Computer Assisted Language Learning (CALL) in support of (re)-learning native languages: the case of Runyakitara

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This study presents the results from a CALL system of Runyakitara (RU_CALL). The major objective was to provide an electronic language learning environment that can enable learners with mother tongue deficiencies to enhance their knowledge of grammar and acquire writing skills in Runyakitara. The system currently focuses on nouns and employs natural language processing in order to generate a large base of exercise material without extensive tuning by teachers. Language learners used the system over ten sessions, and their improvements were charted. Besides this empirical evaluation, we also sought the opinions of Runyakitara experts about the system (as a judgmental evaluation). Results from the evaluation study indicate that RU_CALL has the ability to assess users' knowledge of Runyitara and to enhance grammar and writing skills in the language. This computational resource can be utilized by other interested learners of Runyakitara, and the idea can be extended to other indigenous languages with emigrant populations who wish to maintain their language skills.

Keywords: CALL, re-learning native languages, Runyakitara

1. Introduction

This paper presents a computer-assisted language learning (CALL) system that provides exercise material to learners of Runyakitara, a Bantu language (group) spoken in western Uganda. The system focuses on morphology, a notoriously difficult system in Bantu languages in general (Taylor, 1985), which is also difficult in Runykitara. In order to obviate the need to specify morphological forms one by one, the system employs a morphological analysis system developed with techniques from natural language processing (Nerbonne, 2002), in particular, finite-state morphology (Beesley & Karttunen, 2003).

The intended users of the system constitute an unusual target group for CALL. They are neither high-school or college (or university) students nor do they need to learn the language for their work. They are likewise not tourists who wish to learn enough of a language to function in basic ways while traveling. Instead our intended learners are the children of native speakers who have emigrated from areas where Runyakitara is spoken natively. The children of migrants often fail to learn their parents' language in their new communities, and parents often see little value in passing their language on to their children (Ohiri-Aniche, 1997; Landweer, 2000). As Joshua Fishman (2000:5) put it "People who speak a language don't necessarily transmit it, and that is *the* problem [emphasis in original]". The children of Runyakitara migrants then have only very basic skills in the language (in an essay with another focus Nancy Dorian has dubbed such individuals "semi-speakers", Dorian, 1977), but, as they grow older, they may be motivated to improve their abilities in order to become literate, to function more inconspicuously in their (extended) families, and to keep the option open of moving back to areas where the language is normally used in all facets of life. We aim therefore to support (re-

)learning. We use the term '(re-)learning' with the 're-' in parentheses in order to be studiedly vague about the degree to which the students ever were competent speakers. The students have some limited competence in the target language, Runyakitara, but it is unclear whether they once knew it well. We envision supporting not only this unusual, but sizable group of learners, but also playing a role in more traditional settings for language learning. In school settings, for example, teaching literacy skills in native languages can aid in their preservation by increasing respect for them and providing a larger group of speakers with educated skills in the language. We draw attention to this unusual group of learners, who generally have little access to formal teaching, because CALL facilities may be especially important to them.

We also report on an evaluation of the system which consisted of comments from experts in the language and the analysis of a set of ten lessons in which users' abilities were tracked. The experts were positive, and the users systematically improved in their ability to recognize and to produce very complex Runyakitara forms.

The following section elaborates on our argument that the group of users we target is both unusual but also worth the effort involved in system development.

1.1 Motivation

Uganda is linguistically diverse with 43 living languages (Lewis, 2009). Great ethnolinguistic diversity means that English (the language of the former colonizer) had to remain the official language after independence. Today English is spoken by approximately 5% of the population which has a literacy rate of around 50% (Buttery *et al*, 2009). Although English is the official language of Uganda, a large number of Ugandans do not understand or speak it at all (Tembe & Norton, 2008).

Runyakitara, a name given to four languages, namely Runyankore, Rukiga, Runyoro and Rutooro, is spoken by about 6 million people in western Uganda. Other speakers can also be traced in Tanzania (Haya, Kerewe, Nyambo, etc) and Democratic Republic of Congo (Tuku, Hema, etc.). Having said that, let us hasten to add that the learners we target are in no sense acquiring a standard language on the basis of a mastery of a dialect (see below).

Even though Ugandans are not in general capable in English, local languages such as Runyakitara are not well documented or well known, not even to all their native speakers! Presently, some Ugandans cannot effectively read or write in their first languages even when they are educated, simply because they are encouraged to use English from childhood on and take pride in using it in daily communication. This means that individuals are often motivated later to (re-)learn local languages in order to function socially and economically in different places of residence.

Uganda as a country recognizes an obligation to provide information to its citizens in the languages they understand well, and to encourage the development, preservation and enrichment of all Ugandan languages (Constitution of Uganda, 1995). Therefore, Uganda supports newspapers and radios in local languages. But, because literate speakers of local languages are scarce, government documents in local languages are full of typographical and grammatical mistakes. The people employed are not proficient enough in the different local languages. This means that there is also an officially recognized need to support proficiency in local languages.

We therefore aim to support Ugandans in learning their local languages, in particular by providing CALL systems designed for this purpose. Specialized systems may have an impact on the existing language situation by improving the general level of proficiency.

