Using Cell Phones to Improve Language Skills: The Hadeda Project

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Abstract. Language skills are essential for education and economic development. Many countries (especially in Africa) have more than one official language and even more unofficial languages. Being able to express oneself effectively in the written word is required for tertiary education. Unfortunately, cell phones are often blamed for the degradation of language skills. There have been many studies blaming cell phone usage and instant messaging as being responsible for the the lack of language skills of children, teenagers, and young adults. Hadeda is a facility where teachers and parents can create spelling lists for pupils and children using either a cell phone or an internet based workstation. Hadeda then generates a fun and enjoyable cell phone midlet (computer program) which pupils and children can download onto their personal cell phone. Hadeda pronounces the words with electronic voices and the pupils and children can then practice their spelling on a medium they enjoy.

Keywords: cell phone, spelling, language

1 Introduction

Language skills are essential for economic development. It has been shown that language skills have a direct impact on the employment and earning capabilities of individuals. This has been shown to be true in English[1] and non-English speaking countries[2] and in both first world and third world countries.

Unfortunately, the cell phone has been blamed for the degradation of language skills[3]. Teachers have lamented the lack of spelling skills with pupils who use cell phones, SMS (often called 'texting' in some English-speaking countries), and instant messaging[4].

Hadeda is an attempt to use the cell phone to help improve language skills. It is a facility which allows teachers and parents to create spelling lists in more than one

human language. Hadeda then generates audio clips for the spelling words and packages them into a downloadable cell phone application (or midlet). The pupils and children can then download the midlet onto their own phone and practice their spelling.

Hadeda is named after the Hadeda Ibis bird which is found throughout the grasslands and savannas of Africa[5]. It is a raucous, noisy bird making a distinctive haa-haa-haa-haaa-de-da sound. The name is appropriate for a cell phone application or midlet which makes lots of noise.

2 The Landscape

The cell phone is seen everywhere in Africa. Reports vary as to cell phone penetration on the African continent. The fact that cell phones are shared within a family, however, support the allegation that penetration is high[6].

Quality education, skilled teachers, school rooms, textbooks, paper and pencils, however, are not ubiquitous in Africa.

The question we originally asked was "Can the cell phone be used effectively in education?" Previous work we had done in using cell phones and mobile instant messaging to assist in mathematics education[7][8][9] was successful and encouraged us to now look at the potential use of cell phones in language education.

South Africa has a foot in both the first world and the third world – as does the rest of Africa. Teachers in private schools and government schools in middle class suburbs complain that cell phone spelling and instant messaging are destroying the English Language. While at the same time, pupils in rural schools often do not have competent English teachers.

Yet in both environments, the private school and the rural school, cell phones could be found.

Although the cell phone is everywhere, the capabilities of the cell phones vary. If Hadeda is to be successful, it must take into account the wide range of facilities offered on cell phones.

3 Overall Design of Hadeda

Hadeda consists of two major sections.

The first section is an internet website designed so that it can easily be accessed on a cell phone using either the cell phone browser or Opera Mini. This internet website allows teachers and parents to type in a list of spelling words. The website will then

generate audio files of the words using an electronic voice. It will then package the electronic voices with the classes of a Java midlet and publish the midlet or Java application on the internet.

The second section of Hadeda is the Java midlet itself. The pupils will then download the Java midlet onto their personal (or their family) cell phone. The midlet will then speak to them their spelling words and the pupils or children will have to type in the spelling words on the cell phone keypad. Correct spelling will reward the pupils or children with a recording of the Hadeda shouting haa-haa-haa-haaa-de-da. Figure 1 shows a pictorial description of Hadeda.

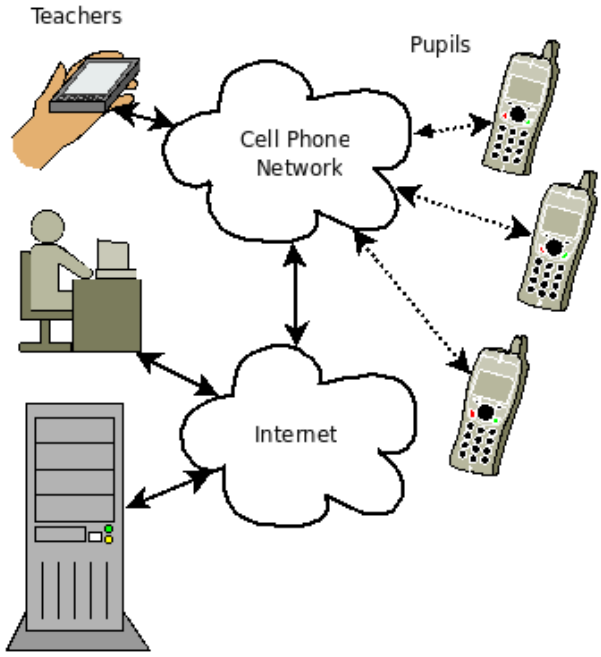

Figure 1: The dotted line on the pupil cell phones is to indicate the temporary nature of that connection. It is only needed when the midlet is initially downloaded onto the cellphone.

