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Learning strategies of dental students in Buenos Aires, Argentina prior to and during the COVID-19 pandemic

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ABSTRACT

Various theories have endeavored to explain how knowledge is accessed. Students, in order to learn, need a good repertoire of appropriate metacognitive and self-regulating strategies and knowledge, which they use consciously or unconsciously. Teachers, in addition to knowing how to teach, need to be aware of students' learning strategies, metacognition, and self-regulation, and of the impact of changes associated with recent pandemic scenarios. ***Aim:*** *The aim of this study was to identify the study strategies preferred by dental students in two different scenarios: prior to and during the pandemic.* ***Materials and Method:*** *The sample consisted of third-year dentistry students at Buenos Aires University (UBA) during 2019 (Group GP, 141 students, face-to-face activity) and 2021 (Group GE, 60 students, e-learning during the pandemic). Participants were asked (a) to provide demographic information (sex and age) and (b) to answer the abridged ACRA scale. Statistical treatment included descriptive tests; Chi², binomial exact and Student's t-test (p<0.05).* ***Results:*** *The proportion of students who participated with respect to total students enrolled was 58.50% in 2019 and 26.20% in 2021, with female gender being significantly higher. There were significant differences in total number of participants during the different periods (p=0.001), and in gender distribution during the pandemic (p=0.007). Comparison between groups GP and GE showed no significant difference regarding preferences expressed in total values for the scale or for the domains. Analysis of preferences according to gender showed significant differences in total group (p=0.007) and the domains CLCS (Cognitive and Learning Control Strategies) (p= 0.008) and LSS (Learning Support Strategies) (p=0.002). The mean values of preferences selected by females were higher. Similar results were found upon analyzing preferences during the pandemic (n= 60) considering total score (p= 0.033) and the domains CLCS (p= 0.035) and LSS (p= 0.007).* ***Conclusions:*** *The study identified trends towards an increase in the score and consequently greater use of techniques included in the domains related to metacognition, especially among women. There is potential neutralization of the impact created by the methodological shift between the two periods (face-to-face and e-learning) probably as a result of the implicit adaptability, latent in students, regarding digital methodology, which enables them to adapt to learning in challenging situations.*

Keywords*: learning strategies - e-learning - gender - COVID-19*

Impacto de la pandemia por covid-19 sobre las estrategias de aprendizaje de los estudiantes de odontología en Buenos Aires, Argentina

RESUMEN

Varias teorías se han esforzado por explicar cómo se accede al conocimiento. Para aprender, los estudiantes necesitan tener un conjunto de estrategias y conocimientos apropiados, y utilizarlos consciente o inconscientemente. Los docentes deben conocer las estrategias de aprendizaje, la metacognición y la autorregulación de los estudiantes, así como el impacto de los cambios asociados con los escenarios pandémicos recientes sobre esas estrategias. ***Objetivo:*** *El objetivo de este estudio fue identificar las estrategias de estudio preferidas por los estudiantes de odontología en diferentes escenarios: previo y durante la pandemia.* ***Materiales y Método:*** *La muestra estuvo conformada por estudiantes de tercer año de la carrera de odontología (UBA) durante el año 2019 (Grupo GP, 141 estudiantes, actividad presencial) y 2021 (Grupo GE, 60 estudiantes, e-learning durante la pandemia). Los participantes proporcionaron información demográfica (sexo y edad) y respondieron el cuestionario ACRA abreviado. El tratamiento estadístico incluyó medidas de tendencia central, dispersión y distribución de frecuencias, prueba Chi2, binomial exacta y prueba t de Student (p<0,05).* ***Resultados:*** *La distribución de estudiantes que participaron con respecto al total de estudiantes matriculados fue de 58,50% en 2019 y 26,20% en 2021, siendo significativamente mayor el género femenino. Hubo diferencias significativas en el número total de participantes durante los diferentes períodos (p=0,001) y en la distribución por género durante la pandemia (p=0,007). La comparación entre los grupos GP y GE no mostró diferencia significativa en cuanto a las preferencias expresadas en valores totales para la escala o para los dominios. El análisis de preferencias según género mostró diferencias significativas en: grupo total (p=0,007) y los dominios ECCA (Estrategias de Control Cognitivo y de Aprendizaje) (p= 0,008) y EAA (Estrategias de Apoyo al Aprendizaje) (p=0,002). Los valores medios de las preferencias seleccionadas por las mujeres fueron más altos. Resultados similares se encontraron al analizar las preferencias durante la pandemia (n= 60) considerando la puntuación total (p= 0,033) y los dominios ECCA (p= 0,035) y EAA (p= 0,007).* ***Conclusiones:*** *El estudio identificó un aumento en el puntaje y consecuentemente un mayor uso de técnicas incluidas en los dominios relacionados con la metacognición, especialmente entre las mujeres. Existe una potencial neutralización del impacto creado por el cambio metodológico entre los dos períodos (presencial y e-learning) probablemente como resultado de la adaptabilidad implícita, latente en los estudiantes, respecto a la metodología digital, que les permita adaptarse al aprendizaje en situaciones desafiantes.*