This research targeted most specifically a group of learners that has not been widely considered, i.e., people not proficient in their own first language. These learners may have suffered from language attrition (Schmid & de Bot 2004; Schmid et al. 2004), but it is likely that many of them never learned their parents language well, just as many migrant children fail to learn their children's language well, as many contributions to Fishman's (2001) collection document (see especially M.Clyne's contribution on Australian immigrant languages). While we envision a larger potential group of beneficiaries for the system we present and evaluate below, we focus in our evaluation on a group of learners who had acquired some ability in Runyakitara from their native-speaker parents, who had moved from the Runyakitara-speaking area to Kampala. The parents often spoke Runyakitara to each other but not to their children, leaving the children with little proficiency in their first language.

Given these circumstances, such people need help in their *own* first language (Fillmore, 2000). In most cases, such people shy away and do not participate where language proficiency is required. As Halliday (1968) states: 'A speaker who is made ashamed of his own language habits suffers a basic injury as a human being: to make anyone, especially a child, feel so ashamed is as indefensible as to make him feel ashamed of the color of his skin'.

2. Related research

Extensive research has been done in CALL and also in Intelligent Computer Assisted Language Learning (ICALL) (Warschauer & Healey, 1998; Gamper & Knapp, 2002). There is also a wealth of research on teaching morphology using CALL (Antoniadis et la., 2005; Shaalan, 2005; Blanchard et al., 2009; Nagata, 2009; Dickinson, 2010; Esit 2011; Amaral & Meurers, 2011). This section does not attempt to review CALL and ICALL generally, but focuses instead on literature on CALL systems for learning morphology and on systems for native African languages.

Warschauer and Healey (1996) observed that recent years had shown an explosion of interest in using computers for language teaching and learning. They describe the role of computers in CALL, a brief history of CALL, and various desgn philosophies, including Behaviorist CALL, Communicative CALL and Integrative CALL. The authors further predict that the future of CALL will heavily rely on the ability of learners and teachers to find, evaluate, and critically interpret net-based information. Their insights informed our research with respect to the history and future directions of CALL.

GLOSSER (Nerbonne & Dokter, 1999) is an early system that extensively utilizes a morphological analyzer in language learning. The major components of this system include a morphological analyzer for French, a part-of-speech disambiguation system, a bilingual dictionary, and aligned bilingual corpora. The system's provided intelligent assistance to Dutch students learning to read French. The system's strength lay in its individualized instruction and its facilitation of access to additional learning resources (see above). The focus, however, is the learning of vocabulary that needs to be acquired separately from reading exercises.

Gamper and Knapp (2002) provide an overview on intelligent computer-assisted language learning (ICALL) systems. The most advanced systems were investigated and classified along five dimensions: supported languages, Artificial Intelligence techniques, language skills, language elements, and availability. The authors also discuss outstanding problems which still need further research in order to exploit the full potential of intelligent technologies in modern language learning environments. This review of literature provided a framework for the practical, empirical research that we aimed at.

Amaral and Meurers (2011) present the motivation and prerequisites of a successful integration of Intelligent Computer-Assisted Language Learning (ICALL) tools into current foreign language teaching and learning (FLTL) practice. The authors focused on (i) the relationship between activity design and restrictions needed to make natural language processing tractable and reliable, and (ii) pedagogical considerations and the influence of activity design choices on the integration of ICALL systems into FLTL practice. We profited from their insights while focusing on the task of support the (re-)learning of afirst language.

Dickinson and Herring (2008) employed the **TAGARELA** framework developed by Amaral and Meurers (2006) to develop online ICALL exercises for Russian. Their system aims to teach basic grammar to learners of Russian, and its strength derives *inter alia* from audio and video exercises that enable the observation of language situations outside the classroom and life-like listening practice. Their system is internet-based, facilitating learning anytime and anywhere. Their exercises have fixed content, however, thus limiting learners to the content the developer put in the exercise.

Shaalan (2005) developed an ICALL system for Arabic learners. His system employs a morphological analyzer, sentence analyzer, reference material, feedback analysis and multi-media exercises. The aim was mainly to teach Arabic grammar to primary school children and learners of Arabic as a second/foreign language. The strength of this system lies in its multi-media and detailed feedback. In addition, learners are encouraged to produce sentences freely in various situations and contexts. The weakness of this system is that it follows a strict primary school curriculum, which may not be suitable for adolescent and adult learners of foreign languages.

Nagata (2009) presents a new version of Robo-Sensei's NLP (Natural Language Processing) system which updates the version currently available as the software package *ROBO-SENSEI: Personal Japanese Tutor*. According to Nagata (2009) the new system can analyze all of the grammatical structures introduced in a standard 2- to 3-year Japanese curriculum. It is supposed to serve as the backbone of a new, online CALL Japanese textbook capable of providing immediate, personalized feedback in response to errors produced by students in full-sentence-production exercises. The research focuses on strategies for error detection and feedback generation and describes how these strategies are integrated into Robo-Sensei's NLP system, what types of errors are detected, and what kinds of feedback messages are generated.

Hurskainen (2009) presents a UNIX-based ICALL system for Kiswahili learners. The system trains word order and concord patterns. It is based on a morphological analyzer of Kiswahili and does not limit the learner with respect to vocabulary. No evaluation or user study is presented. Katushemererwe and Hurskainen (2011) discuss an idea for a Runyakitara ICALL system. The system involves an implementation of rules for learning word order, concord and vocabulary in Runyakitara. No testing or evaluation of the system was done. In addition, the target group was different from the group targeted in the present study because the system targeted advanced students of Runyakitara at university level and teachers of Runyakitara in primary teachers' colleges.

