



# Comparison of Cognitive Learning Strategies of Dental Students at the Beginning and at the End of Their University Course

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## Abstract

**Introduction:** The aim of this study was to evaluate the differences in cognitive learning strategies of students of the faculty of dentistry in Casablanca between the beginning and the end of the university curriculum. **Methods:** A descriptive cross-sectional study was conducted using a questionnaire distributed to 318 students in their 1<sup>st</sup> and the 5<sup>th</sup> year class in the 2021/2022 academic year. **Results:** 17% of 5<sup>th</sup> year students listened without taking notes compared to 42.4% of 1<sup>st</sup> year students. 81.4% of 1<sup>st</sup> year students and 82.3% of 5<sup>th</sup> year students understood the lecture before memorizing. 37.6% of 5<sup>th</sup> year students vs. 31.1% of 1<sup>st</sup> year students used effective mnemonics for elaboration. 24.1% of 5<sup>th</sup> year students and 26% of 1<sup>st</sup> year students used the “paraphrasing” strategy. The ability to invent questions that could be asked on the exam was used by 64.5% of 5<sup>th</sup> year students and 58% of 1<sup>st</sup> year students. 22.6% of 1<sup>st</sup> year students and 16.3% of 5<sup>th</sup> year students made summaries or diagrams. **Conclusion:** Cognitive learning strategies were predominantly similar between 1<sup>st</sup> year and 5<sup>th</sup> year students. A teaching program aimed at raising awareness and developing cognitive strategies is strongly recommended.

## Subject Areas

Pedagogy

## Keywords

Learning Strategies, 1<sup>st</sup> Year Students, 5<sup>th</sup> Year Students, Cognitive Strategies

## 1. Introduction

For students, university represents a new context of study into which they must quickly integrate. Indeed, the student's rapid adaptation to this new world, and in particular the adaptation of his or her learning strategies is one of the keys to academic success [1]. Researchers have been interested in learning strategies since the 1970s [2]. Several authors have proposed a definition of the concept of learning strategies. Authors define learning strategies as behaviors or thoughts that the learner uses during learning to influence his or her information encoding processes. It is also defined as "activities performed by the learner to facilitate the acquisition, storage, recall and application of knowledge at the time of learning" [3]. Four categories of learning strategies have been identified:

- cognitive strategies,
- meta-cognitive strategies,
- affective strategies,
- resource management strategies.

Cognitive strategies are techniques that are used to facilitate the execution of learning processes and thus ensure the acquisition of knowledge or the development of a skill. It aims to facilitate the encoding of information or to build links between new knowledge and old knowledge. These types of strategies are also used to help retrieve previously acquired information [4]. Cognitive strategies can be divided into six sub-categories:

- **Memorization or repetition strategies** involve reproducing what is, in particular by recalling, reciting or revising knowledge. As part of these activities, the student will take notes (word by word, essential...), underline, shade important notions, recite, make lists of terms, symbols, repeat several times (mentally, in a low voice or out loud)...
- **Elaboration strategies** aim to develop the knowledge acquired in order to give meaning to learning or improve comprehension. Elaboration strategies use the student's ability to paraphrase or rewrite in his or her own words the information to be retained and to invent questions.
- **Organizational strategies** involve structuring ideas by trying to link them together, either through some form of grouping, categorizing or hierarchizing, by making diagrams and schemas, or by looking for the main ideas in a text.
- **Generalization strategies** involve extending knowledge to other contexts, by identifying and inventing examples and finding similarities.
- **Discrimination strategies** are used to determine in which situations it would or would not be appropriate to use a concept. They involve identifying and inventing counter-examples and finding the differences. These last two strategies involve a higher level of complexity than the other categories of cognitive strategies.
- **Knowledge compilation strategies** involve making a list of the steps to follow, practicing small steps at a time, and finally practicing the whole proce-

dure.

Based on research into these strategies, two types of approaches have been identified, the deep and the superficial learning [5]. The superficial approach can be recognized by the privileged use of superficial processing strategies such as recall or memorization. The student is essentially concerned with meeting the requirements of the task, which is seen as externally imposed: he or she tries to memorize the various elements without really understanding them, with the sole aim of being able to reproduce them during evaluation. Nor does he takes the time to reflect on the relationships between the various elements, or to ponder the possible implications of what he learns [6]. The in-depth approach translates into a predominant use of cognitive strategies that induce active processing of information, such as the elaboration and organization of knowledge. The task is no longer seen as an external constraint, but rather as something that enables the student to develop. Students focus on the meaning of what they are learning, organizing and structuring content to integrate it in their own way. They establish relationships between their prior knowledge and what they are currently learning. Finally, they critically examine the relationships between arguments and the evidence that is supposed to support them [6].