A technical discussion of how this was achieved is discussed below.

4 Internet Website

The Hadeda internet website was created using a variety of open source and free tools.

The Tomcat servlet container was used for the teacher or parent side of Hadeda. It allows teachers or parents to login, create workspaces, and create spelling lists. The

default Tomcat MemoryRealm was used for login security.

Java FreeTTS was used to generate the audio for English language words. The indigenous African voices (currently only isiXhosa although more will be available soon) are generated by a text-to-speech software developed at Meraka Institute (more specific detail on the indigenous voices is in section 9 below). Espeak was used for the similar purpose with the remaining languages (Afrikaans, Swahili, and all of the European languages). All three of these synthesizers generated WAV format audio files. WAV format, however, is not supported on all cell phones. In addition the WAV files generated by the synthesizers were often 5K for a simple two syllable words.

A combination of Sox and the AMR Codecs was used to convert the WAV format into AMR format which is playable on the majority of cell phones. Recordings of simple words such as “apple” were nearly 5.3K in WAV format and a mere 594 bytes when in AMR format. In view of the fact that midlets or Java cell phone applications have a size limitation, keeping the audio files as small as possible was important.

Once the Java midlet was generated, the Apache webserver was used to actually feed out the midlet to the pupils.

5 Java Midlet

The Java Midlet framework was originally developed using Sun's Wireless Toolkit. A collection of free or open source icons, images, and sounds were incorporated into the midlet to make the midlet enjoyable for children.

Specific care was taken to ensure that the midlet would run on a wide variety of cell phones including phones which had limited facilities. The midlet would internally query the phone on which it was running to find out the phone's facilities.

All images and icons were converted to PNG format. Although many modern phones can display images in JPEG and GIF format, it is not universal.

For Hadeda to be successful in helping children and pupils improve their language skills, it had to run on a wide variety of cell phones.

Figure 2 shows a typical cell phone running Hadeda.

6 Connectivity, Airtime and Costs

Throughout the design and implementation of Hadeda, an attempt was made to keep the costs to both the teachers and to the children to an absolute minimum.

Teachers or parents need to either be connected to the internet via an internet based

workstation or via their cell phone in order to create the spelling lists.

Pupils or children need to be connected to the internet via their cell phone in order to download the midlet. Depending on the pupils' specific phone facilities, it could also be possible to send the midlet to the pupils' phones via BlueTooth. Thereafter, children or pupils could practice their spelling lists without incurring any additional airtime costs.

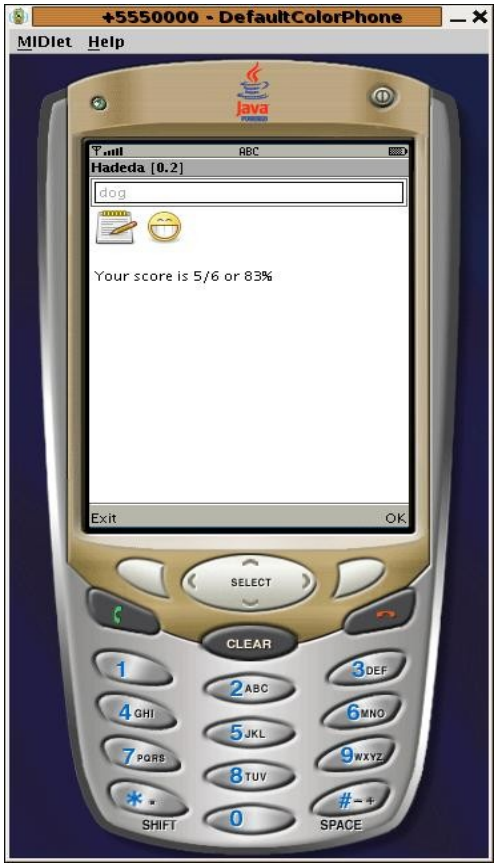

Figure 2: A typical cell phone screen

Typical internet costs for cell phones in South Africa are R2.00 (approximately thirty US cents) per megabyte. Typical sizes of spelling lists with 20 words with two syllables were under 100K giving a cost to the pupil of 20 South African cents (or approximately 3 US cents) to download the Java midlet.