Odejobi and Beaumont (2003), Oyelami (2008), Hamwedi and Dalvit (2012) and Van Huyssteen (2007) report on CALL systems for Yoruba, Igbo, Ohsikwanyama, and eleven (!) South African languages, respectively, focusing on the children of emigrants, and second and foreign language learners. They are therefore different in focus from the present paper.

Despite some interest in CALL for African languages, it is evident that more research needs to be done. From the literature reviewed, the focus of our study remains different from other studies reported in the following ways:

i) We focus on Runyakitara, a less documented and not commonly taught language.

ii) We target "re-learners", including learners who have only basic, passive abilities in Runyakitara, a group unlike those in most other studies.

iii) We provide exercises derived from a natural language processing system, unlike in other learning systems where a morphological analyzer is used to analyze the learners' answers (Shalaan, 2005), or as aid in providing morphological knowledge or dictionary access (Nerbonne & Dokter, 1998; Amaral, 2007). We utilized the morphological analyzer to develop exercises for learning.

iv) We report the results of evaluating an implemented system. Learners experimented with the system, and their experience (including their learning) is analyzed later in this paper.

3. Highlights of Runyakitara noun morphology and consideration for RU_CALL

We have focused on noun morphology in RU_CALL to-date because it is difficult to learn as already stressed by some Bantu language learners: "One of the most difficult aspects of learning Swahili is its system of nouns…"[1] Naturally, a more complete system would have to include exercises for verbs as well. Table 1 illustrates singular and plural morphology in Runyakitara:

Table 1. Examples of noun forms in Runyakitara.

Class 1/2 (people class)	**Singular**	**Plural**
	O**mu**kazi (a woman)	a**ba**kazi (women)
	Mukazi (woman)	**ba**kazi (women)
	O**mw**ana (child)	a**ba**ana (children)
	Swenkuru ((my)grandfather)	**baa**shwenkuru ((my)grandfathers)
	----------	abaryakamwe (people symbolizing oneness)
	O**mu**hangi (creator)	----------
Class 9/10	e**n**te (cow)	e**n**te (cows)
	E**m**buzi (goat)	e**m**buzi (goats
	Ebaafu (basin)	ebaafu (basins)
	Baasi (bus)	**zaa**baasi (buses)

Table 1 shows examples from only six declension classes of nouns, including class 1/2 containing the greatest number of forms. In total there are 18 declension classes in Runyakitara, all of which are instantiated extensively in RU_CALL, each with two or more forms for singular vs. plural. These are complex and challenging to learners. The complexity

[1] www.transparent.com/learn-swahili/overview.html

stems from the fact that they are not phonologically motivated, but rather must be learned lexeme by lexeme.

We focused on nominal morphology not only for its complexity, but also because the noun is an important word category in Runyakitara. The noun class of a given noun influences other nominal constituents such as pronouns, adjectives and verbs which must agree with the nouns they form constructions with (or represent anaphorically). For example, in the phrase *a**ba**ana **ba**to **ba**ija* (‘young children have come’), the noun class plural marker **ba** appears in a noun (*a**ba**ana*), an adjective (***ba**to*) and a verb (***ba**ija*).

Nouns in Runyakitara are associated with an initial vowel which serves as a pre-prefix to the root or stem. These vowels are specific. They include: **a,** (***aba**ntu* ‘people’) **e**, (***eki**tookye* ‘banana’) and **o**, (***omu**ntu* ‘person’) as presented by Ndoleriire and Oriikiriza (1990). There are rules that govern the occurrence of the initial vowel. If the noun class prefix contains the vowel **a**, e.g. **ba** or **ma**, the initial vowel will be **a,** thus, ***ama**te* ‘milk’ ***aba**kazi* ‘women’. When the noun prefix has **i** or -, the initial vowel is **e** for example, ***eki**tookye*, ***emi**ti*, etc. The initial vowel is **o** when the noun class prefix has **u**, as in ***omu**ntu* ‘person’ or, ***omu**ti* ‘tree’. When a noun is preceded by a preposition such as **omu** ‘in’ or **aha** ‘at’, the initial vowel is dropped e.g. *omu muti* ‘in the tree’.

Once the noun morphology has been mastered, the learner has less trouble in phrase and sentence construction in Runyakitara.

4. RU_CALL: design and implementation

RU_CALL is a drill and practice system as well as a testing system. Although we are aware of language teachers’ preferences for communicatively oriented language teaching, we also note that many of the same teachers frequently assign CALL drills and exercises for use outside the classroom (Jager, 2009). Specific objectives for designing RU_CALL were:

i) To act as a testing tool of the learners’ knowledge of vocabulary of their own first language;

ii) To test learners’ knowledge of grammar, that is, whether they can identify a given noun as either singular or plural, and whether, given one form, they can produce another with contrasting number, e.g., plural when shown singular.

iii) To act as an evaluation tool by providing scores which will aid the teacher to evaluate learners of the language.

iv) To provide grammatical (morphological) exercises for students of Runyakitara.

