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Multimedia as a means to enhance teaching technical vocabulary to physics undergraduates in Rwanda

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ABSTRACT

This study investigates whether the integration of ICT in education can facilitate teaching and learning. An example of such integration is computer assisted language learning (CALL) of English technical vocabulary by undergraduate physics students in Rwanda. The study draws on theories of cognitive load and multimedia learning to explore learning in a one-computer classroom in an environment where textbooks and multiple computers are not available. Two groups of students attended a 4-week English-language technical vocabulary course (eight three-hour sessions) taught by two ESP trained science teachers. One group ($n = 13$) was taught using computer-mediated multimedia to present technical vocabulary on-screen. The other group ($n = 19$) received blackboard presentations employing traditional methods to help students internalize the same vocabulary. Post-test scores of the two groups were compared. The results show that the effect of multimedia on the recall of the concepts taught is large (Cohen's d 0.95).

1. Introduction

Recent years have seen rapid advances in the application of instructional and educational technology to facilitate the achievement of educational goals in teaching and learning (Chun, Mayer, Plass, & Leutner, 1998). Computers have appeared as powerful tools to facilitate English language learning and help students and teachers understand various subjects, including sciences.

One of the needs among science students in Rwanda is to improve comprehension by mastering technical vocabulary in their domain of specialization (Alderson, 1984; Laufer, 1991; Nagy, 1988; Nation, 2001). It is assumed (Hyland & Tse, 2007) that, in addition to their existing basic or general service vocabulary that is common to many academic disciplines, teachers and learners of science seek to build a repertoire of specialized academic words to better handle their studies. The present study examines how to equip first-year physics students with the technical vocabulary required in their academic work. The situation has an added complexity in that the students were taught in French in secondary school and had to switch to English when starting tertiary education. How this language gap can be filled is our focus in the present research.

Previous studies suggest that students would understand concepts and phenomena related to their discipline by accurately incorporating specialist language and terminology into their academic work (Woodward-Kron, 2008). Laufer (1989, 1992) claims that learners whose vocabulary size enables them to recognize more than 95% of the words in a text are capable of reaching a reasonable level of comprehension for that text, for example, 55% and above. Thus, learners who master spe-

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cialist vocabulary in their fields are much better able to understand lectures, textbooks and papers in their specialism, which necessitates a good foundation in the general academic vocabulary so as to know how specialist words are related.

The importance of specialized vocabulary is further supported by Hyland and Tse (2007, p. 248) who argue that 'students need to acquire specialized discourse competencies that will allow them to succeed in their studies and participate as group members'. These competencies should include academic literacy that will strengthen critical thinking and arguments based on theoretical or ideological standpoints.

However, if the learners do not understand the vocabulary found in the subject because of its specialized meaning within the discipline or because it is in a foreign language, they may lose motivation and can fail examinations. To confront this problem, researchers (Mudraya, 2006; Nagy, 1988; Wang, Liang, & Ge, 2008; Ward, 2009) propose thorough teaching of vocabulary in order to enhance subject understanding and increased vocabulary size among students who use English as a foreign language.

1.1. Defining terms: vocabulary, concepts, words

In this paper, we have used three terms that need clarification to avoid misunderstanding: *vocabulary*, *concepts* and *words.*

By *vocabulary*, we mean the knowledge of words and their meanings in both oral and print language, and in productive and receptive forms. In our context, vocabulary is understood as those words that students must know so as to read and understand various texts.

A *concept* is defined (Reber, 1985, p. 141) as an internal, psychological representation of shared attributes. For instance, when we talk of *'short-circuit'* in this research, we need learners to understand not only the words but all the steps leading to the occurrence of the phenomenon. In this case we link the *short-circuit* concept with voltage, low resistance, nodes, positive and negative terminals, high current which can further be associated with lightning etc.

Words are terms and labels used to describe, define, discuss, read about or answer questions about concepts. Cohen and Johnson (2011, p. 3) argue that without a command of the meaning of the words, the underlying concepts they label will never fully be mastered.

1.2. Context of the study

Underlying this study is the language situation in Rwanda. Just after the 1994 genocide, many Rwandans were repatriated from different countries where they had taken refuge. Some of these were Anglophone, others Francophone. To cater for the linguistic needs of returning students from various backgrounds, the government established a bilingual system starting from 1996. This was done to help students cope with lecturers who could teach in either French or English. In October 2008 a decision was taken to change the medium of instruction in Rwandan education to English only with effect from January 2009. English was to be used from primary upper level (i.e. standard four to six) to tertiary education.

The policy was supported by several arguments for the increased status of English, including the fact that Rwanda had been part of the East African Community since 2007 and a member of the Commonwealth since 2009 (MINEDUC, 2010). The new language policy was also to be adopted by universities, and students had to be trained to attain proficiency in English to the advanced level of 70% and above before they were allowed to join faculties. These proficiency tests were done at university and were designed following Cambridge English Proficiency tests but were not recognized internationally. The tests were designed in that way because the students used 'New Cambridge English Course' books as their class readers.

Similarly, all lecturers had to take courses in English to be able to use it as the medium of instruction. To embrace the new system, teacher-fronted sessions have been reduced and learner-centred activities are encouraged.

The present research project was carried out in one of the universities in Rwanda where failure and lack of interest in science subjects among students were noted in a longitudinal study covering the academic years 1981/1982 to 1997/1998 (Mureramanzi et al., 2002). Among the subjects with a high failure rate was physics, which averaged 26% compared with 13.33% of other subjects. Due to the poor performance of students at that time, it was suggested that student problems might be related to an overwhelming amount of foreign-language terminology which they did not master. The study was completed in 2002, when the medium of instruction was French. Today, the situation may be more acute due to the recent change in language policy from French to English (Plaut, 2008) as the sole medium of instruction. This article considers the potential of using a multimedia assisted vocabulary learning (MAVL) instrument that was recently created by the researcher, in collaboration with two subject teachers and 82 volunteer students (Rusanganwa, 2011). This instrument is intended to facilitate the teaching and learning of the technical vocabulary required to understand science concepts. The instrument is based on the Cognitive Theory of Multimedia Learning (CTML) proposed by Mayer and colleagues (Chun, Mayer, Plass & Leutner, 1998; Clark & Mayer 2003; Mayer 2001, 2003, 2005, 2008; Mayer & Moreno, 2003; Plass, Chun, Mayer & Leutner, 1998, 2003).

Together with the MAVL programme, another programme of teaching vocabulary called 'traditional vocabulary teaching' was created and allowed to run in parallel with it. This programme was also created to help teach the same 81 concepts in a traditional 'talk and chalk' manner. Thus, the learners were trained to master technical vocabulary in English which they had probably encountered in their high school education conducted in French and would encounter in more depth during their subsequent physics courses on electricity.