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COMPUTER ASSISTED WRITING - APPLICATIONS TO ENGLISH AS A FOREIGN LANGUAGE

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Abstract

Preliminary results on the use of a computer writing tool aimed at assisting non-native users of English in the preparation of scientific papers are presented. The environment - named *AMADEUS* - implements a resource based on the compilation of well-written expressions appearing in scientific texts. Template-expressions with blank spaces where reference to specific material is expected are stored in a sentences base and may then be used as reference material by non-native writers. The efficacy of the resource proposed was analysed by the monitoring of texts produced by Brazilian students. Positive aspects which emerged from the use of *AMADEUS* include helping users to get started with their writing tasks, to improve text organisation, and also to cope with global writing problems in a way other resources can not do.

1. Introduction

A number of writing tools have been developed over the past few years aimed at assisting the writer in the various stages of different writing tasks. Most of these are postwriting evaluation tools (Williams, 1989; MacDonald, 1982) which detect spelling, style and gramatical mistakes and assess the readability of a given text. Some tools, such as outliners and ideas organisers (Wayner, 1992; Stefik, 1987) provide help in the structuring of the text and may be considered as preprocessing tools. There are also tools which make use of re-usable texts in order to enhance the production of standard documents (Born, 1992) and to reduce average writing time (Buchanan, 1992). Fewer writing environments present a suit of tools, integrated into a structured cognitive model of writing, which assist authors throughout the writing process (see Smith, 1987; Sharples, 1989). To our knowledge there is no writing tool available targeted specifically at non-native users of English. Software tools which occasionally consider the production of written material are available to assist in the learning of languages by foreigners (Byron, 1990; Lelouche, 1992), but these are not specifically concerned with the production of quality scientific texts. Yet, the production of good-quality written material in English is a major difficulty faced by academics whose mother tongue is not English.

Although postprocessing writing tools are *a priori* applicable both to native and to non-native users, and are useful in various aspects, they do not address an important difficulty common to many non-native users of English: the production of a first draft (by generating texts or chunks of text) which can be later polished. In the generation of this draft, the non-native user will have to cope with a range of difficulties concerning several aspects of the English language, namely lexico-semantic, syntactic, morphological as well as discourse and pragmatic factors. It has been noticed that the difficulties met by non-native writers may have a negative effect both on the writer and on the outcome. On the one hand, they may create a block on the part of the writer, which would turn the writing exercise into a very tough task. On the other, they may affect the outcome's intelligibility in such a way that improvements on the draft would be impossible to make, unless the draft itself were entirely rewritten.

In an attempt to reduce the impact of these and other related problems, such as time pressure and unavailability of self-access reference material, we conceived an empirical resource, named *CHUSAURUS*

(Oliveira et al., 1991), which consists of selected linguistic input in the form of template-expressions stored in a sentences base. The expressions available for reference can be indexed according to different criteria - e.g. their suitability to a particular section and topic within a scientific paper, or the presence of a certain keyword, or the representation of a particular communicative goal (or rethorical function). In this paper we report on the implementation of this resource in a software environment (named *AMADEUS* -**AM**iable **A**rticle **D**evelopment **E**nvironment for **U**ser **S**upport) for assisting the writing process of experimental research reports, which is targeted specifically at non-native users of English. *AMADEUS* is described in Section 4, following a discussion on the difficulties faced by non-native writers when producing a first draft for a text in English (Section 2); and a brief review of the resource proposed to address such difficulties (Section 3). Preliminary results of some experiments carried out to evaluate the effectiveness of the resource and to provide further feedback to the development of the software are presented in Section 5.

2. Problems Faced by Non-Native Writers

The difficulties faced by writers when preparing texts in a foreign language (provided they have a basic operational knowledge of that language) seem to arise from at least two main factors. The first one is sociolinguistic diversity, as languages differ considerably with respect to phonology, syntax and lexicon, as well as at the pragmatic level (Wolfson, 1989). Consequently, different languages use different rhetorical patterns and elements to organize discourse (Henner-Stanchina, 1985). The second factor which is likely to affect the written outcome has to do with the relationship that holds between comprehension and production: although further evidence is required, it is now generally accepted that comprehension is beyond production. In fact, learners and foreign language users' seem to be able to understand language forms and functions which they do not normally use in a production context.

