



# Effects of Multimedia Learning on ESP Learners' Reading Comprehension and Cognitive Load: A Case of Winning, Surviving, or Losing?

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## Abstract

*Although multimedia technologies have proven to be effective educational tools for language learning, most of the studies in this area have been conducted in EFL/ESL contexts. However, there is a need for an increased understanding of the contribution of multimedia technologies to ESP courses, where language use is limited to the professional environment, and the learners are heavily influenced by time and resource limitations. This study was conducted to investigate the role of implementing multimedia on ESP learners' reading ability and cognitive load in an Archival Science ESP course. The participants consisted of 48 archivists working in the National Library and Archives of Iran in two experimental groups selected based on convenience sampling. Two multimedia-assisted task-based and task-based-only methods were employed in a 10-session ESP course. Following a mixed-methods design, the data were collected and analyzed through using independent samples t-tests comparing the means of the two groups on the reading comprehension tests and the cognitive load self-rating scale in the quantitative phase of the study. Moreover, an inductive thematic analysis approach was employed in the qualitative phase to analyze the data gathered through stimulated recall sessions considering the cognitive load the participants had experienced while they were engaged in multimedia-assisted task-based ESP learning. The quantitative findings suggested that multimedia learning was significantly effective in improving ESP learners' reading ability; however, it generated a higher level of cognitive load in the learning process. The qualitative findings revealed that technology-related problems, learner-related problems, content-related problems, and instruction-related problems were the most important factors leading to an increase in the cognitive load in the multimedia-assisted task-based ESP condition.*

**Keywords:** English for Specific Purposes (ESP); Multimedia Learning; Reading Comprehension; Cognitive Load (CL).

## 1. Background

English for specific purposes (ESP) is a language teaching approach in which the content and objectives of the course are defined based on the specific needs of the target learners [1]. A significant characteristic of ESP courses is that the nature of the content, the language needed to present it, the learners, the materials, the approaches to teaching and assessment, and the context of teaching are unique in each specific field. Practitioners in the field of ESP always try to employ new approaches and techniques in their classes to make language learning more enjoyable for learners and more responsive to their needs.

With the advancement of technology, different language learning software have been developed, and a large part of educational material is presented in the form of multimedia content on related platforms. Although technology provides ESP instructors and learners with better opportunities for language teaching and learning [2], its effectiveness should be examined in different ESP contexts with different learners having diverse learning needs and characteristics.

In most ESP contexts, learners work and study at the same time under great time and workload pressures. Hence, engaging learners in technology-assisted language learning can make the learning environment and educational materials more accessible everywhere and at all times [3]. However, there are some concerns regarding the efficiency of presenting digital content to learners because of the limitations of human working memory (WM) and the possible cognitive load (CL) that technology-assisted and multimedia learning can impose on the learners [4]. Hence, more research is required to



examine the effects of multimedia content on the level of mental effort that learners need to employ to process the information and to help ESP instructors and material developers to design and implement optimal instructional materials to overcome the potential limitations in this regard. Accordingly, the purpose of the present study was to investigate the effects of using multimedia in an ESP course on the reading comprehension of Iranian archivists and the cognitive load they perceived in this process.

## **2. Method**

### **2.1 Research Questions**

This study targeted the following questions:

1. Is there any significant difference between using multimedia-assisted task-based vs. task-based-only language teaching approaches on improving the reading comprehension of Iranian archivists in an Archival Science ESP course?
2. Is there any significant difference between using multimedia-assisted task-based vs. task-based-only language teaching approaches on the mental efforts of Iranian archivists in an Archival Science ESP course?

### **2.2 Instruments**

The following instruments were used to achieve the purposes of this study:

- A researcher-made reading comprehension pretest including 20 items;
- A reading comprehension posttest similar to the pretest in terms of content, difficulty level, and readability (the mean Flesh readability quotient of 16.65);
- The cognitive load self-rating scale developed by Paas [5] in a 9-point Likert scale format;
- Stimulated recall sessions.

### **2.3 Participants**

The participants consisted of 48 male and female Iranian archivists working in the National Library and Archives of Iran attending a mid-career course. They were between 30 and 45 years old and were either graduate or postgraduate students or held an MA or PhD degree. Almost all of them were at the low-intermediate level regarding general English and the technical language of Archival Science. They were members of two intact classes randomly assigned to two experimental groups.

### **2.4 Materials**

A course handbook prepared by the researchers using authentic technical content in the field of Archival Science at the right level of difficulty was used to teach both classes. The related multimedia content consisted of some audio and video files, pictures, and texts selected based on Mayer's recommendations.

### **2.5 Procedure**

In the pre-treatment phase, the homogeneity of the participants was checked using the Preliminary English Test. In the first session, the participants of both groups received a reading comprehension pretest. The first experimental group (EX I) received multimedia-assisted task-based language instruction while the second experimental group (EX II) received task-based-only language instruction in a 10 weeks mid-career ESP course.

