

Development of a Web-based multilingual resource for equal access to ICT education in South Africa

Lorenzo Dalvit, Sarah Murray, Alfredo Terzoli, Xiaogeng Zhao.

Corresponding author: L. Dalvit, room 213, Hamilton Building, Rhodes University PO Box 94, Grahamstown 6140, South Africa. E-mail: g01d0010@ru.ac.za

Abstract: This paper describes the needs analysis and the development of an application designed to provide access to ICT education to speakers of an African language with low English proficiency. The focus group of our research are speakers of an African language who are also foundation students of Computer Science at Rhodes University, in South Africa. The statistical analysis of the academic longevity and performance of speakers of an African language in the field of Computer Science at Rhodes indicates that many students are disadvantaged by their lack of English proficiency. A preliminary investigation carried out with questionnaires and interviews suggests that students support the production of resources using both English and the African language. The purpose of our project is to help speakers of an African language cope with the use of English as a medium of instruction and to improve communication and organisation in the classroom. In line with South African governmental policy, our goal is to give a larger number of speakers of an African language the opportunity to study Computer Science confidently and successfully from the very beginning of their academic career. This will give them a basic computer literacy and a better chance to cope with more advanced courses.

Index Terms: African languages, bilingual education, Computer Science education, ICT education.

1. INTRODUCTION

In this paper we describe the needs analysis, the development and the features of a Web-based tool designed to assist speakers of an African language from a disadvantaged background in learning Computer Science at university level in South Africa. Webb and Kembo-Sure (2000) indicate that 80% of the African¹ population of South Africa has a

¹ In spite of the tendency of many individuals of European descent but born in Africa to consider themselves African, here the term will be used to refer to individuals classified as “blacks” under

very basic or no knowledge of English at all. As a legacy of Apartheid's education policy, the average level of English proficiency among African students from the rural areas or township schools is also low. This is clearly a disadvantage in an education system which, especially at university level, functions predominantly in English. The implementation of the tool is intended to fill the language gap and thus help to bridge the ICT divide that still separates the previously advantaged and the previously disadvantaged communities in South Africa.

Our work focuses on speakers of an African language who are also students of Computer Science at Rhodes University, a traditionally English-medium South African institution. In particular, our preliminary investigation explored the problems encountered by first-year students. Among these, the target group for our intervention are students in the foundation course of Computer Science (CSc1B). These are students with recognized academic potential but from a disadvantaged background, and they are required to take a foundation year before they can carry on with mainstream courses. They are all speakers of an African language and only a small minority of them attended schools for speakers of English as a first language. We feel that providing students in this course with linguistic and organisational support would provide them with a better understanding of the basic concepts, give them a better chance to cope with more advanced courses of Computer Science up to postgraduate level.

We will start with a description of the broader context of our research. We will then discuss the findings of our preliminary investigation and the problems encountered by students, which motivated and shaped the creation of the tool. We will then provide a brief description of the tool and of the practical aspects connected with its development. Finally, we will summarise the work done so far and define a framework for the implementation of our resource.

2. THE CONTEXT

2.1 *Historical context*

Since the end of Apartheid, South Africa has been engaged in a process of social reconstruction. Prior to 1994, the only official languages in South Africa were English and Afrikaans.² African languages had official recognition only in the *homelands*.³ In the urban areas of Apartheid South Africa, Africans lived in designated areas called *townships*. The education system was racially segregated and the *Bantu Education Act* of 1953 regulated the education of individuals classified as "blacks". African students received instruction in their mother tongue for the first phase of their education. After that, only English and Afrikaans were officially used up to university level to teach all subjects but the African languages themselves. The bad quality of teaching and severe underfunding ensured that African students could not gain a good level of proficiency in English and were excluded from the study of technological subjects.

Apartheid, consistently with the terminology currently used in South Africa.

²Afrikaans is a West Germanic language derived from 17th century Dutch. It is now spoken by a section of the "white" population and by the majority of the "coloured" population.

³ Under Apartheid, any of the semi-autonomous countries within South Africa in which individuals classified as "blacks" could claim citizenship and permanent residence.

2.2 Present situation

According to Heugh (2000), little has changed since the end of Apartheid in 1994. The average level of English proficiency within the African community is still comparatively low. For this reason, in many rural area and township schools students are still taught in their mother tongue, in spite of the official language policy which (in most cases) prescribes the use of English as the sole medium of instruction.