In higher education, and particularly at the Faculty of Dentistry in Casablanca, the academic results of some students are disappointing. Our aim was to understand why these students were finding it difficult to study effectively, by looking at their learning strategies. Our final objective was to improve their academic success and help teachers in their fundamental task of conveying knowledge. The aim of this 1<sup>st</sup> part of the study was to assess the cognitive learning strategies of dental students of the Faculty of Dentistry of Casablanca and another part of the work will be dedicated to the study of other strategies.

## 2. Materials and Methods

To accomplish this work, a descriptive cross-sectional study was conducted. Our study targeted 1<sup>st</sup> year and 5<sup>nd</sup> year classes at the Faculty of Dentistry of Casablanca, Morocco, during the 2021-2022 academic year, because lectures begin in the first year and end at the 5<sup>th</sup> year, the 6<sup>th</sup> year of the university course being dedicated only to clinical internships. To collect the data required for the study, a questionnaire was developed on the various aspects of cognitive strategies. It was designed based on Biggs's questionnaire [7]. Data collection took place between 5<sup>th</sup> May 2022 and 25<sup>th</sup> May 2022. Contact with 5<sup>th</sup> year students took place in the various departments of the university Hospital, during clinical shifts, after obtaining permission from all the teachers concerned. The questionnaire was distributed at the start of the shift and collected at the end of the same shift. For the 1<sup>st</sup> year students, contact took place on all second-semester examination days. Results were entered and analyzed using SPSS 10.0 software (Statistical Package for the Social Sciences) at the Epidemiology and Biostatistics Laboratory of the Faculty of Dentistry, Casablanca. Analysis was descriptive for all variables.

### 3. Results

The participation rate was 98.8%. Our sample comprised 177 students in 1<sup>st</sup> year and 141 students in 5<sup>th</sup> year. The female rate was 53% in 1<sup>st</sup> year and 57.4% in 5<sup>th</sup> year. Detailed data on the cognitive strategies used are summarized in **Tables 1-4**.

**Table 1.** Note-taking during the course.

VARIABLES	1 <sup>st</sup> year N (%)	5 <sup>th</sup> year N (%)	<i>P</i>
- Word by word	7 (4%)	7 (5%)	0.678
- Taking only the essential	89 (50.3%)	98 (69.5%)	0.0008
- Listening without taking notes	75 (42.4%)	24 (17%)	$8.56 \times 10^{-7}$
- Recording the lesson on phone	14 (7.9%)	23 (16.3%)	0.022

**Table 2.** Memorization strategies and tips.

VARIABLES	1 <sup>st</sup> year N (%)	5 <sup>th</sup> year N (%)	<i>P</i>
<b>Memorization strategy:</b>			<b>0.917</b>
- Memorizing by heart (superficial learning)	32 (18.2%)	25 (17.7%)	
- Understanding the course before memorizing	144 (81.8%)	116 (82.3%)	
<b>Memorization tips:</b>			
- Reciting to someone else	20 (11.3%)	19 (13.5%)	0.556
- Paraphrasing (rewriting in own words) what you want to retain	46 (26%)	34 (24.1%)	0.701
- Reading the course several times	111 (62.7%)	98 (69.5%)	0.204
- Constructing a main word from several key words (e.g. FES = Frontal bone, Ethmoid bone, Sphenoid bone)	55 (31.1%)	53 (37.6%)	0.222
- Other:	10 (5.6%)	7 (5%)	
▪ Listening to audio	1 (0.6%)	-	
▪ Turning the course into a story	1 (1.1%)	1 (0.7%)	
▪ Understanding the course very well	1 (0.6%)	-	
▪ Turning course into questions	1 (0.6%)	-	
▪ Reciting aloud	2 (1.1%)	-	
▪ Activating recall	1 (0.6%)	-	
▪ Singing	1 (0.6%)	-	
▪ Mnemonics	1 (0.6%)	-	
▪ Diagramming the course	-	1 (0.7%)	
▪ Rewriting the course	-	1 (0.7%)	
▪ Reciting mentally	-	1 (0.7%)	
▪ Explaining the course to himself	-	1 (0.7%)	
▪ Asking someone else to explain the course	-	1 (0.7%)	

