

The Effects of an Instructional Intervention to Foster the Use of the Selection and Organization of Ideas as a Learning Strategy

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Abstract

This article presents an impact evaluation of an instructional intervention oriented to foster learning strategies, regarding to ideas selection and organization, on a first year engineering students. Learning strategies are mental processes that students may perform to facilitate the achievement of a learning task. Ideas selection and organization is a kind of strategy classified as cognitive, since it allows processing the information read by a student. The didactic sequence implemented consisted of introducing, through instruction, how to elaborate academic summaries and afterwards the students wrote a summary about technical Engineering texts. Participants on this research were Electrical and Electronics Engineering freshmen from a Colombian university enrolled in an introduction to Engineering class, who developed the intervention proposed. Additionally, a freshmen group from another Engineering program was evaluated in order to compare its performance in terms of this learning strategy. The MSLQ-Colombia questionnaire was the psychometric instrument used to measure whether instruct and practice writing summaries allowed students fostering the selection and organization of ideas. From the evaluation of the gathered data, the authors concluded that the participants in the educational intervention promoted significantly (statistical significance) the use of cognitive strategies. In addition, the contrast between groups also showed that the instructional strategy was effective to develop the intended strategy.

1. Introduction

Learning strategies are “actions taken by students to make learning easier, more effective, and more self-directed and more transferable to new situations” [1]. The learning strategies favor significant learning, are related to academic performance positively, enable self-regulated learning and intercede on “learn how to learn” and reaching the autonomy in learning [2].

McKeachie and et al [3] classify learning strategies in cognitive, metacognitive and strategies for resources management. Cognitive strategies enable processing information received through codification [4], therefore, they ease transforming the information received into something more significant and easy to remember [5]. Memorization, elaboration and organization of ideas are considered cognitive strategies [4]. The cognitive strategies of selecting and organizing ideas, aim of this study, consist in identifying the main ideas of the topics and organize them by making connections [3]; these strategies make the information significant for the student; that is, they allow the student provide coherence to the contents, understand topics, create new meanings and memorize information in a long-term [6]. We can consider as techniques to select and organize information: underline learning materials, take notes in class, make diagrams with the topic important concepts, the clustering [3], the mnemonic keyword method [5], text structures recognition [7] and self-directed summarization [8], among others.

The researchers have found that the students of technical and experimental careers, in Latin American countries, use learning strategies in a small proportion [9]. Additionally, it was found that Engineering students are likely to use the least the learning strategies, in comparison to other students of different careers [9]. Due to the advantages of using learning strategies in learning processes, the researchers suggest to make new efforts for the Engineering students to learn using those strategies.

The level at which the Engineering Students of the National University of Colombia use the learning strategies was described in a previous stage of the study presented in this article. The results suggested the strategies least used by the participant population of that study were the strategies of selection and organization of ideas [10]. It is important for an Engineer learn how to select and organize information because it is a strategy that makes easier doing several activities, distinctive of their profession; for example, solve problems [11] and understand engineering technical texts [8]. These strategies comprise the most interesting and useful cognitive processes within learning in a

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university context [3]. According to this, it was decided to design, implement and assess an educational intervention for the freshmen students of the Electric and Electronics Engineering careers of the National University of Colombia, in order for them to learn and practice a technique to select and organize ideas. The design and assessment of the intervention effects are exposed in this article. We expect the methods used, and the answers found, to contribute for other initiatives whose purpose is encouraging the engineering students to use the strategy of selection and organization of ideas when they read.

2. Methods

2.1 Instructional intervention

Writing summaries was the technique chosen for this educational intervention, to facilitate the students applying strategies to select and organize ideas. The bases of this technique have been developed from the investigations on reading strategies to understand and study technical texts. The investigations of Cook and Mayer [12], Mayer and Bromage [13] and Derry and Murphy [14] are an example of this kind of studies. This technique was chosen because its hypothesis suggests writing summaries makes easier selecting and organizing information when reading technical texts [14]. Additionally, since summaries are documents frequently written by engineering students and professionals throughout their career [15], this intervention also purposes to improve the students' competence of academic writing.

The didactic sequence implemented in the educational intervention consisted of three workshops: in the first one, the methods of reading comprehension of engineering technical texts [14], based on the identification of the text structure, and the methods of writing summaries, were introduced to the students. In the second workshop the students received an engineering technical text and were asked to read it and summarize it using the method presented in the first workshop. Likewise, the teachers summarized the text. At the end of the workshop, the students had to compare their summary with the one wrote by the teachers; the aim of this exercise was to demonstrate the students that a text summary may have many acceptable versions. In the third workshop the students familiarized with the evaluation criteria for the summaries. At the end, the students composed three summaries in total.

2.2 Participants

This intervention was an educational strategy, brought together to the objectives of two subjects of the National University of Colombia – Bogotá: Introduction to Electric Engineering and Introduction to Electronics Engineering. Both subjects belong to the first academic year and expect the student to recognize contexts and scopes of the engineering professional practice, and to foster the written communication competence. In total, 95 students participated: 50 students of Electronics Engineering and 45 students of Electric Engineering. The participants had an average age of 19.3 years (standard deviation: 2.5 years); 8 were women and 87 were men. In the results section of this article, this group of participants was referred as experimental group.