Many African students are unprepared when they enrol at university, both from an academic and a linguistic point of view. As pointed out by Dlamini (2001), such students are disadvantaged compared to English speakers. On top of that, many South African students with a disadvantaged background have no experience with computers and, in some cases, have little experience with any kind of technology. Therefore, they need additional support to cope with the study of technological subjects such as Computer Science at university level.

2.3 The CSc1B course

The South African Government has recently encouraged traditionally “white” institutions to increase the possibilities of access to tertiary education for African students (NCHE 1996; CHE 2001). Like other universities, Rhodes runs a foundation year course designed to prepare members of previously disadvantaged communities for studying at tertiary level. Students in this course are all speakers of English as a second language who would not normally meet the entry requirements for Rhodes but have academic potential. During the foundation year, students attend a course of academic English and some preparatory courses in the subjects they intend to study.

The foundation course in Computer Science (CSc1B) is designed for students who need a basic computer literacy as well as those who intend to continue their studies in Computer Science. Since most students have little or no experience with computers, a hands-on approach is taken and all lectures and practicals take place in a computer laboratory from the very beginning. The content of the lecturer’s screen is displayed on a bigger screen and makes it easier to follow explanations. Five tutors are available to answer the questions of the students and to assist them on request.

3. PRELIMINARY INVESTIGATION

Two different studies informed and motivated the development of our resource. The first was a statistical analysis of the results and academic longevity in Computer Science at Rhodes. The second was a survey of the language attitudes of first year students of Computer Science.

3.1 Statistical analysis

The first preliminary study focused on the difference between the academic longevity and performance of speakers of an African language as opposed to speakers of English. Special attention is paid to students from a disadvantaged background and in particular to those who have been through the foundation program.

Table 1 shows the number of enrolments in various years of Computer Science in

the past six years. It reports the figures for all South African⁴ students, for English speakers and for speakers of an African language. To distinguish between the last two groups we relied on the language chosen as a first language in the matriculation exam rather than the home language. The former is in fact a good indicator of the school background of the students and allowed us to select students who attended rural areas and township schools. Among these, the figures for foundation students have been highlighted in the bottom row.

Table 1: Number of students in various years of CS in the period 1999-2004

	1st	2nd	3rd	Honours	Masters	PhD	Total
All South Africans	5211	772	641	102	78	16	6820
English L1	3446	565	465	83	48	13	4620
African language L1	781	81	88	1	2		953
Foundation	275	17	7				299

Table 1 shows that speakers of an African language from a disadvantaged background are still a minority (14%) in Computer Science. The percentage of students who attended the foundation course clearly decreases over the years. It is interesting to note that speakers of an African language are severely underrepresented among postgraduates. This can be explained looking at the average marks for this group of students.

Table 2: Average mark in various years and for Honours in the period 1999-2004

	1st	2nd	3rd	Honours	Total
All South Africans	65%	61%	60%	73%	64%
English L1	67%	62%	62%	73%	66%
African language L1	56%	54%	51%	62%	56%
Foundation	60%	56%	52%		60%

As shown in Table 2, speakers of an African language perform poorly compared to English speakers in all years of study. In particular, a generally poor performance in the Honours course stops most of them from continuing into Masters.

Table 2 also suggests that the hands-on approach followed in CS1B gives students from a disadvantaged background a better chance to perform well in the following courses. Their average mark is in fact higher than for other speakers of an African language, both in second and in third year. With our application we intend to explore the full potential offered by the use of computers in the classroom, a distinctive feature of the foundation course.

3.2 Survey

A survey of the language attitudes of 59 speakers of an African language who were also first year students of Computer Science (both in the foundation and the mainstream course) at Rhodes was carried out in the first semester of 2004. The methods used were questionnaires and interviews.

⁴ Given the peculiar nature of the South African education system, it would have made little sense to compare South Africans with students from other countries.

The survey revealed that, in spite of positive attitudes towards English as the dominant language in tertiary education and in the field of Science and Technology, students thought that African languages should get more recognition. At least half of the sample, in fact, was in favour of the use of support material and resources in both English and the African languages. The main reason was that using the students' mother tongue would help them understand things better, without hampering their ability to function in English.

