# Glosser-R$\underline{u}$G; a user study

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**Abstract**

This paper describes a user study of *Glosser-R$\underline{u}$G*, a *Computer Assisted Language Learning* (CALL) application that facilitates the reading of French texts. The usefulness of this CALL application is compared to a traditional method of text reading, by evaluating a number of users' reading and comprehension skills using Glosser-R$\underline{u}$G on the one hand, versus a hand-held dictionary on the other. Glosser-R$\underline{u}$G supports the specific task of reading a text containing new or unfamiliar words, by providing an on-line dictionary, morphological analysis, Part-of-speech disambiguation and examples of word use in a corpus of diverse texts.

## 1 CALL and Glosser-R$\underline{u}$G

Traditionally, CALL software has mainly emphasized on providing drills, answer keys and grammar explanations, thus, in a sense replacing the human teacher in traditional language education [10]. The position of Glosser-R$\underline{u}$G in the CALL-paradigm [12], however, is focused on the improvement of *communicative* skills. The function of the application then, is mainly *assisting* novice readers in developing their comprehension and reading skills, thereby improving their ability to communicate in French.

This paper supports Last's claim [10] that relatively straightforward programs, as Glosser-R$\underline{u}$G is, can achieve a great deal of success within the general framework of CALL. One of the key aspects of any learning system is that the relationship between teacher (that is, the CALL system) and student is imperilled by anything which may provoke a lack of confidence by the latter in the former. This implies that CALL systems should be extremely stable with respect to software, as well as to the specific educational support it provides, thus that complex systems are more likely to cause problems in the student-teacher (program) interaction. The more one moves from the level of individual word and phrase to the semantic level, the greater is the danger that the relationship of trust between the student and computer will be inadvertently broken, given the current state of the art in linguistic technology. The focus of Glosser-R$\underline{u}$G, therefore, is mainly on the level of words. This stance is widely supported by previous work. The reading of text significantly improves the learners' vocabulary by providing lexical context, even without the use of additional sources like dictionaries [6]. This context not only serves in a better understanding of the possible use of a specific word, but also creates a framework in which words are more easily remembered [8].

On the one hand, Glosser-R$\underline{u}$G is a CALL application, in that it facilitates language learning by providing on-line information on individual words of French texts thus helping students improve their comprehension of French texts and increasing their vocabulary. On the other, it is also a *tool* for text comprehension, in that it assists people who know a bit of French but cannot read it quickly or reliably due to the presence of a number of unknown words in the text [5]. Therefore, it can be used in educational tasks, and as an on-line tool for "Just-In-Time knowledge" [1], creating a multitude of potential applications in education and professional use. Although Glosser-R$\underline{u}$G is specifically designed for French texts, the architecture of the program makes it suitable for processing any language for which the informational sources used in the current application are available. In fact, the program is mainly an integrated and unified account of several previously developed linguistic tools and methods. The major informational sources are: an on-line dictionary provided by Van Dale

Lexicografie [7], morphological analysis software provided by Rank Xerox [2], and examples of the use of the respective word in other texts. The program relies heavily on the morphological analysis software, which provides the link between inflected word forms and the "citation forms" found in dictionary entries [11], and which determines the part-of-speech a specific word constitutes in a sentence; this latter analysis is used in dictionary lookup. Each word for which information is sought is analyzed within its linguistic context (being the sentence a word occurs in) and disambiguated with respect to its base form, lexical category and the morphological properties of the word ("tags") that determine its appearance or inflections. The analysis thus provides the link between the possibly inflected form of the word as it appears in the text and the citation forms as they are listed in a dictionary. This *lemmatization*, therefore, plays a dual role: it is informational in that it provides the user with information about the precise inflections of a given word and their grammatical interpretations, but it is also functional for further processing, by providing the link between surface forms as they appear in the text and the dictionary forms of words.

## 2 A Detailed Outline of Glosser-R$\underline{u}$G

The complete Glosser-R$\underline{u}$G system as used in this study [1] consists of a read-only editor, a dictionary, a morphological analysis/POS-disambiguation system and an example-lookup. The program is completely window-oriented and designed to be user-friendly; little knowledge of, and experience with computers is necessary to use Glosser-R$\underline{u}$G. The complete screen the user gets when all modes of information are activated and a specific word is looked up is shown in figure 1. (The menubar at the bottom of the screen is not a part of Glosser-R$\underline{u}$G.)