Palabras Claves*: estrategias de aprendizaje - aprendizaje virtual - género - COVID-19*

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INTRODUCTION

Various theories have endeavored to explain how knowledge is accessed. A constructivist, cyclic conception of learning[1–8] recognizes organized, coordinated mental operations or cognitive processes. These are inferred based on the subject's behavior during reasoning or problem-solving tasks which, operatively, act as the goals to be attained. This processing takes place as a path followed by the student to develop skills and learn contents: their learning method. During this process, the student employs flexible sociocultural instruments learned in contexts of interaction, applying procedures that include several specific techniques or operations in pursuit of a purpose: learning or problem-solving.

Learning to learn, or being strategic to learn, is essential in today's culture, where it is necessary to process and deal with large quantities of information and frequent challenging situations. To do so, students need to have a good repertoire of appropriate metacognitive and self-regulating strategies and knowledge, and use them consciously or unconsciously[9].

According to Díaz Barriga and Hernández Rojas[10], learning strategies are procedures or sequences of conscious, voluntary actions, and applying them involves the student knowing how to select intelligently among several resources available to him/her and knowing how to control the cognitive processes in order to complete a task successfully. This enables monitoring and assessment while a student is involved in the process according to given contextual demands and to the achievement of certain learning goals. Learning strategies are activated whenever the student is required to learn, remember or solve problems related to learning contents.

Learning strategies are propositional activities that are reflected in the four broad phases of information processing. These phases have been included in the ACRA (Acquisition, Encoding, Retrieval, Support, by its Spanish acronym) evaluation instrument[11]:

1. Information *ACQUISITION* phase, with attentional strategies (exploration and fragmentation) and repetition strategies.
2. Information *ENCODING* phase, which includes mnemotechnic, developmental and organizational strategies.
3. Information *RETRIEVAL* phase, with memory searching strategies (search for codes and clues), and answer generation strategies (planning and preparing the written answer).
4. Processing *SUPPORT* phase, which is divided into: metacognitive strategies (self-knowledge and self-management), affective strategies (self-instructions, self-control and distraction suppression), social strategies (social interactions) and motivational strategies (intrinsic motivation, extrinsic motivation and escape motivation).

Teachers, in addition to knowing how to teach, need to be aware of students' learning strategies (cognition), metacognition, and self-regulation. Activities conducted in a scenario of uncertainty created by the pandemic and the consequent methodological change (e-learning) were considered challenging. The aim of this study was therefore to identify the study strategies preferred by university students of both genders in different learning scenarios: regular and challenging.

MATERIALS AND METHOD

Sample

All third-year dentistry students during the years 2019 (GP) and 2021 (GE) were invited to take part in the study. Participation was voluntary and independent of any academic assessment. The sample was grouped as follows:

- Face-to-face group (GP), which included 141 students (58.50% of 241 total enrolled students) in the context of normal environmental situation and in-person attendance (year 2019), and
- E-learning group (GE), which included 60 students (27.39% of 219 total enrolled students) in the context of environmental challenge and e-learning (year 2021).