The children would not incur any additional airtime costs after the spelling list midlet was downloaded onto their phones.

7 Ethics and Safety

Throughout the design and development process, we were continually aware that it would be minor children (some as young as 5 years old) who would be the end users of Hadeda. From the initial conception of Hadeda, the safety and well being of these children was paramount.

There were three important safety issues which we addressed

1. Teachers and parents who wanted to generate spelling lists needed to contact the authors of this paper in order to get permission to use our internet website. This was necessary because we did not want unsavoury adults to create spelling lists which had vocabulary which were not appropriate for minor children.
2. Any teacher or parent who abused this authority and generated spellings lists which were not appropriate could be easily removed from our server.
3. No personal information about the minor children was stored on any of our servers. While the pupil or child was, in fact, running the Hadeda midlet application on their phone, a running score or total was kept on the phone. This score, however, was removed when the midlet was finished.

8 Educational Issues

We have based our research on the extended activity framework [10] adapted from Engestrom's [11] extended activity model. From this our aim has been to support the activities of educators in their endeavors to teach or facilitate, and students in their endeavors to learn.

The drill and practice of spelling lists is founded in the Behaviorist theory. Greeno, Collins and Resnick [12] cluster this under the assumption of "learning as activity." Kearsley [13] identifies three fundamental principles common in behaviorist learning:

1. Positive reinforcement
2. Learning in small manageable blocks
3. Generalization of learning can produce secondary conditioning

Hadeda has incorporated these implicitly in its design and explicitly as a desired outcome in that fluency in spelling could produce secondary results in literacy. The learner is encouraged to drill and practice by presenting the spelling list with technology that they are familiar with and that is personal and motivational. The amount of words is limited to 20 to enable learners to complete a cycle in a relative short amount of time. The predictive spelling feature can support learners additionally in early stages of the practice.

Hadeda, as the result of the mobility of the technology, will facilitate group work as a face to face exercise in class context or individually as reinforcement.

9 Indigenous voices

The implementation of the isiXhosa audio voice clips is based on work done by the Human Language Technologies research group at Meraka Institute. This relies on a number of core language resources and tools including:

- Data resources:
  - Text corpora
  - Speech corpora
  - Pronunciation models (in the form of grapheme-to-phoneme conversion rules) developed by using the Default&Refine algorithm [14] implemented in the DictionaryMaker software package [15].
- Software modules:
  - Natural language processing modules (e.g. language specific syllabification algorithms).
  - Synthesis engine (a modular synthesis framework and engine designed for multilingual environments named Speect [16] is used).
  - System development tools (software including automatic phonetic alignment capabilities optimized for scarce resourced environments [17]).

These resources and software modules are especially suited to developing technologies in resource scarce contexts such as South Africa.

The synthesizer uses the unit-selection synthesis approach and consequently the voice has a quality similar to the speech corpus it is based on. The runtime system follows the client-server model where the client sends a synthesis request including a language designation to the server which responds; synthesizing a waveform by applying the following the basic processes:

1. Text processing
2. Linguistic analysis
3. Waveform synthesis

In the case of this application all input is in the form of single words, thus this process reduces to grapheme to phoneme conversion, syllabification and unit selection and resynthesis from the acoustic database.

10 Pilots

Hadeda has had two formal pilots. The first was an English home language pilot in an English language primary school. The second was a German second language pilot in an English language secondary school.

The first pilot was at a private English speaking primary school in the North West province of South Africa. The school had a policy in place where children could bring

their cell phones to school during the day but could not use them during school hours. The pilot was held at the end of the academic school year in South Africa and the school relaxed their cell phone policy for this pilot.

A number of technical issues were encountered during this pilot and Hadeda was modified to cater for these issues. These included:

1. A number of extremely old cell phones could not play any type of sound file. The pupils, however, were extremely enthusiastic and we modified Hadeda so that these pupils could view the spelling word on the screen for a few seconds. Hadeda would then erase the spelling word from the screen and the pupils would have to type in the spelling word on the cell phone keypad. This is similar to the old "pencil and paper" drill of practicing spelling words but just using a different medium.
2. A number of phone could not handle the diacritical marks on letters in words such as the Afrikaans "môre" or "sê". We discovered that such cell phones did not have the appropriate character sets loaded. We again modified Hadeda so that it would test the cell phone to see if the appropriate character sets were loaded. If not, the pupil could still type in the correct letters (without the diacritical marks) on the cell phone and Hadeda would print a large warning sign indicating that the diacritical marks were missing.