The interviews with students, tutors and lecturers highlighted some of the problems encountered by speakers of an African language in their first year of Computer Science. CSc1B students showed an enthusiastic support for the development and implementation of a Web-based resource like the one described in the present paper. The interviews also informed the process of development of our resource.

4. THE PROBLEMS

4.1 Language Problem

As noted by Halliday and Martin (1993), one of the main obstacles for science students (both first and second language speakers) seems to be terminology. Apart from the obvious difficulties in learning acronyms and technical terms referring to new and unfamiliar concepts, noted by Dlamini (2000), CSc1B students appear to struggle with more common English words, such as *buffer* or even *drag*. This has two sets of consequences. First of all, it prevents them from understanding simple instructions and keeping up with explanations and required tasks. Secondly, it forces them to do a lot of memorisation and may even lead them into false conclusions. For speakers of English as a second language many terms used in Computer Science (such as *monitor*, for instance) do not possess a whole *semantic cloud* (i.e. the set of concepts, ideas and meanings attached to a word, that connects it with similar or related words and relevant experiences) that makes their meaning intuitive and easy to remember. The meaning of such words must therefore be guessed from the context of use and they must be remembered as "magic formulae" (something similar to using random combinations of letters as variables in programming). In other words, as pointed out by Sweetman-Evans (2000), when studying in a second language, most students are unable to integrate new knowledge into their knowledge structures and simply memorise the information passed on to them. In addition to that, some students seem to think that some common English words, such as *metaphor* for instance, are computer-related technical terms simply because they meet them only in that context.

Consistently, interviews with lecturers, tutors and students suggest that, no matter how simple the level of English, there are concepts that some students can understand only in their mother tongue. In the interviews students claimed that it is easier to understand something in their mother tongue, and that such knowledge can later be translated into English. Heugh (2000) indicates that code-switching between English and an African language is a common practice in many rural and township schools, and evidence suggests that it takes place also at tertiary level (Dalvit 2004). We therefore thought that it would be useful for the students to have access to a resource that could provide definitions and explanations of difficult words both in simpler English and in their mother tongue, a sort of glossary.

4.2 Organisation and Communication Problem

A second problem emerged during an interview with one of the tutors. She noted that, in classroom practice, it was not uncommon for several students to lag behind because of the same problem without the lecturer realising it. This problem could be easily solved by promoting communication within the classroom between students, tutors and lecturers. In this way, students who have finished their task or understood an explanation and have time at their disposal can help others, and it is easier for lecturers to monitor the difficulties encountered by the students and pace themselves accordingly. A chat-room feature should be appropriate. In addition to that, a sort of newsgroup can be used for communication outside class.

5. DESCRIPTION OF THE TOOL

Access to the resource is restricted to CSc1B students, tutors and lecturers only. Users are expected to log in with their name (for teaching staff) or student number as username and a password. The login page is connected to a database, which automatically detects the mother tongue of each user to inform the process of information retrieval in the glossary feature. The resource keeps track of frequency and time of log in for each student. The three features (chat room, online glossary and knowledge base/newsgroup) are instrumented to inform the development of the tool itself as well as future research.

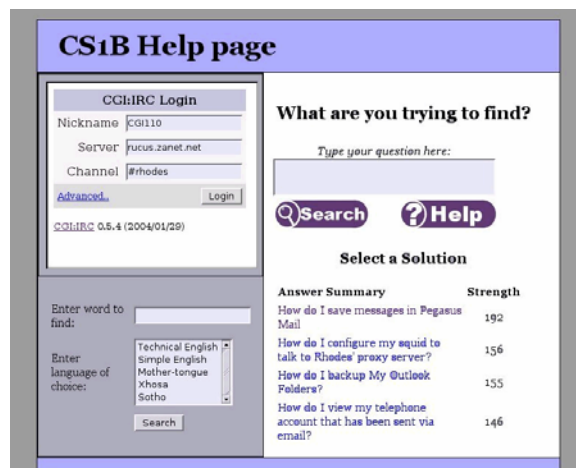


Figure 1: Main page

5.1 Chat Room

With this feature students can communicate with each other during lectures and practicals. Reliance for help on the persons sitting nearby, which classroom observation indicates being the first “port of call”, can therefore be extended to the whole class. In this way, students who have time at their disposal can assist others, either in English or in an African language. The students’ number/username, displayed next to what they type, should be anonymous enough for them not to feel shy about asking questions but would also make it possible to track someone who is misusing the tool (chatting about private matters, for instance).