Although the causes of errors are not central to the purpose of this article, error categorisation and error gravity analyses have been useful to identify problem areas. Drawing on McKeating (1981), James (1984) and James (1989), a framework for error analysis was derived and applied to students' texts. It was observed that localized errors, i.e., those which can be treated isolately, do not cause as much damage to communication as those which affect the global meaning of the text or the meaning of large

chunks of text. What we are trying to argue is that isolated items, and to some extent connected items within sentence boundaries, can be easily handled with the use of a dictionary, a grammar book or related software tools. But intersentence relationships or meaning of a more global nature, as well as functional meaning in discourse, tend to be better treated by means of input material which is more likely to offer microelements in context to form the macrostructure of the text.

A few examples taken from pieces of academic writing by Brazilian students (shown in Box 1) support the view that help is needed not only at the lexical and grammatical levels; moreover, textual information is required to aid students with the writing of connected prose. Observation has shown that such errors range from the misuse of a single word to complex suprasentential problems. The last example in Box 1 illustrates difficulties which are textual in nature, requiring rethorical (organizational) knowledge to link ideas by means of the adequate connectors and reference words. It is our belief that the *CHUSAURUS* resource (Oliveira et al., 1991) discussed in the next section may provide a faster and more effective way to deal with textual global problems.

Form Used	Intended/Correct Form	Type of Error
posterior	subsequent	lexical (substitution)
informations	bits of information	grammatical (addition)
the literature's sources more new	recent literature sources	mixed:grammatical and lexical (misordering, addition) and (substitution)
in this area	(which area?) previous reference required	textual (reference)
The third misconception claims that every language is (..) used and understood by all its practitioners (..), but there are dialect-users in each (..) country (..), that may have serious problems understanding but all the people have somewhat in common.	The third misconception claims that every language is used (..) and understood by all its practitioners (..). As a matter of fact there are dialect-users in each (..) country (..), that may have serious problems understanding each other. However, in spite of this people have somewhat in common.	textual (logical relations, reference, punctuation)

Box 1: Examples of erros made by Brazilian students

3. The *CHUSAURUS* Resource

Whether due to transfer, overgeneralisation, ignorance of rule restrictions, incomplete application of rules, false concepts hypothesised (Richards, 1974) or any other reason, errors should be given an appropriate treatment in academic writing aiming at error-free productions, or at least at the elimination of critical errors which cause a breakdown in

communication. To help the writer overcome a great number of difficulties in the production of academic texts, we propose a resource which can minimize such errors and is suitable for implementation in writing environments.

The devising of this resource was suggested by the strategy employed by many non-natives when writing which consists of seeking help from competent language users (appeal to authority, cf. Tarone, 1978 and elsewhere). The resource is based on the compilation and classification (using human expertise) of well-written, useful expressions appearing in scientific papers and books, which can then be used as reference material by non-native writers. Template-expressions are stored in a sentences base with blank spaces (representing missing words) where reference to specific material is expected. Templates can be extracted from the sentences base and inserted directly into the text being edited, with the user filling in the blank spaces to suit his/her needs. Further details on the *CHUSAURUS* resource can be found in Oliveira et al. (1991).

Similar techniques have been employed in the natural language generation context by Smadja (1991) and Miller and Rennels (1988), for example. This simple approach, however, appears not to be in use as an aid to the composition process of scientific texts.

