these pictures and their English labels were now familiar to them after repeated exposure within the Atlas Mission). Most children also showed improvements in reading ability, being able to read more of the words in the post test as compared to the baseline test. Crucially, they were now using letter sounds to help them blend the individual letters to form words. When they were presented with unfamiliar words that were not part of the curriculum for this study, they were able to use their knowledge of letter sounds to attempt to blend the letters in the new words, oftentimes being successful in their endeavours. Interestingly, they also picked up non-curriculum words like the names of all the countries visited inside the game - indicating that vocabulary learning was spontaneous.

Key Findings

Overall, children showed significant improvements in both their vocabulary and reading skills when they were tested after playing the Atlas Mission. If we combine the results of both phases of the study, on average, in the vocabulary post-test, children showed a 50% increase in their ability to identify words compared to the baseline test. If they identified 12 words out of 20 in the baseline test, they were now able to identify 18 of those same 20 words in the post-test.

Similarly, in the reading post-test, on average, children showed a 75% increase in reading ability compared to the baseline test. If they were able to read 8 words out of 20 in the baseline test, they were able to read 14 of those same 20 words in the post-test. These gains in vocabulary and reading skills were largely retained after 1 month as demonstrated by the retention test.

What was truly telling was that many children were also using letter sounds to help with their reading, where they had previously been unable to do so. As a result, many of the children who could not blend letters to form words at the beginning of the study, seemed to now be able to use their knowledge of letter sounds and blends to try to read completely novel words.

In addition to the curriculum words that were accessible within the games, children also showed retention of vocabulary that was incidental to the games such as the names of the countries that they encountered in the Atlas Mission. This spontaneous learning was another notable success for the study.

There was also a significant improvement noted in overall screen literacy, with children becoming increasingly confident in their use of the tablets and very efficient while playing the Atlas Mission.

Future Work

The outcome of the study was very encouraging and the children really enjoyed playing with the Atlas Mission as well as benefited from it. This has prompted Whitefield Ready to propose a formal collaboration with the Learning Yogi Foundation in order to take the Atlas Mission to all the schools that they work with as part of their supplementary learning programs.

Additionally, we decided to take the pilot study a step further and introduce it to children living in an orphanage in Bangalore. This study will be aimed at assessing the effectiveness of the Atlas Mission in a "free play" scenario, where children are not restricted from sharing the device with others. The possibility for group learning from the Atlas Mission is intriguing and will be the focus of this new study.

Last, based on the success of this pilot, the Learning Yogi Foundation intends to partner with additional NGOs in order to scale up the impact of the Atlas Mission in India and other countries.

Conclusion

The study showed very positive learning outcomes after children used the Atlas Mission. Children remained engaged with the educational material provided and were able to self-regulate their learning via trial and error. Their subsequent improvements in vocabulary and reading, and retention of newly acquired knowledge, strengthens the view that game-based learning techniques, when implemented well and with the right context provided to children, can be powerful tools for learning. We also gained valuable insights into the viability of using such technology based interventions in social-economically disadvantaged communities and schools in India - it is seemingly possible, at a relatively low cost, to have a significant impact on children's learning behaviours in such communities.

Appendix

Table A: Community Pilot Data

S.No	Age	Baseline Testing		Post Test					Delayed Retention Test				
		Baseline Flash cards (20)	Baseline Words (20)	Repeat Baseline Flash cards (20)	Repeat Baseline Words (20)	Post Test Familiar Flash cards (20)	Post Test Familiar Words (20)	Post test Unfamiliar Words (20)	Repeat Baseline Flash cards (retest 20)	Repeat Baseline Words (retest 20)	Post test Familiar Flash cards (retest 20)	Post test Familiar Words (retest 20)	Post test Unfamiliar Words (retest 20)
1	4 years 8 months	10	0	17	4	10	3	0	15	4	10	4	0
2	5 years	13	4	17	15	13	8	4	17	12	12	6	4
3	5 years	13	2	15	11	13	10	4	15	10	11	10	3
4	6 years	12	0	17	7	16	11	5	17	7	15	10	6

Table B: School Data

S.No	Age	Baseline Testing		Post Test					Delayed Retention Test				
		Baseline Flashcards (20)	Baseline Words (20)	Repeat Baseline Flashcards (post test 20)	Repeat Baseline Words (post test 20)	Post test Familiar Flashcards (20)	Post test Familiar Words (20)	Post test Unfamiliar Words (20)	Repeat Baseline Flashcards (retest 20)	Repeat Baseline Words (retest 20)	Post test Familiar Flashcards (retest 20)	Post test Familiar Words (retest 20)	Post test Unfamiliar Words (retest 20)
1	9 years	12	10	17	15	14	10	4	16	16	13	9	5
2	9 years	12	9	17	14	13	12	3	16	13	13	9	4
3	10 years	6	7	17	12	12	7	3	16	12	13	7	3
4	9 years	13	7	20	14	15	10	5	19	11	14	8	4
5	9 years	11	15	20	20	19	17	19	20	20	17	19	18
6	9 years	15	12	20	20	15	15	6	18	18	15	13	6
7	8 years	9	3	15	6	11	5	0	13	3	11	3	0
8	10 years	10	13	17	20	16	16	14	17	18	13	15	14
9	11 years	13	12	18	17	14	12	6	17	15	10	12	4
10	9 years	16	18	20	20	18	17	17	19	20	17	17	17
11	9 years	11	9	16	10	9	10	7	15	10	8	10	5
12	8 years	9	7	18	13	14	10	5	17	12	11	10	7

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