Tutors can answer at least some of the questions from one of the machines in the

laboratory. This allows them to work more efficiently and save some of their time. Lecturers have the Web page on their screen during lectures. This makes it possible for them to see the kind of questions students are asking, thus getting a better feeling of the problems. Moreover, the lecturer notices immediately when several students are asking the same question, and can slow down or repeat.

An optional feature related to the chat room could be a button that students could click when the question they want to ask has already been asked by someone else. This would highlight which problems are common to more than one student. The text that appears in the chat room is recorded for future research, as it could help to inform the development of the course. Recording also make it possible to track students who misuse this resource.

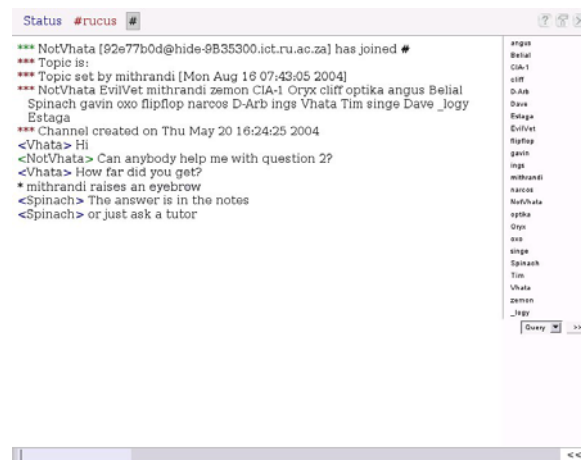


Figure 2: Chat room

5.2 Online Glossary

The second feature works very much like existing online dictionaries (Webster's, 2004; O'Kennon, 1996; Schryver and Joffe, 2004). It is possible for students to choose between an explanation in technical English, one in simple English and one in various African languages. Explanations in technical English are readily available on the Internet (High-Tech dictionary, 2004; Webopedia, 2004), while explanations in simpler English and in the African languages can be produced by the students themselves under the appropriate supervision (see Ramani and Joseph 2002).

Given the difficulties many speakers of an African language encounter with the written variety of their mother tongue (see Barkhuizen 2001), an interesting option is to record an audio explanation as well, produced by a native speaker competent in Computer Science. The audio can be streamed from the database to the machines on which students are working, and they can listen to it with headphones (see Discovering computers 2002 for an example with English). Keeping track of the words students look for more frequently, of the preferred explanation and, most importantly, of the terms for which no explanation can be provided will help to shape the database to the students' needs.



Figure 3: Online glossary

5.3 Knowledge Base/Newsgroup

Students can use this feature to ask about more complex problems. The system links their question to relevant documents available on the Web or, alternatively, gives the possibility to e-mail lecturers or tutors. The title of the query eventually becomes the reference for the answer, which becomes available to all students in case others are interested or share the same problem. This resource contributes to better communication between students and teaching staff, which in turn informs teaching practice. The advantage is that, once an explanation is given to one student, it is readily available to all others.

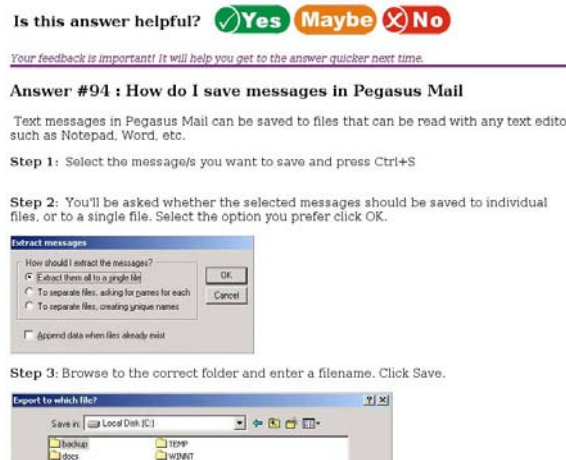


Figure 4: Knowledge base/ newsgroup

6. DEVELOPMENT OF THE TOOL

All three components of the system have Web-based interfaces accessible from the same main page. Some open-source resources already available on the Web can be used. These various systems are all fine-tuneable, and can be customized to suit the various requirements of the deployment environment.