To achieve the above objectives, the following was devised as a conceptual design:

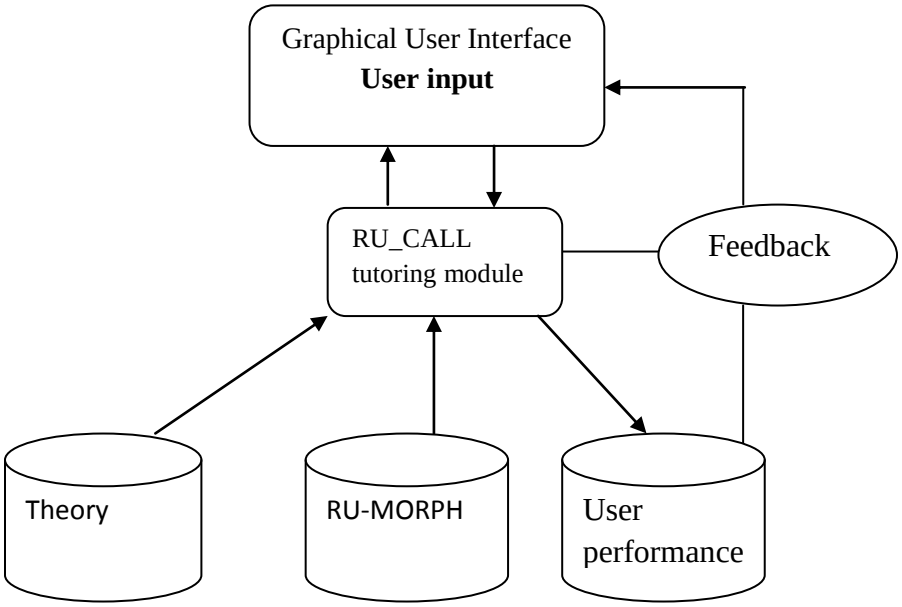

Figure 1. A Simplified RU_CALL Architecture

We chose to develop a stand-alone system rather than a web-based system in order to benefit communities in Uganda where there is little or no Internet connectivity, including therefore the large majority of places where it is limited or unreliable. RU_CALL provides the learner the opportunity of learning at his convenience in terms of time and medium.

4.1 RU_MORPH (The Morphological Analyzer of Runyakitara)

The linguistic knowledge in this learning system is derived from a morphological analyzer of Runyakitara, which was developed using Natural Language Processing (NLP) techniques (Jurafsky & Martin, 2008). NLP techniques have been identified as instrumental in developing pedagogically sound language learning applications (Nerbonne, 2002) and computationally tractable (Amaral & Meurers, 2011). The morphological analyzer of Runyakiara specifically utilized Finite State Automata (Beesley & Karttunen, 2003; Hanneforth, 2009).

Because the the work on the morphological analyzer for Runyakitara nouns has been published in a journal (Katushemererwe & Hanneforth, 2010), we refer the reader to that article for technical details. But we summarize here that the 4274 nouns used were extracted from a Runyankore-Rukiga dictionary, *Kashoboorozi* (Oriikiriza 2007), which, according to Oriikiriza (2007), incorporates the material from all the Runyankore-Rukiga dictionaries published earlier. In addition, *Kashoboorozi* was the most recent dictionary available at the time. We note nonetheless that *Kashoboorozi* does not cover all the nouns in all the four Runyakitara languages. Since, however, the four Runyakitara languages are judged to be 80% mutually intelligible (Lewis, 2009), we expect the coverage to be quite adequate for all four languages.

The software was also tested at various levels of development and it presently analyzes newspaper corpora at 78% recall, and 72% precision. In addition to measuring based on newspaper text, we asked lecturers on the Runyakitara language (see below for more detail on these lecturers) to evaluate the coverage of the the nouns in RU_CALL by the recall and precision searching for 100 nouns s/he knew. They reported that 90% of the nouns they sought were in the system. We interpret this to mean that the nouns most commonly known and used are covered by RU_CALL.

The following is the sample test output from the morphological analyzer of Runyakitara:

Table 2. Linguistic Information from the Morphological Analysis System.

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aheeru :          aheeru[ADJECTIVE_ROOT15S
ahi :             ahi[DEM_PR_CLASS16]
ahu :             ahu[DEM_PR_CLASS16]

ahurira :         a[VERB_PREF_SPM3S Spm3s=agrmt3s][VERB_PREF_PRESENT
                  Present=habitual]hurir[VERB_ROOT_SIMPLE
                  Simple=simpleverb]a[VERB_END_IND Ind=mood]

ebijwaro :        ebi[NOUN_PREF_8P 8s=npref8p]jwaro[NOUN_ROOT_IT It=class7]

naagamwaraguza : n[VERB_PREF_SPM1S Spm1s=agrmt1s]aa[VERB_PREF_ASPECT2
                  Aspect2=perfective]ga[VERB_PREF_OPM6 Opm6=agrt6]
                  mwaraguz[VERB_ROOT_SIMPLE Simple=simpleverb]a[VERB_END_IND
                  Ind=mood]
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All word categories are described in the morphological analyzer of Runyakitara as illustrated above. For the purposes of the RU_CALL system, the following word categories were exploited:

Word category	**Class**	**Number of forms**
Nouns – classes	1-18	12,480
Demonstrative pronouns	1-18	72
Adjectives - classes	1-18	1,546

4.2 RU_CALL tutoring module

RU_CALL comprises learning content, tutoring and feedback control. As noted above, we offer grammar exercises. Awareness of language forms and rules is important in language learning (Amaral & Meurers, 2011). Jager (2009) further elaborates that many teachers pursue a communicative philosophy in class but assign grammar-oriented CALL exercises.