**Table 3.** Reviewing notes before a lesson or exam.

VARIABLES	1 <sup>st</sup> year N (%)	5 <sup>th</sup> year N (%)	<i>P</i>
<b>Reading what was explained in the previous session before attending the class:</b>			<b>0.087</b>
- Always/Often	46 (26.1%)	24 (17%)	
- Never/Rarely	130 (73.9%)	117 (83%)	
<b>Inventing questions that could be asked on the exam:</b>			<b>0.146</b>
- Always/Often	102 (58%)	91 (64.5%)	
- Never/Rarely	74 (42%)	50 (35.5%)	
<b>Reading the notes again just before the exam:</b>			<b>0.014</b>
- Always/Often	118 (67.4%)	114 (80.9%)	
- Never/Rarely	57 (32.6%)	27 (19.1%)	

**Table 4.** Resources and strategies used to revise a course.

VARIABLES	1 <sup>st</sup> year N (%)	5 <sup>th</sup> year N (%)	<i>P</i>
<b>Ressources used for course revision:</b>			<b><math>4.427 \times 10^{-06}</math></b>
- Support provided by the teacher	47 (26.7%)	8 (5.7%)	
- Summaries	29 (16.5%)	27 (19.1%)	
- Teacher provided support and summaries	93 (52.8%)	104 (73.8%)	
- Other resources	7 (4%)	2 (1.4%)	
▪ Internet	2 (1.1%)	1 (0.7%)	
▪ Questions from previous years	1 (0.6%)	-	
▪ Everything useful	1 (0.6%)	-	
▪ VIDEOS/MOOC	1 (0.6%)	-	
<b>Strategies used for revising a course:</b>			
- Identification of key words	70 (39.5%)	45 (31.9%)	0.137
- Underlining important concepts in fluorescent	70 (39.5%)	89 (63.1%)	<b><math>4.384 \times 10^{-05}</math></b>
- Reading the text quickly to understand the general idea, then reading slowly to deepen understanding	76 (42.9%)	57 (40.4%)	0.590
- Stop after reading part of a text to make a summary or diagram	40 (22.6%)	23 (16.3%)	0.147
<b>Review Strategies for the exam:</b>			
- Retaining all course content	68 (38.4%)	51 (36.2%)	0.652
- Retaining parts of the cours	54 (30.5%)	49 (34.8%)	0.441
- Retaining elements on wich the eatcher has insisted	71 (40.1%)	67 (47.5%)	0.200
- Retaining only answers from previous exams	15 (8.5%)	12 (8.5%)	0.996

## 4. Discussion

The results of this study showed that there was a significant difference ( $p < 0.05$ ) between 5<sup>th</sup> year and 1<sup>st</sup> year students in terms of note-taking during the course: 17% of 5<sup>nd</sup> year students listened without taking notes, compared with 42.4% of 1<sup>st</sup> year students (**Table 1**). Vanmuylder *et al.* compared the learning strategies used by ULB (Université Libre de Bruxelles) medical students during the first three years of medical studies (CM1/CM2/CM3) and the learning strategies of 1<sup>st</sup> year medical students (CM1) with first year medical biology graduate students (BM1) and nursing school students (I/A1). A comparison of the results obtained from CM1, BM1 and I/A1 students respectively showed that the use of “memorization” strategies appeared identical. On the other hand, a comparison of the results obtained respectively among CM1/CM2/CM3 students showed that the use of “memorization” strategies decreased over the three years of study [8]. Dilk concluded in 2010, at a university college in Saint-Boniface, Canada, that the use of these cognitive rehearsal strategies proved to be fairly characteristic of all the subjects in his study [9].