4. The *AMADEUS* Environment

The environment provides an implementation of the resource described above, comprising composing tools to assist users in the writing of technical articles in English by offering linguistic input in the form of contextualized expressions (Caldeira et al., 1992). It is being implemented in a Sun Workstation within XView (**X** Window-system-based **V**isual/**I**ntegrated **E**nvironment for **W**orkstations), a user-interface toolkit that supports the development of graphics-based interactive applications running under the X-Window system. In order to meet different users' needs we have conceived three versions for the writing environment, namely a **Tutorial** (the most complex in terms of computational development), a **Support** and a **Reference** version. The latter requires the least computational development and is already implemented for a specific area of Experimental Physics. The user may access templates in the sentences base in one of three ways:

1. **Taxonomy** - The expressions are indexed according to a taxonomy which includes the main sections and macrostructures likely to appear in a paper, and are accessed by selecting an item in the taxonomy. On the basis of the relationship claimed to hold between the structure of scientific texts and the stages of the scientific method, the following sections and their subdivisions comprise the taxonomy items: Introduction, Problem, Methods, Results, Discussions and Conclusion (Deyes, 1982). Drawing also on Weissberg and Bucker (1990), who use similar superstructures subdivided into various substructures, we have also used the sections and subsections of the scientific paper in order to make it easier for the user to identify more precisely the subject(s) in each section and also to reflect our specialized corpus. Abstracts were also included, as they normally precede scientific papers.

2. **Communicative Goals** - To date there seems to be no consensus about the issue of communicative goals, which have been defined differently by a number of scholars from the field of linguistics and computational linguistics alike (Trimble, 1985; van Ek, 1987; Tarone, 1980; McKewon, 1985, to quote just a few). For operational reasons, at the initial stage of our project, we have used this term loosely as an umbrella term to cover not only the intended meaning (or purpose) of the whole discourse, but also the specific communicative/rhetorical functions used in the generation of a research paper.

In this access mode the search identifies those expressions which are related to a specific communicative goal (describe, justify, compare, contrast, etc.). This mode was implemented because we believe the non-native writer must receive help related to some of his/her most common questions at the very beginning of the writing process. Such questions include how to express comparisons, contradictions, definitions, etc. The same concern is expressed by Beeken in the CONST-Project (Beeken et al., 1992), which is aimed at the development of writing tools for the (eventually automatic) production and verification of business-oriented texts in Dutch. In our case, it is essential to provide help at this level as different languages provide different means to realize such communicative goals and each language has well defined patterns to express them.

3. **Keywords** - The search is carried out by selecting a keyword that appears frequently in texts of a given area. It can also be used for linguistic items which are usually troublesome for non-native users, such as homophones, near homographs and false cognates (stationary/stationery, real/royal, actually/really), phrasal verbs and prepositions in general.

The choice of the three modes available to access the template expressions in AMADEUS's Reference Version finds support in the work of Trimble (1989) that discusses a rethoric of EST (Scientific and Technical English) discourse. Trimble shows the several levels in which rethoric arises within a piece of discourse. At the first level (A) is the purpose of the total discourse, which in our specific case is the detailed description of a physical experiment. The next level (B) consists of those major pieces of text which, once added together, make up the complete discourse. At this level we have, usually labeled by the headings and sub-headings, the stating of purposes, the reporting of research or physical experiments, etc. In the Reference Version, this is represented by the taxonomy of the paper, through which the writer is made aware of the general rethorical functions present in a scientific text.

In a greater level of detail (C), specific rhetorical functions, such as description, classification and definition, for instance, within the framework of the general rhetorical functions, are used to meet a general discourse objective like detailing an experiment. In order to complete the sections and sub-sections, which consist of rethorical units grouping related paragraphs or even of single paragraphs, we make use of the communicative goals of the Reference Version.

At the last level of detail (D) are the rethorical techniques chosen by the writer that establish the relationships within and between the rethorical units of level C. The Keywords access mode can be used to search the discourse markers that arise in the rethorical techniques such as causability and result (e.g. because, therefore, as a result), order of importance (e.g. first, second, most important), exemplification (e.g. for example, for instance), etc. It provides an alternative way of accessing the communicative goals.