4.3 Theory

The system has supplementary material in form of grammatical explanations. This content is not part of the morphological analyzer, but can be accessed by the learner when

he/she accesses the system. Grammatical content is organized in topics and sub-topics which should be easy for the learner to understand. We do not elaborate on this here as it is not innovative.

4.4 Learner Performance Monitoring

We maintain a database containing learners' identification (name and/or student number), date of learning, content already covered and scores the learners obtained. In addition, a search facility was designed to allow teachers to search for the scores of a given learner in case the number of learners gets bigger.

4.5 Feedback

After each input from the learner there is feedback. The importance of feedback in enhancing learning has been demonstrated often (Sauro, 2009). There are three types of feedback included in our system: corrective, motivational, and directive feedback. When the input is correct, feedback is motivational, i.e., the learner is informed that the input is correct and directed to the next course of action. When the input is incorrect, the learner is also informed accordingly and normally asked to try again or to consult the theory module. With respect to corrective feedback, the learner is given the correct answer after a number of attempts. The learner is also guided to consult theory just in case s/he wants to learn more about the word/phrase.

5. The RU_CALL system

RU_CALL system may be described from different perspectives: a user's view of the system, RU_CALL tutoring, assessment, morphological analyzer and theory.

5.1 User's view of the system

An interface provides a means of communication between the user and the RU_CALL system. It is used to present lessons, allow the learner to submit input and to obtain feedback.

5.1.1 Learner

To access the system, the learner must first register to allow the system recognize the learner profile and be able to store his or her scores. Once the learner is logged on, s/he performs an exercise, including the following: i) answering the multiple choice questions, ii) providing alternative singular/plural words and phrases as prompted, and iii) getting feedback. The learner can also ask for an answer in case s/he does not have any clue. The learner is also free to invoke theory if s/he needs it either before, during or after learning. None of these steps are mandatory. One can start answering questions without accessing theory or vice versa. One

can also ask for a correct spelling without answering the question. We walk through one exercise item in section 5.1.2.

5.1.2 RU_CALL tutoring module

This module controls the sequence and selection of the subject matter presented to the learner. In addition, it has a response mechanism to answer learner's questions with appropriate answers. This module also tracks the learner's level of proficiency in the exercises.

RU_CALL implements two types of lessons covering plural formation in Runyakitara. The first consists of individual nouns, while the second consists of noun phrases. A learner is required to identify whether the material – word or phrase – is singular or plural and then go on to provide the appropriate alternative (singular/plural). For example, if a learner selects a word as plural (correct form), the system prompts the learner to then provide additionally its singular form. Figure 3 shows the interactive interface with the learner:

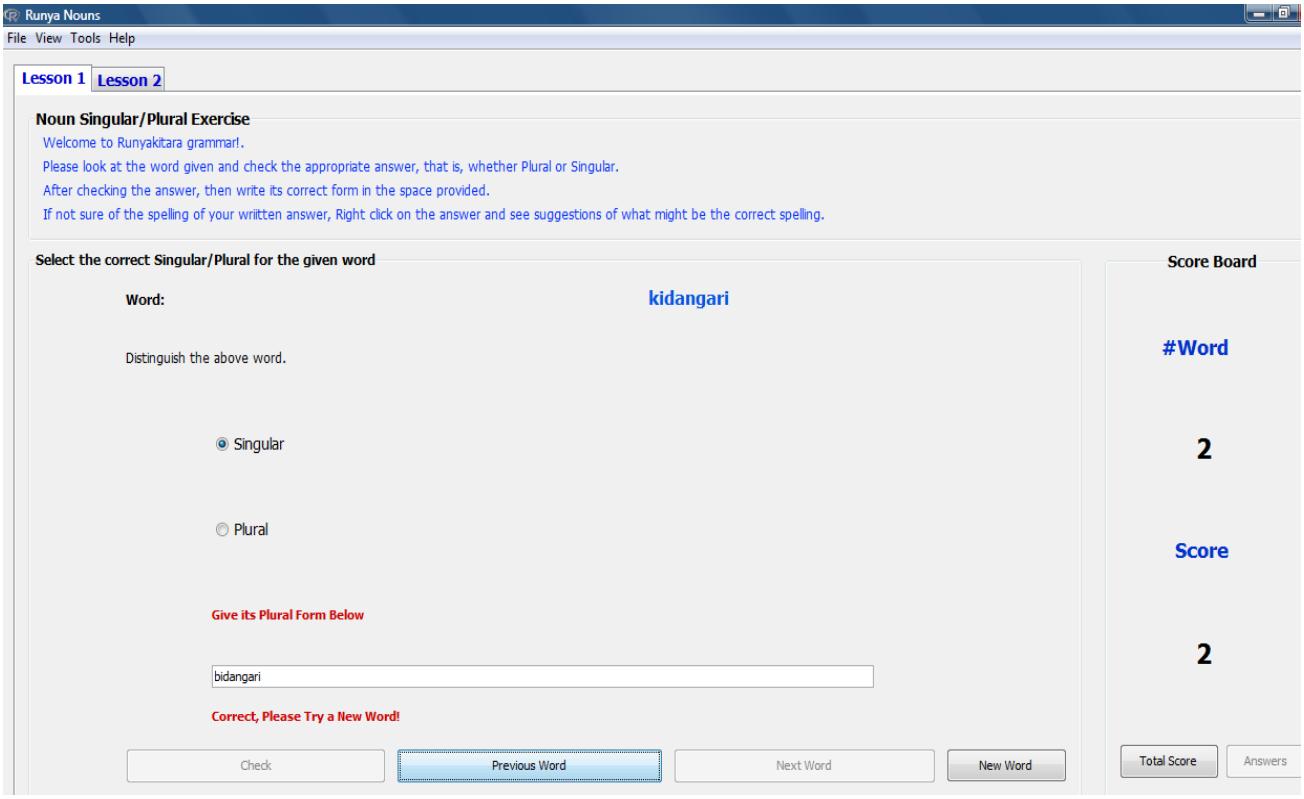


Fig. 2: RU_CALL learning interface

Feedback, as part of the RU_CALL tutoring module, was implemented motivationally as '*please try again'*, correctively as '*the right answer is …*' and directively 'next'. The following exercises illustrate the steps the user takes to interact with the system using the example in fig. 3. Section a illustrates a correct input, while section b a wrong input.

a)	System:	select the correct singular/plural form of the given word - **kidangari**
	User:	singular
	System:	Correct, please give its plural form below.
	User:	bidangari
	System:	Correct, please try a new word.
b)	System:	select the correct singular/plural for the given word - **kidangari**
	User:	plural
	System:	Incorrect. Please try again
	User:	singular
	System:	Correct, please give its plural form
	User:	kidanga
	System:	Incorrect, please try again
	User:	kidangariri
	System:	Incorrect, please try again
	User:	kidangari
	System:	Incorrect, the correct form is bidangari

Table 3: user interaction-system exercise

These are not simple tasks given the learners and the nature of the language. In the first place, the task requires knowledge of both words and phrases. First, if the learner does not know the word, (as in the case of b) s/he has no ability to identify its grammatical number. Second, the task requires writing skill of the learner. By requiring a written singular or plural form, productive competence and writing skills are being tested.

5.1.3 User Performance

The module keeps track of every learner with respect to individual lesson(s) and the date, time and success of learning, and uses the data to compile statistics and provide feedback to the learner and the teacher. The statistics compiled are the total score and the percentages for each lesson. The system displays performance in two ways: to the learner, the score board is displayed immediately after login. To the teacher, the system compiles a list of all learners who are registered together with their scores, and is able to display it on request. Figure 4 illustrates the scores interface:

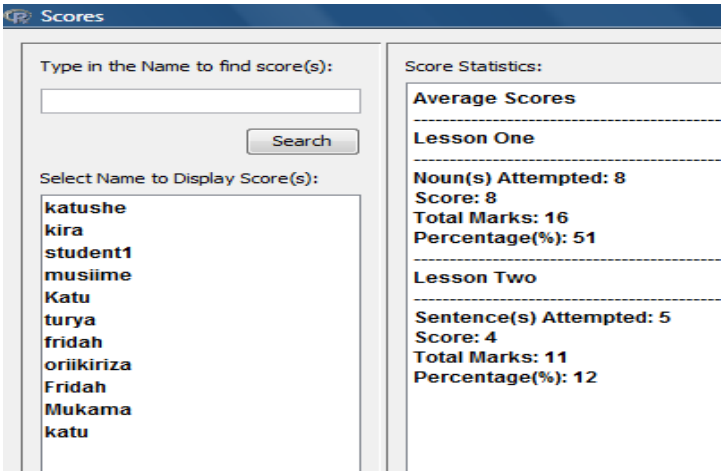


Fig. 3: Scores interface of RU_CALL

5.1.4 Interface to morphological analyzer.

Rather than require that the (rather complex) morphological analyzer be invoked during use, we compiled its output for several thousand nouns and nominal phrases and stored this in a database, Noun Property. Noun Property has a list of all nouns, a display window, and a search facility. When you click on a particular noun, properties of that noun are displayed on the noun property window on the right. The purpose of the search facility is to find nouns not visible on the list. This is illustrated in Figure 4 below:

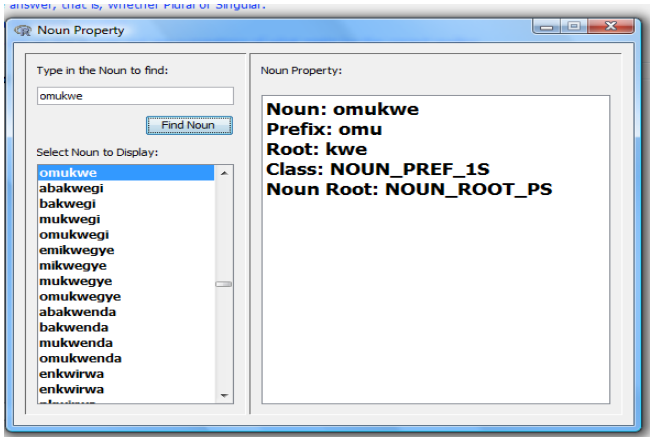


Fig. 4: A noun property view from the morphological analyzer.

6. Evaluation of RU_CALL

6.1 Study design

Evaluation was carried out in terms of the learning outcome, system appropriateness and users' general views about the RU_CALL system, keeping in mind that it was their first experience. The following were the more specific research questions:

How do experts evaluate the appropriateness of the system with regard to:

- Learner fit, as described by Hubbard (2006): What is the quality of the opportunity for engagement with language under conditions appropriate for the learners?
- The accuracy of the learning that is stimulated?