We also encountered a number of "softer" issues which were unrelated to the technicalities of Hadeda. These included:

1. Pupils are extremely attached to their cell phones. Many often view the cell phone as a part of themselves. A number of pupils felt embarrassed when Hadeda did not originally execute properly on their personal phones. One child actually cried when Hadeda would not run on her phone (although we did manage to get it running the next day). In future pilots, we will have some spare phones available for pupils to use in such cases.
2. Pupils are good at "viral marketing". During our original pilot, only a handful of pupils came to the first day of our pilot program. But as they told their friends about the pilot, more and more pupils arrived with signed consent forms and took part.
3. Older participants are always willing to help younger participants to configure their cell phones. In future pilots, we may consider having a pre-pilot day to just train older pupils on the use and let them train the younger pupils the subsequent days.

Our second pilot was at a German second language class in an English speaking private secondary school. The only problem we encountered during this pilot was the use of the ß letter in German words. Our software mistakenly allowed pupils to type in the letter B instead of two s letters on cell phones which did not have the proper character sets loaded.

11 Conclusion

Preliminary results from informal testing indicate that Hadeda may have a positive impact on language skills learning; however, firm conclusions will not be available until after additional educational pilots.

12 The Way Forward

At the time of writing this paper, Hadeda can generate vocabulary spelling lists in English, French, Portuguese, German, Afrikaans, Swahili and isiXhosa. The basic technological framework allows other TTS voices to be used. In the near future we will be implemented another of South African's official languages developed by the Human Language Technologies research group at Meraka Institute.

References

1. C Dustmann and F Fabbri, "Language Proficiency and Labour Market Performance of Immigrants in the UK," *The Economic Journal,* volume 113 issue 489 , pp 695-717
2. S. Rendon, "The Catalan premium: language and employment in Catalonia," *Journal of Population Economics*, Springer, volume 20(3), pp 669-686
3. E Yanzon, "Does Text Messaging Affect the Spelling Skills of Students?" *Far Eastern University English Language Journal,* Volume 1, pp 33-37
4. N Baron, "Instant Messaging and the Future of Language," *Communications of the ACM,* Volume 48 No 7, pp 29-30
5. G Maclean, *Roberts Birds of Southern Africa, Fifth Edition,* CTP Book Printers, Cape, 1984, p 74
6. M Ford, J Batchelor, "From zero to hero – is the mobile phone a viable learning tool for Africa?", 3rd International Conference on Social and Organisational Informations and Cybernetics, SOIC 2007, Orlando, USA, July, 2007, pp 7
7. L Butgereit, "Math on Mxit: The Medium is the Message", 13th Annual National Congress of the Association for Mathematics Education of South Africa, pp15
8. L Butgereit, "Dr Math Rocks! Using Instant Messaging to Help Pupils with Mathematics Homework," IST-Africa 2008, Windhoek, Namibia
9. L Butgereit, "Thumb Tribe Math Wars!", 14th Annual National Congress of the Association for Mathematics Education of South Africa
10. A Botha, J Traxler, L Marques, C Isias Sedona, E Sutinen, "More than Mobile", IST-Africa 2008, Windhoek, Namibia

11. Y Engestrom, “Learning by Expanding: An Activity-Theoretical Approach to Development Research,” Helsinki, Orienta-Konsultit Oy.
12. J Greeno, A Collins, L Resnick, “Cognition and Learning,” *Handbook of Educational Psycology*, NY Simon & Schuster MacMillan
13. G Kearsley, “Explorations in learning and instruction: The theory into practice database,” http://tip.psychology.org, retrieved March 14, 2008
14. M. Davel and E. Barnard, “Pronunciation Prediction with Default & Refine”, Computer Speech and Language, Vol 22, pp 374-393, October 2008.
15. M. Davel and E. Barnard, “DictionaryMaker” software available for download from http://dictionarymaker.sourceforge.net
16. J.A. Louw, “Speect: a multilingual text-to-speech system,” in Proceedings of the Nineteenth Annual Symposium of the Pattern Recognition Association of South Africa, Cape Town, South Africa, November 2008, pp. 165–168.
17. D.R. van Niekerk and E. Barnard, “Phonetic alignment for speech synthesis in under-resourced languages,” in INTERSPEECH, Brighton, UK, 2009, pp. 880–883.