Figs. 1 and 2 show screendumps displaying, respectively, the features of the Composing and Acquisition Interfaces of the Environment's Reference Version. The Composing Mode supports the writing process, whereas the Acquisition Mode enables customization of the sentences base by the inclusion of new expressions and/or new items in the taxonomy. Clicking the option **Main Menu** the user is returned to the menu which displays the options **Composing** and **Acquisition**. In the Composing Mode, clicking the **Experimental Research Report** button the user is displayed a selection of labels describing the parts likely to appear in a paper, whereas

the buttons **Communicative Goals** and **Keywords** present the user with scrolling lists of options to choose from.

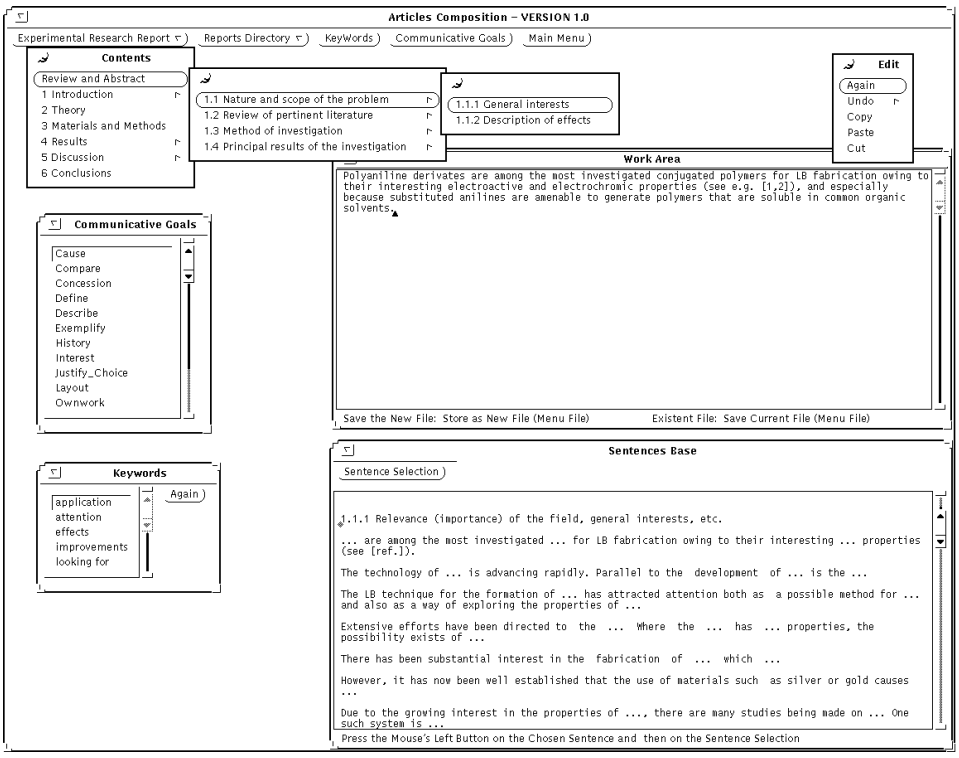

Figure 1: Screendump showing the Composing Interfaces of the Reference version for AMADEUS.