How well have users mastered the forms of Runyakitara, focusing on specific aspects of grammar, vocabulary and writing?

- Can a learner recognize/understand the meaning of a given word?
- To what extent can a learner distinguish a given noun as singular or plural?
- To what extent can a learner write an alternative *number form* of a noun accurately?

What is the learning outcome of the digital Runyakitara learning environment?

- To what extent will the digital learning environment help Runyakitara learners enhance their knowledge of grammar?

How do learners evaluate CALL system for Runyakitara?

- What unique aspects do learners discover in this learning environment?
- Do they find the system to be useful?
- How do they compare it with classroom controlled learning?

Study participants/subjects. The study used two categories of respondents: experts and learners. Experts were included to judge the appropriateness and accuracy of the system, learners were essential for gauging the effectiveness of the system empirically. Three experts were employed, all university lecturers of Runyakitara. Runyakitara has a limited number of experts; therefore, only three were available to take part in the study.

Learner respondents were students entering university and were of Runyakitara heritage. This particular group of students was randomly selected to participate in the study. Some CALL authorities suggest that between 20 and 30 participants are appropriate for user studies (Ma and Kelly, 2006). We targeted 30 learners, but only 26 participated in the study.

Instruments. A checklist and also a questionnaire were designed to obtain judgmental responses from experts. The checklist required 'yes' or 'no' answers, while the questionnaire comprised both structured and open-ended questions.

For learners, a pre-experiment test and a post-experiment test together with an evaluation questionnaire were designed. The pre-test comprised 100 fill-in-the-blank questions involving nouns and nominal morphology. The post-learning test was administered after the software (RU_CALL) was used to ascertain whether there were gains in grammar and spelling. The post-test was constructed in the same fashion as the pre-test. The purpose of the pre-test was to gauge vocabulary, spelling and grammatical knowledge of students before the digital learning content exposure. The post-experiment questionnaire was intended for acquiring information concerning the learners' views on the learning environment.

Procedure. The entire experiment for learners followed a three-step procedure: pre-learning test, learning experiment and post-learning questionnaire. The learning program was installed on (Makerere University, School of Computing) computers. Before interacting with the electronic learning system, a pre-test was administered on paper. All learners were then exposed to the learning material in RU_CALL, to learn and do exercises at their own pace, two hours a day, so that the overall time of the experiment was ten hours, spread across five days. Given that the learners had had passive exposure to Runyakitara, we hypothesized that ten hours of continuous grammatical exercises would be sufficient to demonstrate enhanced command of the language. Detailed instructions were given to learners regarding system access, use, and the entire learning procedure was fully explained.

6.3 Results and Discussion

6.3.1 Results from experts

We asked experts to evaluate RU_CALL system with respect to the following dimensions: effectiveness, coverage, accuracy and selection of content for learning.

System effectiveness. The three experts agreed that RU_CALL would be able to achieve its intended objectives. We interpreted this to imply that RU_CALL was ready to be empirically evaluated.

Coverage. The system was intended to cover all Runyakitara nouns, and the experts were satisfied that over 90% of the nouns would be covered. One also pointed out some missing common nouns, which we took to indicate that the system must be updated from time to time. The nouns which were missing at the time of evaluation were later included, since the system is easily expandable.

Content accuracy. The noun forms in the system were intended to be accurate and familiar to the experts of Runyakitara, because they were from a 2007 dictionary of Runyankore-Rukiga. In the experts' opinion, nouns were mostly familiar, but they also noted a few cases where nouns seemed foreign. For example, none of them knew the meaning of *ebyangato*, even

though it is from a dictionary. Perhaps this shows only that not even experts know all the words in the dictionary.

Random selection of content for learning. Regarding the pedagogical aspect of selecting content for the learner, the experts were all dissatisfied with the random selection of nouns as a good method of selecting content for learning. They suggested that nouns should be systematically presented (arranged under topics) and selected so that learners would be likely to understand them. Our assumption had been that learners should focus on grammar in these exercises rather than on vocabulary. We concede, however, that it would be preferable to group nouns in order to synchronize the morphological learning with other parts of language courses which may systematically vary the situation in which a language is used.

6.3.2 Results from learners

At the beginning of this study, it was not clear whether the assumption we had about learners was true. The basic assumption was that students of Runyakitara heritage raised in a non-Runyakitara area would have limited knowledge of the Runyakitara language. We therefore tested the extent to which they knew Runyakitara vocabulary, grammar and writing. Table 4 below presents the mean scores for the pre-test, broken down into vocabulary and grammar scores. (We examine scores for improvement below):

Table 4: Mean Scores and Standard Deviations for the Pre-test.

	Pre-test experiment (N=26)		
	Vocabulary	**Grammar**	**Grammar + writing**
Mean	60.0	63.5	54.8
Standard deviation	16.9	18.2	16.5

The pre-test results indicate that participants had fair knowledge of vocabulary, indicating that the average learner could provide an English equivalent for 60 out of 100 words. Every Runyakitara speaker would like to improve his or her vocabulary knowledge.

With respect to grammar, we tested only whether the participants could identify a word as plural or singular. Knowledge of grammar and writing resulted in an average of 55.1. We note in passing here that these low early scores indicate level of ability that would be low for native speakers, but not for “semi-speakers” who need to re-learner their first language. In this exercise, learners were required to specify the correct *number* of a word, that is, singular or

plural and to provide an alternative form, meaning that spelling was also tested. The scores in Table 4 show that participants indeed had considerable knowledge of their language, even if they clearly do not have native-speaker levels of ability.