6.1 Chat Room

The chat room has been developed starting from CGI IRC (2004). This component uses a program based directly on the browser. The program is written in Perl (2004) and it

allows to impose more restrictions compared to other IRC applications. In fact, it is necessary to stop students from privately messaging each other or moving to other chat rooms. This can be done easily by changing the configuration of the program. The code can be easily modified to impose further restrictions.

Compared to java applets designed to perform the same function, the Perl code can be easily modified and, most of all, it makes the application more portable. Applets, in fact, require dedicated plug-ins and take up a lot of memory.

6.2 Online Glossary

Creating the glossary has been slightly more complicated. Since no similar resource is available on the Web, this feature had to be created from scratch. The languages used were PHP (2004) for the user interface and MySQL (2004) for the backend.

The interface is connected to a database indexed by the word being queried. To each term, the database associates various definitions/explanations (in technical English, in simple English and in various African languages) as well as audio and multimedia files. Such files can be easily streamed to the machine where the user is working using a standard protocol.

The application records the frequency with which every term is looked for, which definition/ explanation is chosen and if it has been chosen as a first, second or third option,, as well as the feedback from the users. In case a word is not in the database or a definition/ explanation is not available, a new entry is created and the system administrators are notified. Definitions can be entered or updated by those involved. In this way, inadequate definitions can be fixed and missing definitions created. The glossary will gradually be improved, approaching completeness with time.

Terms and definitions/explanations are fully browsable from the users. Links to existing online dictionaries for the African languages (Webster's, 2004; O'Kennon, 1996; Schryver e Joffe, 2004) or to online glossaries of computer-related English terms (High-Tech dictionary, 2004; Webopedia, 2004: Discovering computers, 2002) complete the interface to provide further information.

6.3 Knowledge Base/ Newsgroup

The knowledge base has been developed starting from an existing online resource (Mindmeld, 2004). Among the resources available on the Web this seemed to be the best option, since it allows users to browse and search documents. Users can also send comments on this component. If they are not satisfied with the documents provided by the knowledge base, students can email tutors and lecturers. The answer to their query becomes part of the available documents.

7. CONCLUSIONS

In summary, the goal of our application is to provide increased and more meaningful access to the study of the new technologies by addressing the particular problems of students in our focus group. It will hopefully allow more members of previously disadvantaged communities in South Africa to study Computer Science at university level. Its relevance to the field of ICT Education is twofold. On the one hand, it makes use of a computer-based teaching resource, thus making the use of computers more

meaningful for the students. On the other hand, it facilitates the students' access to computer literacy and to more advanced courses in Computer Science.

We feel that our application contributes to research into the teaching of the new technologies in Africa by providing an example of a tool whose development has been fully shaped by the needs of our students. All interactions with the resource are recorded in order to inform future research as well as the development of the resource itself. This makes it a very flexible tool which can be easily customised to suit the needs of different groups of students, at different levels of education and in different contexts.

We are currently testing a demo version of our application. Hopefully, feedback from students and lecturers will inform the development of a final version by the end of 2004. We are planning to update our resource regularly during the next two years. We are also exploring the possibility of extending the implementation of our application in neighbouring institutions. An interesting option would be to test our tool at the University of Fort Hare, a previously disadvantaged institution with which Rhodes has a tradition of cooperation through the respective Centers of Excellence. Another interesting testing ground could be some of the schools in the neighbouring township, to which the Rhodes Center of Excellence provides Internet connectivity.

ACKNOWLEDGEMENTS

This work has been sponsored by the Telkom Center of Excellence of Rhodes University, Grahamstown, South Africa and by the *Opera Universitaria* of Trento, Italy. We thank Mr. Jonathan Hitchcock for helping us to find and select some of the open-source tools used for our resource. L. Dalvit would like to thank Ms. Brenda Mallinson of the Department of Information System at Rhodes for helping to set up the questionnaire for the preliminary investigation. He also thanks the IT Division and all the staff members of the Department of Computer Science at Rhodes for their cooperation and help.