In the first condition, the instructor taught the materials and monitored the learners' progress on Schoology. The instructor uploaded the textual version of the lessons on the platform with the related multimedia files to facilitate the learners' understanding of the content. She also projected each text accompanied with the related multimedia content on the classroom screen to discuss the new words with the learners. Next, she checked their understanding by involving them in different receptive and productive tasks. The treatment in this group was not limited to in-class activities since the learners had to continue their work on each lesson in Schoology anywhere, anytime they preferred.

The treatment in the second condition consisted of pre-task, task-cycle, and post-task phases. In this group, each session began with brainstorming the target topic. Then, the instructor wrote each word separately on the board and asked the learners to provide its meaning based on the task they had performed before. After providing the intended meaning of the words in the specific professional context of use, she shifted the focus of the lesson to the technical text. The final stage involved some question-and-answer activities. The learners were also required to do some matching, selecting, sorting, and completion tasks as homework.



The participants of both groups were also required to rate the mental effort they had experienced during their learning process on a self-rating scale at the end of each session. At the post-treatment phase, the reading comprehension posttest was administered to both groups and all the participants of the EX I took part in the stimulated recall sessions.

### 3. Results

The results of an independent samples *t*-test indicated that EX I outperformed EX II in terms of reading comprehension ( $t(46) = -2.13, p = 0.03 < 0.05$  (two-tailed)) at the posttest.

**Table 1. Independent Samples *t*-test for the Reading Comprehension Posttest Scores**

	F	Sig.	<i>t</i>	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	0.66	0.41	-2.13	46	0.03	-1.72	0.80	-3.34	0.09
Equal variances not assumed			-2.14	45.74	0.03	-1.72	0.80	-3.33	-0.10

Moreover, another independent samples *t*-test demonstrated that the EX I had experienced a greater CL, while learning ESP through the multimedia-assisted task-based approach ( $t(46) = -2.14, p = 0.03 < 0.05$  (two-tailed)).

**Table 2. Independent Samples *t*-test for Scores of the Cognitive Load Self-rating Scale**

	F	Sig.	<i>t</i>	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	0.57	0.45	-2.14	46	0.03	-5.75	2.68	-11.16	-0.35
Equal variances not assumed			-2.14	45.37	0.03	-5.75	2.68	-11.17	-0.34

An inductive approach of thematic analysis was used to analyze the CL data. At this stage, 20 codes were extracted which were later reduced to four major themes: *Technology-related problems*, *Learner-related problems*, *Content-related problems*, and *Instruction-related problems*.

### 4. Conclusions and Discussion

The findings indicated that multimedia-assisted task-based language teaching facilitated reading comprehension of ESP learners. This might be because of the potential of multimedia learning in involving multiple senses of the learners in the learning process [6]. Moreover, the nature of multimedia content makes it possible to present difficult and challenging technical concepts using video clips, audio commentaries, animation, etc. When learners have access to multimedia content, they can make a link between what they see in the textbook or hear from the instructor, and the images, pictures, and sounds provided to them and extract the meaning of the technical terms and texts more easily [7].

The higher CL perceived by the participants of the multimedia-assisted task-based group can be justified by referring to the principles of cognitive load theory. The obtained results show that language learners may find it difficult to remember the intended content when dealing with different types of data at a time in multimedia learning due to an unintended increase in the CL imposed on their WM. As highlighted by Martin [8], working memory overload could negatively affect the learning process, because in such a situation learners are not able to understand the new input. This can result in misinterpreting the content and failing to encode the data effectively in long-term memory. On the



other hand, in line with Sweller [9], the use of technology-enhanced instructional materials prevented the participants from effectively engaging in the process of schema construction and automation as a result of the CL they experienced in this learning condition. Moreover, presenting the instructional material through different forms of media may force learners to become involved in more extraneous processing, which in turn can distract them when they need to be focused on two or more forms of media simultaneously [10]. In addition, multimedia-assisted learning might impose a greater burden on learners' cognitive and metacognitive processing capacity; hence, there might be an increase in the CL they perceive during the learning process and a decrease in their learning outcomes.

The results also demonstrated four factors affecting the CL the participants had experienced during the treatment. Technology-related problems could have led to extrinsic CL by requiring them to acquire the input by using a new virtual learning platform and following a relatively difficult and unfamiliar method of language learning. Learner-related problems might have also contributed to extrinsic CL by involving learners who suffered from poor general English, low self-confidence and motivation, great mental engagement, and tiredness to use a new method of language learning that required them to invest more time and mental energy in learning. The specific characteristics of technology-based instruction, the employed digital materials, and technophobia could have also resulted in both intrinsic and germane load.

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