Grammar improvement. After the pre-test (manual exercise), learners were given the RU_CALL system to learn and complete exercises. Table 5 shows That performance clearly improved once learners used the system.

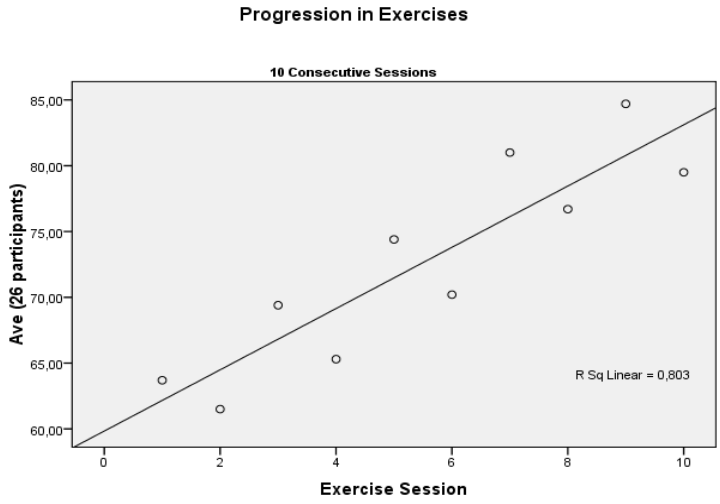
Table 5: Before and After Scores for Learners.

Variable	**Learners**	**Mean score**	**Standard deviation**
Pre-test	26	59.73	17.4
Post –test	26	74.61	9.17
t-value (paired differences)	**Degrees of freedom**		**Probability**
7.413	25		<.001

Table 4 indicates that there is a statistically significant difference between the mean grammar scores for the pre- and post-tests for the study participants ($t(25)=7.413$, $p < .001$). In other words, after using the software the participants had mastered nominal morphology better than they had in the pre-test. The digital learning environment appears to help in learning Runyakitara.

To confirm that students are indeed improving as they follow instruction, we conducted a regression analysis using the average session score as a dependent variable and the session number as an independent variable (the first session had the value 1, the second 2, etc.). This confirmed that we see a significant and steady learning effect ($r=0.89$, $p<0.001$). As the students used the system, their daily scores improved (See Figure 5).

Figure 5. Progression in Exercises.



The scatterplot also indicates that the average scores of students on even-numbered lessons (e.g., lesson 2) were consistently lower than those in the previous odd-numbered lesson (e.g., lesson 1). This happened because lesson 1, etc. focused on words, while lesson 2, etc. focused on phrases. The pattern indicates that words were easier to learn than phrases.

6.3.3 Learners' evaluation of RU_CALL

This section examines learners' views regarding the usefulness and of RU_CALL and its perceived advantages and disadvantages when compared with classroom learning. Results discussed in this sub-section are from the rating scale questions and the open-ended questions.

*Perceived RU_CALL usefulness***.** Learners rated RU_CALL on a Likkert scale of 1 (very useless) to 5 (very useful). Their ratings used only the categories 5 (very useful) and 4 (useful). Table 5 summarizes their responses:

Scale rate	**5**	**4**
Number of respondents	20	6
Percentage	77	23

Table 6. Usefulness of RU_CALL

The fact that none of the participants used the lower or even the middle section of the scale implies that RU_CALL was appreciated for its role in enhancing participants' grammar and spelling. The system's usefulness could also be seen in the comments learners made about using the software: *All* twenty-six learners indicated that they will continue using the software.

Unique aspects found in RU_CALL. The learners also found that they had understood the instruction and content provided by the digital learning environment for Runyakitara, and they remarked on how it was flexible in allowing them to revise their answers and to find correct answers. Some found the system good for documentation, and others indicated that it was convenient and enjoyable. Most indicated that the assessment part was unique and interesting to them because it was their first time to learn and get real time feedback.

7. Conclusion and pointers to future research

This study has presented a CALL system of Runyakitara, including a review of its design and implementation and an evaluation of its effectiveness. Our main objective has been to provide a digital learning environment that enables learners to enhance their grammatical mastery of this difficult language and to support the acquisition of writing skills. We applied both judgmental and empirical evaluation.

The results from the evaluation are positive. We confirmed that our targeted learners hadbasic, but limited knowledge of vocabulary and grammar in Runyakitara so that they needed to improve if they wished to function smoothly in Runyakitara.

The system also led to enhanced grammar abilities, which was the most important goal of the development effort. Learners improved regularly and substantially. The system facilitated the learning of Runyakitara, the opportunity to use CALL software was motivational for the participants, most of whom admitted that their first interaction with the software (day 1) was a challenge, which motivated them to work hard to benefit from it. Some reported that they had been accustomed to consulting dictionaries, and others, native speakers in order to acquire information on the language.

With respect to the learners' subjective evaluation of software, results are quite satisfactory, with majority of learners reporting that they would like to continue using it.

Future practical steps should be to include other grammatical structures in the system, especially verbs and their tense, aspect, and topic morphology, which are essential to effective language useFuture directions to this research might be to include the morphological facilities in more natural exercises such as choosing the correct forms of words already embedded in texts.

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