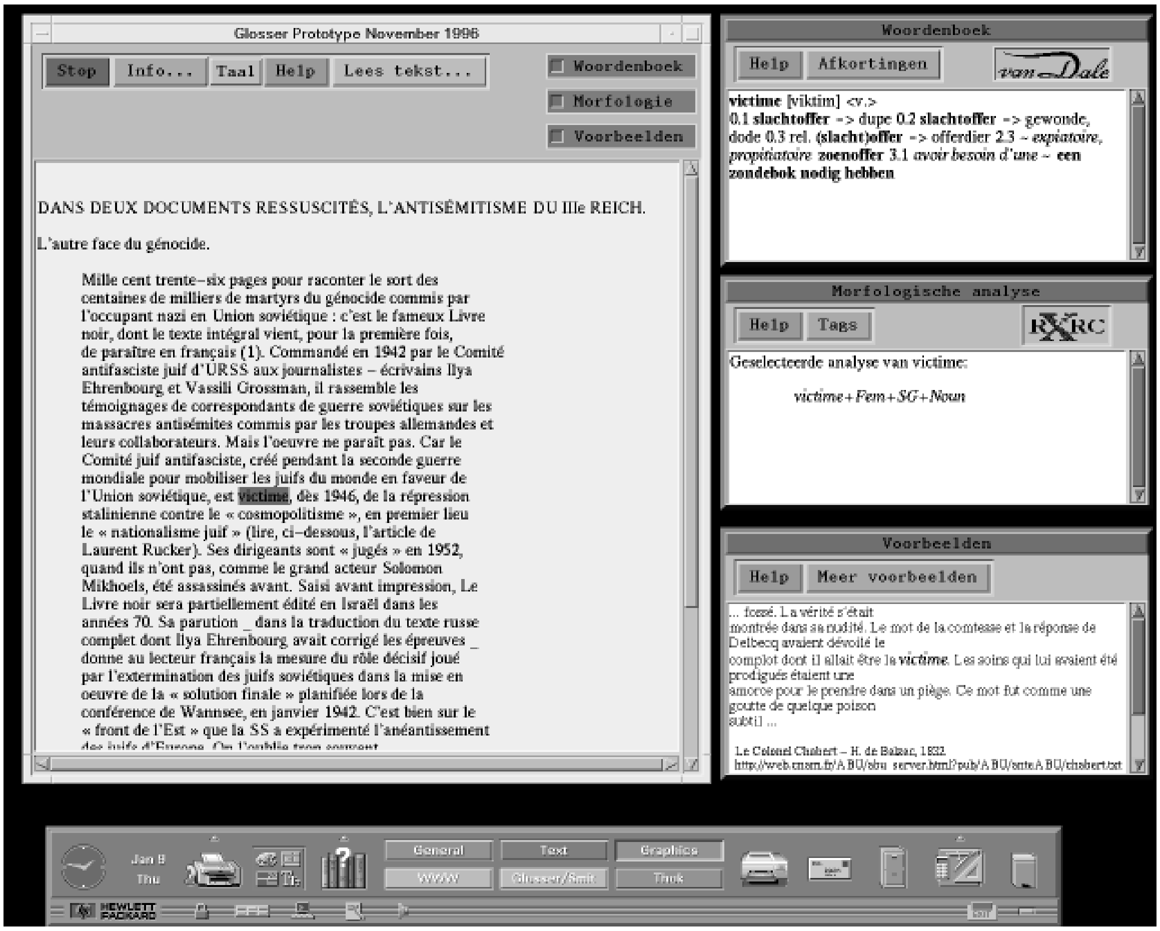


Figure 1: *Glosser-R$\underline{u}$G as it is displayed on the screen. The window providing help is omitted*

[1] This version is still a prototype, but relatively stable. New features have already been added according to results from this study, see section 3.3

The left window is the read-only editor in which the text to be read is displayed, the upper-right window is the dictionary, below that is the window displaying the morphological analysis, and in the lower-right corner is the window displaying examples of the selected word in other texts. Figure 2 shows the appearance of the editor, with the highlight on the word *victime*. This highlight simply follows the mouse-cursor. When a word is highlighted, it is selected for lookup by a single mouse-click.