For memorization, our study showed that there was no significant difference between 1<sup>st</sup> and 5<sup>th</sup> year students in terms of their strategies for learning a course ( $p = 0.917$ ). 81.8% of 1<sup>st</sup> year students and 82.3% of 5<sup>th</sup> year students preferred to understand the lecture before memorizing (**Table 2**). According to a similar study carried out in 2016 on the learning strategies of dental students at the two faculties of Casablanca and Rabat, 86.5% of students understood before memorizing, compared with 13.5% of students who memorized directly [10]. Another study carried out at Bahria University in 2018, with the aim of comparing learning approaches (deep and superficial) in junior and senior dental students, showed that the two cohorts did not differ significantly in deep and superficial learning approach [11]. In a descriptive study published in 2008, on the learning practices of 4<sup>th</sup> year medical students at the University of Nantes, the researchers found a predominance of the deep learning approach: students try to understand, with the aim of retaining information as long as possible [12].

For the cognitive strategy of elaboration, a comparison of the results obtained by the 1<sup>st</sup> and 5<sup>th</sup> year students in our study showed that there was no significant difference. Effective mnemonic means were used by 37.6% of senior students and 31.1% of junior students, and the “paraphrasing” strategy by 24.1% of 5<sup>th</sup> year students and 26% of 1<sup>st</sup> year students (**Table 2**). On the other hand, the ability to invent questions that could be asked on the exam is used by 64.5% of 5<sup>th</sup> year students and 58% of 1<sup>st</sup> year students (**Table 3**). In a study carried out at the Collège d’enseignement général et professionnel (Cégep) in Montreal, the aim was to describe the learning strategies used by nursing students and to track the evolution of their strategic choices over the first three terms of training. The results of the study showed a marked improvement in elaboration strategies during group work. During individual work, elaboration strategies were also more widely used between the first and the third sessions, but still too few stu-

dents used them in the third session [2].

In our study, a similarity between 1<sup>st</sup> and 5<sup>th</sup> year students was found with regard to the majority of cognitive strategies for repetition or memorization. In fact, 62.7% of 1<sup>st</sup> year students compared with 69.5% of 5<sup>th</sup> year students preferred to read a course several times as an aid to memorization. Only 26.1% vs. 17% of 5<sup>th</sup> graders often reread their notes just before a lesson. A significant difference was noted between the two years ( $p = 0.014$ ): 67.4% and 80.9% of 1<sup>st</sup> and 5<sup>th</sup> year students respectively preferred to reread notes before the exam to refresh their memory (Table 3).

Furthermore, there was no significant difference ( $p \geq 0.05$ ) in the use of cognitive organization strategies, which remained infrequent for students in the two classes. Indeed, after reading a lecture, 22.6% of 1<sup>st</sup> year students and 16.3% of 5<sup>th</sup> students made summaries or diagrams (Table 4). However, as an effective tool of thinking, mind-map can develop human potential and the students' thinking ability greatly. Mind-map is made up of lines, symbols, text, color and graphics elements. One can visualize the storage, organization, arrangement, study, and review and memorize information by applying this effective means of thinking. It is based on the related way of thinking style that one can construct his own knowledge system [13].

Several studies have highlighted the influence of organization and elaboration strategy on student performance. Larue *et al* separated students into strong and weak performers according to their final course grade, and then compared the strategies used by these two groups. Strong and weak students mainly used memorization strategies. Strong students, however, used more organizing and elaborating strategies than weak students, suggesting that these strategies were related to performance [14]. Trottier compared the strategies used by strong and weak undergraduate students in several disciplines, including health sciences. They found that the use of organizational strategies was associated with success in all disciplines. Then, specifically in Health Sciences, strong students used significantly more elaboration strategies than weak students [4]. Mc Nulty *et al* looked at the learning strategies used by first- and second-year medical students at Loyola University Chicago. The researchers used two categories of strategies, memorization strategies that use repetition to integrate information and construction strategies that use organization, integration and adopting an overview to gain a deep understanding of the content. Researchers observed that the use of construction strategies was related to performance, while the use of memorization strategies was negatively correlated with performance [15].

## 5. Conclusions

The learning strategies adopted by 1<sup>st</sup> and 5<sup>th</sup> year dental students of the faculty of dentistry of Casablanca are largely similar. For the first part of the work, we recommend the organization of workshops and seminars to:

- raise awareness of the value of different cognitive strategies in learning,

- help junior students to improve their note-taking skills during lectures,
- improve memorization techniques in both classes,
- improve course reading and revision in both classes,
- improve elaboration and organization strategies in both classes.

### Conflicts of Interest

The authors declare no conflicts of interest.

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