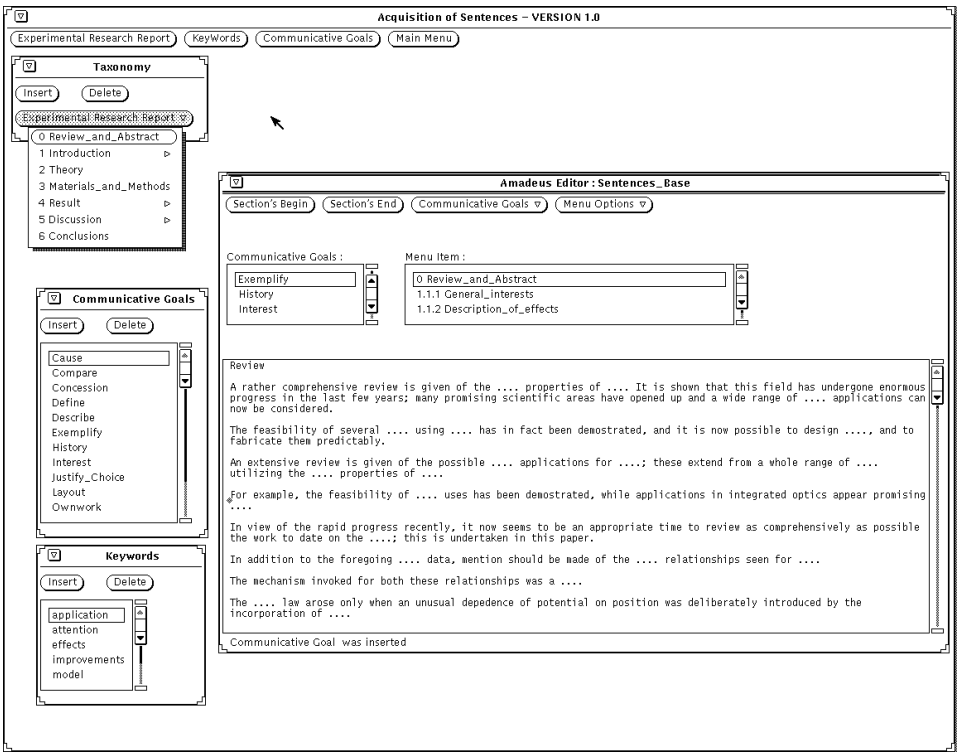

Figura 2: Screendump showing the Acquisition Interface for the Reference Version of AMADEUS.

These buttons thus correspond to modes 1, 2 and 3, respectively, for accessing the templates. Two windows are provided, one of which is a working area for text editing that contains all the basic functions of edition (e.g. undo, cut-copy-paste, find-replace, inclusion and saving of files, etc.). The other displays the selected expressions from the sentences base which can be automatically copied into the working area. In the Acquisition Interface, text can be typed in as well as entered in the form of pre-processed (ASCII) files; in addition, new keywords and communicative goals can be inserted (or deleted) into the corresponding lists. A communicative goal may be linked to one or more sentences by the user.

The Reference Version also includes a catalog, accessed through the button **Reports Directory**. It contains several commented prototypical articles which illustrate relevant aspects of technical articles (choice of verbs

for different sections, for example). Users can bring those into the working area and use them as starting points for the production of first drafts.

The other two versions have not as yet been developed. In the **Tutorial**, the whole writing process is to be monitored by the system, which will offer a rigid frame for the organisation of the paper and give hints as to what type of material should be included. An automatic selection of expressions, driven using expert rules, should guide the user throughout the writing exercise. Users will not be allowed to customize the sentences base by entering new expressions, so as to avoid inexperienced writers adding inadequate material. The **Support** version is under development and will be similar to the Tutorial one except that it will offer hints as to how better structure the paper rather than offer a rigid frame, and will also allow for acquisition of new material into the sentences base in order to meet specific user needs. Functions such as praise, criticisms and explanations will be responsible for analysing positive aspects, suggesting improvements and providing theoretical background to support user choices.

Potential users of the environment may be classified into three categories, namely advanced, intermediate and beginner, according to two axes, namely their background knowledge of the English language and their experience in writing papers. The Reference Version is recommended only for experienced writers with advanced or intermediate knowledge of English, while the Support and Tutorial versions are recommended to wider classes of users. As will be discussed in the next section, the resource employed in the environment is not particularly helpful for writers with poor knowledge of English.

5. Preliminary Results and Discussion

Two primary issues which must be addressed when assessing the usability of the *AMADEUS* environment are its user-interface (see De Oliveira et al., 1992) and the effectiveness of the resource as far as text production is concerned. The interface proved extremely friendly, with considerably short learning times observed for those people already familiar with the OpenLook "look-and-feel". In most cases few minutes sufficed for the user to start working with the tool. However, for most users it took longer for getting accostumed with the "search and fill-in-the-blank" strategy which would enable him/her to identify adequate sentences or linguistic items to meet his/her needs.