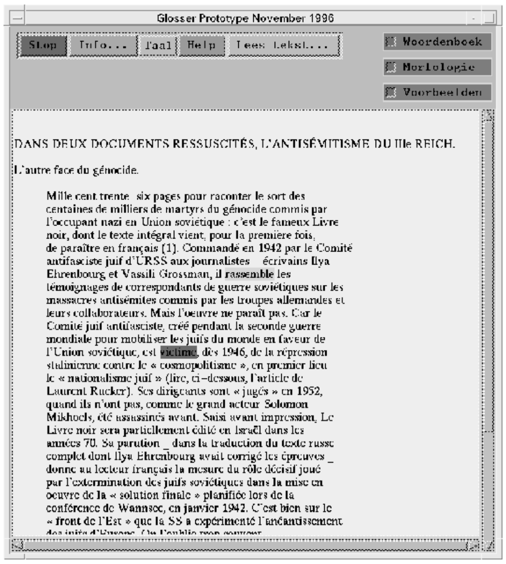


Figure 2: *The read-only editor with an opened text.*

In the upper-right corner of the editor three on/off-switches control the specific sources that are to be used for a single lookup. Other features (buttons) include a hypertext oriented help function that is shown in a separate window, a file selector and language selector (not yet functional in this prototype). The precise functionality of this buttons on the editor window (and of the other windows) is beyond the scope of this paper, see [3] for a complete account of this prototype.

## 2.1 Morphological Analysis

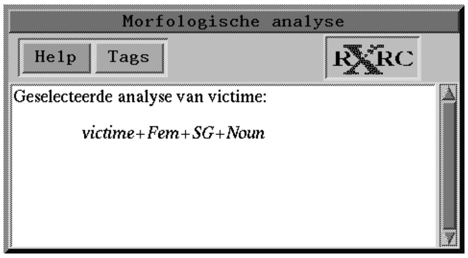


Figure 3: *Morphological analysis.*

Morphological analysis is a necessary prerequisite for dictionary lookup, since most dictionaries do not contain inflected word forms as a distinct entry. Glosser-R<u>u</u>G was fortunate to be able to incorporate *Locolex*, a state-of-the-art system provided by Rank Xerox [2]. An example of morphological analysis is displayed in figure 3. (Additional information on the used tags is available for users of the application in the hypertext help function.)

Locolex analyzes the morphological properties of a word, and disambiguates the part-of-speech (POS) which the selected word constitutes in the text, based on syntactic context. The lemma thus found is used for dictionary and example lookup. Apart from the lemma, the POS tag is also used for dictionary lookup, to disambiguate entries that occur within different syntactical categories.

## 2.2 Dictionary Lookup

An important source of information on words for Glosser-RuG (and of course, in general) is an on-line dictionary, provided by Van Dale Lexicografie [7]. This dictionary is actually a number of tagged text files, that is, no search routines are implemented. Therefore, an index has been generated, consisting of <*word, POS, file, position*> quadruples. This (sorted) index can be accessed using binary search, ensuring fast lookup of words. For dictionary lookup lemmata are used, as generated by the morphological analysis, as well as the POS of the word as determined by Locolex. The latter feature implies that the correct entry is found, for words with multiple entries (due to different possible syntactic categories), that is, in accordance with the POS the word is tagged with. Figure 4 shows the display of the dictionary entry for *victime*.

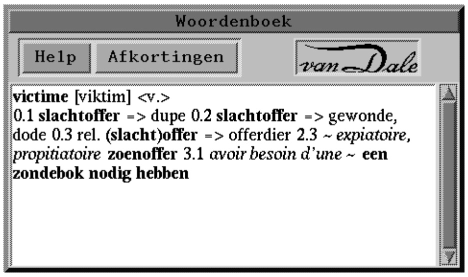


Figure 4: *The on-line dictionary.*

## 2.3 Examples

The third informational source of Glosser-RuG is constituted by the availability of examples of the use of a given word in a corpus of French texts. This provides the user with several distinct lexical environments of a word, which has been shown to be an important factor in vocabulary learning [8], [6], see section 1.

Ca. 5 Mb of text is used for these examples, accounting for a coverage of 7892 different lexemes [2] of the French vocabulary. The texts are indexed by determining the lemmata of the individual words using the same morphological analysis method as described in section 2.1, and creating an index of N occurrences of each lemma thus found [4]. The index then provides a link between the lemmata and the full, possibly inflected forms, which enables the user to see examples not only of the specific word as it occurs in the text that is being read, but also of other inflections. Examples are displayed, with a reference to the source (if available), in the "examples" window, as shown in figure 5.