2.3 Instruments for evidence collection

The MSLQ – Colombia [16] was employed to collect evidences, in order to analyze the effects of the educational intervention. The MSLQ-Colombia is an adapted and validated version of the Motivated Strategies for Learning Questionnaire (MSLQ) [17] for Colombian engineering students. The MSLQ-Colombia is a self-report questionnaire to characterize, at a specific moment and in a specific subject, the student motivation, the level of usage of cognitive and metacognitive strategies and the usage of strategies to manage resources for learning tasks. Since the purpose of this intervention was to foster the strategy of selection and organization of ideas, only the data related to that subscale of the MSLQ-Colombia is presented in the results section of this article, thus, there are just four items:

- (a) When I study the written material of this subject, I underline the material to organize my ideas.
- (b) I write summaries to organize the main ideas of the topics.
- (c) I make diagrams, tables, charts, among others; to organize the information of the subject topics.
- (d) When I rehearse my notes taken in class, I make a diagram using the most important concepts of the subject.

The participants of this study filled out the MSLQ-Colombia twice: at the end of the workshops and after submitting the three summaries. Likewise, 65 of the freshmen students of Introduction to Engineering, from a different engineering degree in the National University of Colombia, were asked to

fill out the MSLQ-Colombia at the beginning and at the end of the academic period. This group didn't participate in the three workshops of the educational intervention. In the results section this group would be referred as control group. The results of the first test of the MSLQ-Colombia, enabled identifying the initial state of the students, regarding to the employment of strategies to select and organize ideas. The second time, the re-test, enabled characterizing how much the students of the experimental group (participant of the three workshops) and the control group (students who studied a first year subject at the university, but did not learn about writing summaries) used the strategies.

3. Results

The Table 1 presents the results of the test and re-test obtained by the students for the items of Selection and Organization of ideas of the MSLQ – Colombia.

The Descriptive Statistics columns show the students of the experimental group and control group, at the beginning of the academic period, use slightly the strategies to select and organize ideas (see column Mean Test); and the average for each item might be between 1.00 and 7.00, and the values are between 3.17 and 5.77.

Specifically, before the intervention, the strategy of writing summaries (item (b)) to select and organize the information presents an average of 3.51 and 5.77 for the students of the experimental group and control group. The second time the test was filled out (see Mean Re-test), taking into account the gain values and p-value of the *t* test for items (a), (b) and (c), it was found that the experimental group students increased significantly and positively the usage of strategies to select and organize ideas (gain: 0.48; 0.90 and 0.46). For the control group students, no participants in the intervention, it was found that at the end of the academic period in the university, they didn't foster, with statistical significance, the selection and organization of ideas (no items with significant gain). The effects of the intervention (see column Effect size) were positive and presented Cohen's *d* values of 0.27; 0.47 and 0.25 for items (a), (b) and (c). These values are considered moderate or excellent for interventions made in educational contexts [18]. The strategy of making diagrams with the important concepts (item (d) of the MSLQ-Colombia) wasn't fostered by both, the experimental and the control group.

4. Conclusions

From the results of the educational intervention, it can be concluded that learning and practicing to write summaries favored the freshmen students of engineering to foster the use of strategies to select and organize information. The students started to underline more the study material, make summaries to organize ideas and make diagrams, tables and charts to organize information. The strategy most promoted by students was to write summaries to organize the ideas. The strategy to make diagrams

Table 1. Descriptive statistics MSLQ-Colombia – Strategies of Selection and Organization of Ideas

Items related to selection and organization of ideas (MSLQ-Colombia)	Descriptive statistics						Significance (gain)	Effect size
	Group	Mean Test	D.T.	Mean Re-test	T.D.	Gain	p-value of the <i>t</i> test	Cohen's <i>d</i>
(a) I underline the study material	Experimental	3.96	2.02	4.44	1.56	0.48	0.009**	0.27
	Control	3.72	1.64	4.03	1.82	0.31	0.115	--
(b) I write summaries to organize the ideas	Experimental	3.51	2.12	4.41	1.66	0.90	0.000**	0.47
	Control	5.77	1.19	5.54	1.404	-0.23	0.265	--
(c) I make diagrams, tables and charts to organize the information	Experimental	3.51	2.00	3.97	1.65	0.46	0.037*	0.25
	Control	3.69	1.90	4.03	1.72	0.34	0.176	--
(d) I make diagrams using the important concepts	Experimental	3.17	1.86	3.57	1.68	0.40	0.072	--
	Control	3.94	1.73	3.91	1.77	-0.03	0.877	--

* The gain is significant at a level $\alpha = 0.05$

** The gain is significant at a level $\alpha = 0.01$

-- The effect size is not calculated because the gain had no statistical significance

T.D. Standard deviation

with the important concepts wasn't foster by the students. Additionally, by comparing the results of the experimental group to the results of the control group, it can be concluded that the educational intervention contributed for the students to foster these strategies.

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