In order to test the efficacy of the resource from the outcome's point of view, we monitored writing exercises carried out by post-graduate students during a course on technical writing held in the Physics Department at the University of São Paulo in São Carlos, Brazil. As part of the programme, students were asked to write Abstracts for given texts, and Introductory Sections for hypothetical papers, based on a list of items which were to be discussed. Some of the tasks were done with the help of the resource and then a brief analysis of the written material was carried out. These early investigations were aimed essentially at providing feedback for the development process of *AMADEUS*, rather than carrying out a rigorous linguistic analysis on the writing process by non-natives, which explains the informal approach adopted in the investigation.

Box 2 shows a few excerpts from students' texts, where expressions taken from the sentences base are underlined, and doubly underlined parts indicate spelling as well as grammatical mistakes. Fragment 1 above is an example of an over-long sentence, the sort of sentence likely to cause serious difficulties to non-native writers. Nevertheless, the fragment's author managed to convey his/her message quite successfully because the errors (except for the use of what instead of which) do not hamper communication. The use of template expressions was combined with the user's own writing, producing reasonable connected prose. Misspelt words (`aplications' and `caracteristics') do not affect communication here, particularly because of the similarity with the corresponding correct forms. The only error which may be deemed serious in the fragment is the substitution of `which' (relative pronoun which requires an explicit antecedent, i.e., `bonds') for `what' (relative pronoun which does not require an explicit antecedent).

Since the first conducting polymer was developed over a decade ago, a number of new materials that have conjugated bonds what allow the electrical conductivity have been improved and different structures with different caracteristics and properties with a wide variety of aplications have been developed.

The properties of Langmuir-Blodgett (LB) films have attracted considerable interested in recent years. The application of those films has interested not only physicists, but a wide variety of research workers in other fields. The LB films are formed by the sucessive deposition of monolayers of one or more types of amphiphilic molecules with a regular planar array at the interface between water and air. The experimental method of investigating the properties of LB films are founded in the MSS [1]. Here we study the various physical techniques used to determine the crystallographic structure of the films together with the influence of deposition methods on his structure.

This study intends to present one research made about LB films, widely used by the physicists, electronic engineers, chemists and biologists because it has an interdisciplinary nature. Beyond, there are recently very works in this field. However, the large amount them needs to be checked carefully.

Box 2: Fragments from Brazilian students' texts.

Similarly, in fragment 2, a fairly lengthy paragraph, few errors occur, most of which are grammatical in nature (apart from the reference problem in the last line). For example, in the first sentence, `interest' (noun) and not `interested' (adjective) is the correct form, but such a grammatical mistake does not obscure the general meaning of the sentence. In the third sentence a number of minor errors occur: inadequate addition and then omission of the definite article `the', a spelling mistake (`sucessive'), and the addition of a plural morpheme to `molecule', which should be singular. The fourth sentence presents substitution problems at the grammatical and lexical level, `is found' being the correct form for `are founded'. In the last sentence a reference problem occurs: `his' was used instead of `their', the correct reference form for `films'. Although these problems blurr

communication, the resulting piece of writing makes sense and can easily be corrected.

The third fragment, comparatively, presents errors which affect communication in a more severe way. The last two sentences are difficult to understand and to correct because they lack cohesion and coherence. Several misordering, substitution, addition and omission problems at the grammatical and lexical levels occur in the fragment, making it hard to recover the author's intended meaning. In order to build up coherence a whole reconstruction was necessary. A possible improved version goes as follows: *`The purpose of this study is to present a piece of research on LB films, which are widely used by physicists, electronic engineers, chemists and biologists due to the interdisciplinary nature of this research area. In spite of the fact that there are several recent works in the field, a large amount of them needs to be checked.'* While the mistakes in the first sentence do not hinder communication, those in the last two sentences make meaning impossible to be conveyed. `Beyond' was used instead of the correct form `in addition', `very' is used for `many/several', the definite article `the' should be replaced by the indefinite article `a' and a preposition (`of') is required in the phrase `of them'. Moreover, the relation of contrast between the two sentences is more accurately expressed by `in spite of/although'. When all the cohesive problems are solved, if coherence should be improved, the ambiguity created by `it' in the phrase `it has an interdisciplinary nature' must be solved by means of explicitation of the element referred to by `it', i.e. research area. Another aspect which would help improve the general coherence in the paragraph would be the inclusion of an explicit sentence to give continuity to the propositions in sentence one, linking them to sentence two. A definition of LB films, for instance, would seem to be appropriate.