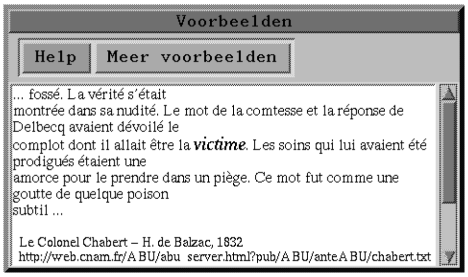


Figure 5: *Examples in other texts.*

# 3 A User Study

The goal of this study was to evaluate Glosser-RuG in comparison to a traditional method of text reading and comprehension, by using a hand-held dictionary. The specific factors that were regarded as relevant, and could be accounted for in this study, included the overall judgement of the program, a simple measurement of the effect which the use of Glosser-RuG had on text comprehension and the functionality of the program. The group of 22 subjects was divided into a group that used Glosser-RuG, and a group that used the hand-held dictionary. Apart from the above factors, the subjects using Glosser-RuG were asked to comment on the system, so as to get a clear picture of users' demands of the application and suggestions for improvement.

## 3.1 Setup

Each session starts with an introduction that explains the major purpose of the experiment and a short demonstration of the program. At first all the subjects are given 5 minutes to get acquainted with Glosser-RuG. This is considered to make the subjects more comfortable with the experimental

[2]Note that these are the lexemes as found after processing the text with Locolex, that is, the number of inflected forms in the corpus is much higher

environment. Then the students are randomly assigned to two groups. Both groups are presented the same text; their task is to read this text within a limited time (20 minutes) and answer questions about this text afterwards. The text is extracted from Jules Verne's "De la terre Á la lune" 1865, and contains approximately 250 words. The first group has this text displayed in the Glosser-RuG environment editor as described in section 2, the other group has a version on paper and they are provided with the same dictionary in a hand-held format.

After the time for reading is up, the text is taken away and the subjects are given a questionnaire. This questionnaire consists of two parts. The first, eleven questions on the text, is identical for both groups. The second part, consists of several questions concerning the evaluation of the *program* for the group using Glosser-RuG, and the *hand-held dictionary* for the other. The second part of the questionnaire is given here. The text in italics represents the phrases that differ according to the specific group:

1. What is your level in French?
   *novice– 1 2 3 4 5 –advanced*
2. Do you read French texts on a regular basis?
   *never– 1 2 3 4 5 –very often*
3. How well do you understand the text?
   *poor– 1 2 3 4 5 –excellent*
4. Do you think that the information *Glosser-RuG/the dictionary* gives for a word is sufficient for a good understanding?
   *insufficient– 1 2 3 4 5 –complete*
5. Do you like using *Glosser-RuG/ the dictionary*?
   *not at all– 1 2 3 4 5 –very much*
6. *Would you like to use programs like Glosser-RuG in the future? /Have you ever used a computer program for language learning?*
7. What is your overall judgement on *Glosser-RuG/the dictionary*?
   *bad– 1 2 3 4 5 –very good*

All questions are answered on a scale of 1-5 to enable statistical analysis, except question 6 which is answered by *yes* or *no*.

## 3.2 Results

The results from this study can be divided into three classes, according to the specific issue addressed:

1. comprehension (part one of the questionnaire, question 3 of part two)
2. functionality of Glosser-RuG vs. dictionary (question 4, number of lookups)
3. subject evaluation of Glosser-RuG vs. dictionary (question 4,5,6 and 7)

The other questions (1 and 2) were used for overall control. The first class can be evaluated objectively according to the questions on the text. A maximum score of 100 points was possible, for 11 questions, that is approximately 9.1 points per correctly answered question. In this study, other possible factors for measurement of comprehension are not included, like the time necessary for reading the text and testing the vocabulary after reading.

The average score of Glosser-RuG users on the questions was 58.8, while the score of the dictionary users was 50.5. Although results show a higher average for the Glosser-RuG users, the difference was not significant. It is expected that it might be significant with a larger subject group. An interesting point here is that the users of Glosser-RuG scored significantly better on the question concerning self-estimation (question 3). There might be some effect of the use Glosser-RuG on the comprehension users *think* they have, due to the relative ease with which a user can look up unfamiliar words.