REFERENCES

Barkhuizen G. P., *Learners' perceptions of the teaching and learning of Xhosa as a first language in Eastern and Western Cape high schools: summary report*, occasional papers nr. 3, PanSALB, Pretoria, 2001.

CGIIRC, 2004. <http://cgiirc.sourceforge.net/>

CHE (Council on Higher Education), *Language policy framework for South African Higher Education*, CHE, Pretoria, 2001.

Dalvit L., *Attitudes of isiXhosa-speaking students at the University of Fort Hare towards the use of isiXhosa as a Language of Learning and Teaching (LOLT)*, Master's thesis, Rhodes University, Grahamstown, 2004.

De Schryver G. M. e Joffe D., *Online Sesotho sa Leboa (Northern Sotho) – English dictionary*, 2004. <http://africanlanguages.com/sdp/>

Discovering computers (online version), 2002.
<http://www.scsite.com/dc2002/default.cfm?module=terms>

Dlamini C. R. M., *The attainability of multilingualism at university*, Aambeeld/Anvil, 29, 2001, 33-36.

Halliday M. A. K. e Martin J. R., *Writing science: literacy and discursive power*, University of Pittsburgh Press, Pittsburgh, 1993.

Heugh K., *The case against bilingual and multilingual education in South Africa*, occasional paper nr. 6, PRAESA, Cape Town, 2000.

High-Tech dictionary, 2004.
<http://www.computeruser.com/resources/dictionary/index.html>

Mindmeld knowledge base, 2004. <http://mindmeld.sourceforge.net/mmsf/index.php>

MySQL 2004. <http://www.mysql.com/>

NCHE (National Commission on Higher Education, A framework for transformation: the report of the National Commission on Higher Education, Government Printer, Pretoria, 1996.

O'Kennon M. R., *Online isiXhosa – English dictionary*, 1996.
<http://mokennon2.albion.edu/xhosa.htm>

Perl scripting language, 2004. <http://www.perl.org/>

PHP 2004. (<http://www.php.net/>

Ramani E. e Joseph, M., *Breaking new ground: introducing an African language as medium of instruction at the University of the North*, Perspectives in Education, 20, 1, 2002, 256-260.

Sweetnam-Evans M., *Academic achievement, underachievement and bilingual/multilingual education: what the university can contribute*, Aambeeld/Anvil, 29, 2001, 47-53.

Webb V. N., e Kembo-Sure J., *African voices: an introduction to the languages and linguistics of Africa*, Oxford University Press, Oxford 2000.

Webopedia, 2004. http://www.pcWevopedia.com/Computer_Science/

Webster's Online dictionary (the Rosetta edition), 2004. <http://www.Wevesters-online-dictionary.org/definition/translation-english/>

Φιλεναμε:

Δαλπιτ+Μυρραψ+Τερζολι+ΖηαοΜυλτιλινγαλΡεσ
ουρχε – Λορενζο Δαλπιτ, Σαραη Μυρραψ, Αλφρεδο Τερζολι, Ξιαογε
νγ Ζηαο.

Διρεχτορψ: Γ:.:σεσσιον ΙΙΙ_φυλλπαπερσ

Τεμπλατε:

Χ:.:Δοχυμεντσ ανδ Σεττινγσ.:ψοναταν.:Αππλιχατ
ιον Δατα.:Μιχροσοφτ.:Τεμπλατεσ.:Νορμαλ.δοτ

Τιτλε:

Συβφεχτ:

Αυτηορ: ΡΗΟΔΕΣΔΥΔΕ

Κεψωορδσ:

Χομμεντσ:

Χρεατιον Δατε: 9/14/2004 6:33 ΠΜ

Χηανγε Νυμβερ: 2

Λαστ Σαπεδ Ον: 9/14/2004 6:33 ΠΜ

Λαστ Σαπεδ Βψ: Νεγα Αλεμαψεηυ

Τοταλ Εδιτινγ Τιμε: 0 Μινυτεσ

Λαστ Πριντεδ Ον: 9/22/2004 6:08 ΑΜ

Ασ οφ Λαστ Χομπλετε Πριντινγ

Νυμβερ οφ Παγεσ:11

Νυμβερ οφ Ωορδσ: 4,173 (αππροξ.)

Νυμβερ οφ Χηαραχτερσ: 23,787 (αππροξ.)