Comparing the three fragments, the second one is better structured from a textual point of view, while the third poses the most serious problems for communication. As the three passages were written with the aid of AMADEUS, it is difficult, at the moment, to assign likely reasons to the qualitative difference in the outcomes. We can only hypothesise that the variable competence of the users in English may provide an answer.

Overall, the types of error identified in our observations on a number of students' texts (including several not shown here) are consistent with those of (James, 1984) to the extent that the written exercises show problems which range from spelling mistakes to vocabulary difficulties, from misuse of the article system, logical and grammatical connectors to the

use of coined terms to supply lack of appropriate words, misordering and over-long/over-complex sentences.

Focusing on the positive aspects which emerge from using the resource, it is clear that the combination of the user's own writing with the available template expressions can produce positive results regarding text organisation, in spite of some remaining problems. Most importantly, using the tool helped students to get started in their writing tasks. This is encouraging because getting over the writer's block has been mentioned as one of the most important problems faced by writers (Williams, 1990). From a linguistic point of view the use of this resource is beneficial insofar it helps users to cope with writing problems in a way that other resources can not do. Indeed, besides offering authentic input for academic writing at different degrees of complexity, the resource leaves with the user the decision as to how much guidance she/he wants to get. It is interactive and applies both to controlled and free writing tasks.

As for the shortcomings of the environment, perhaps the most critical one has been the frustration on the part of some users who had too high expectations and believed the software could solve all their writing problems. According to (Williams, 1990) frustration can be a severe drawback of writing tools. The tool is obviously not a panacea and cannot help if the user has not a minimum-level proficiency. Indeed, students with poor knowledge of English had difficulties in using the resource because they were not able to make sensible connections between different expressions, and also because they normally made far too many mistakes when having to add in their own text (as in the third fragment in Box 2). This result is not surprising as cohesion in a text is an important feature which requires more than mere juxtaposition of well-written sentences (Coupland, 1984). Another reason for the production of poor texts was that some users did not manage to find canned expressions for some important communicative goals. On the basis of such criticisms we are now working on the linguistic contents of the sentences base, either by inserting new expressions, or by establishing new links between expressions and the communicative goals, or between rhetorical functions and linguistic expressions aimed at particular goals.

6. Final Remarks

We believe the resource is best suited to users possessing a good reception of the English language, i.e. users that can understand

sophisticated constructions and have a reasonable background knowledge of the English grammar. Though we have not carried out any studies in this connection, it is our guess that this minimum required level would roughly correspond to a score of 500 in the TOEFL (Test of English as a Foreign Language). It may be argued that writers who already have a good background in English could be able to produce good texts anyway, which would make the availability of the resource redundant. This is not always the case, however, for non-native writers may know the grammar and have a reasonably rich vocabulary, but they still suffer from the problems of linguistic interference from the mother tongue, and consequently produce poor texts that may be grammatically correct though not idiomatic. Basically, the *AMADEUS* environment that implements the *CHUSAURUS* resource offers help to users with different needs and linguistic knowledge, and its efficiency depends to a great extent on the user's purposes. In brief, major uses for the environment/resource are intended at: (1) users who want/need to write a paper but do not know how to approach the task; (2) users who are familiar with academic writing but still need some guidance or feedback; (3) proficient or near-proficient English users who need to write papers under constraint of time and self-access reference material; (4) learners of English who want both to improve their communicative competence while exercising their writing skills.

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