The class of *functionality* concerns the quality and usefulness of the sources used for Glosser-R*u*G, being a dictionary, morphological analysis and examples, and of the application as a whole. This issue can be addressed in comparing the number of lookups, the number of words not found in the dictionary and evaluating question 4. Since all subjects used the full 20 minutes to read the text, a simple ratio is sufficient to describe the difference in lookups. The average number of lookups with Glosser-R*u*G in relation to the average number of lookups with the dictionary was 45/14, which is a very significant difference (p ¡ 0.001). The actual number of lookups with Glosser-R*u*G was still higher, constituting a ratio of 53/14, but some words were looked up more than once, which was uncontrollable for the dictionary lookups. This figure clearly states that users of Glosser-R*u*G managed to lookup a much larger number of words (and read the given information) in the same time. The average time needed for a single lookup for the program-users is 22.6 seconds, that of a dictionary user 85.7 in this study. The content of the dictionary given by Glosser-R*u*G, was preferred to the content of the hand-held dictionary, although the difference in validation was not significant. Although both the hand-held dictionary and the on-line dictionary were similar in content, the display of the entries in Glosser-R*u*G differed by scope, due to POS-disambiguation, as well as by lay-out. Another issue concerning the functionality of the program is the specific use which the subjects made of the possible informational sources:

| Searches= 629 | | |
|---|---|---|
| **source** | **used** | **% of total** |
| Dictionary on | 623 | 99.0 |
| Morphology on | 276 | 43.9 |
| Examples on | 261 | 41.5 |

Clearly, the dictionary is regarded the most important source for support in reading texts. An interesting point here, which does not show from these numbers, is that users often consult other sources immediately after lookup of the same word with the dictionary only. This indicates that when the information a dictionary provides is regarded insufficient for direct comprehension of a word, or a part of the text, other sources are consulted. Of this specific text, 3 different words could not be found by Glosser-R*u*G. These included one English word and one word abbreviated with an apostrophe (*jusqu'alors*). For the dictionary users this number was four words, including an inflected form of a verb (*sait*). This offers an interesting perspective on automatic morphological analysis previous to dictionary lookup, as described in section 2.1. This issue remains to be investigated.

The last class, the evaluation of Glosser-R*u*G in general, contrasted with the evaluation of the hand-held dictionary, is compared in accordance with questions 5, 6 and 7. The use of Glosser-R*u*G (question 5) was judged better than the use of the dictionary, although this result is not significant. All users were keen on using future versions of Glosser-R*u*G (or continue using this version). The overall judgement of the program was very positive, 4.2 on a scale of 1-5.

## 3.3 Qualitative Data

Apart from the quantitative data obtained with statistical analysis, some useful information on the functionality of the system was provided by remarks of the users during and immediately after the sessions. This section will discuss the additional features of Glosser-R*u*G, that were suggested by the subjects and added after the study.

In the first prototype a user had to select a word by dragging the cursor over a part of the text, with the left button held down. This led to a large number of error-messages, since this procedure asked for some precision: non-words might be selected and ruled out afterwards by the program, punctuation had to be filtered out. After a selection was made, it had to be submitted for a search by explicitly clicking on a search button. This was regarded a redundant action by most users. Therefore, the new prototype automatically selects words currently under the mouse and highlights the selection. A single mouse-click now starts a search action. Automated selection ensures that no erroneous words can be submitted for lookup; control is entirely with the application.

A second important addition is the possibility of actually making notes in the original text. Data on the searches conducted by single users on a single text showed that a number of words was looked up several times, which indicates that users do not remember each word that has been previously looked up. It would therefore seem an improvement to enable the user to write translations found directly in the text that is processed. Moreover, users specifically requested this kind of possibilities for Glosser-R*u*G. Hence, a new prototype enables the user to click on translations found in the dictionary, upon which the chosen translation is inserted in the text, directly after the original word. A simple mouse-click on a translation removes it if necessary. In the first case, in order to select, the highlight follows the mouse in the dictionary window, in the same way as for selection in the text that is being read. In the latter case the cursor changes shape, so as to show the nature of the action, that is, deleting the translation-note.

During the study, it appeared that some of the elderly subjects were unable to use the mouse-driven features of the application and could therefore not comfortably interact with the program. This is considered a general contemporary problem and is not addressed further in this paper, although these results have been incorporated in the data given.

## 4 Conclusions

It can be concluded that Glosser-R*u*G improves the ease with which language students can approach a foreign language text. The most important difference is simply the number of words that can be looked up and the subsequent decrease in time needed for reading the text. Both of these may be expected to improve vocabulary acquisition. Although the difference in text comprehension shown by the two groups was not significant, involving larger numbers of subjects in further experiments will cope with the general tendency of exhibiting a greater difference. The exact figures of a further study will be the subject of a future investigation. This work will include the topics of short/long-time retention and variable reading times to achieve a better insight into text comprehension. However, the overall evaluation of Glosser-R*u*G showed a very positive result toward further development. All subjects judged the information Glosser-R*u*G gives to be sufficient, and the program in general to be user-friendly.


## Acknowledgements

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