Students were requested (a) to provide socio-demographic information (sex and age), and (b) to answer the validated abridged ACRA scale (Acquisition, Encoding, Retrieval, Support, by its Spanish acronym)[11].

The information was requested via the same method being used for classes in each group, i.e., face-to-face for GP and virtual for GE, without teachers adding any modalization in either group.

Statistical analysis

For the descriptive analysis, the categorical variables were described by means of frequencies and percentages, and the numerical variables were

expressed as mean, minimum and maximum. Variables were compared by the Chi-square test and the binomial exact test for independent samples. Student's t-test was used for independent samples to compare the two groups with quantitative variables. Differences were considered statistically significant when $p < 0.05$.

RESULTS

Analysis of the sample

Student participation was 58.50% of total students enrolled in the 2019 cycle (GP) and 26.20% of total students enrolled in the 2021 cycle (GE). No statistical difference was observed between the percentages of GP and GP according to gender (Chi square test: p=0.400). There were statistical differences in participation between groups GP (58.5%) and GE (26.2%) (binomial proportions test p<0.001). Thus, participation was greater in the pre-pandemic period, but the gender proportion was maintained (Table 1).

Age differed significantly between groups (pre-pandemic/post-pandemic intervention period) and gender differed significantly in the "pandemic" condition (GE) (p=0.007). Average student age was higher during the pandemic, and among females (p=0.001) (Table 2).

Analysis of scores among study strategies on the abridged ACRA scale

No statistical difference was observed between GP and GE in the total ACRA score or in the domains (Table 3).

In the whole sample (n=201), the items that significantly increased in agreement ("agree" or "strongly agree") were items 2 (p=0.030) and 3 (p=0.001) in the Cognitive Strategies and Learning Control domain. In the Learning Support Strategies Domain, item 8 showed a significant increase in disagreement ("strongly disagree") (p=0.040) (Table 4).

Table 1. Frequency distribution and percentage of students included in the study

Group	Gender		Students participating in the study	Students in the class	% Students participating
	Female	Male			
Pre-pandemic (GP) n (%)	105 (74.5%)	36 (25.5%)	141	241	58.5%
During the pandemic (GE) n (%)	48 (80.0%)	12 (20.0%)	60	229	26.2%
Total	153 (76.1%)	48 (23.9%)	201	470	42.8%

GP and GE by gender: (p=0.400)
Participation pre-pandemic and during the pandemic (0.001)

Table 2. Participating students according to age, gender and study period

Variables			Mean age ± SD (Min - Max)	N	p value
Gender		Female	22.5 ± 2.4 (19-31.0)	153	0.438º
		Male	22.2 ± 1.7 (20.0-28.0)	48	
Intervention period		GP	21.8 ± 1.9 (19.0-31.0)	141	0.001*
		GE	23.8 ± 2.5 (20.0-31.0)	60	
Intervention period	GP	Female	21.7 ± 2.0 (19.0-31.0)	105	0.321º
		Male	22.1 ± 1.8 (20.0-28.0)	36	
	GE	Female	24.1 ± 2.6 (20.0-31.0)	48	0.007*
		Male	22.6 ± 1.4 (21.0-26.0)	12	
Total participating			22.4 ± 2.3 (19.0-31.0)	**201**	

*Student's test for independent samples with Welch correction
ºStudent's test for independent samples
SD: Standard deviation
Min: minimum value
Max: maximum value

Table 3. Average scores on the ACRA scale (total score and domains), according to study period (GP and GE).

Dimension Analyzed	Period	Mean ± SD (CI95% LL - UL)	n (min -max)	p value
Total Score	Pre-pandemic	42.4 ± 3.9 (41.7-43.0)	141 (33-51)	0.904
	Pandemic	42.5 ± 4.5 (41.3-43.6)	60 (33-52)	
	Total	**42.4 ± 4.1 (41.8-43.0)**	**201 (33-52)**	
Cognitive Strategies and Learning Control	Pre-pandemic	20.0 ± 2.1 (19.7-20.4)	141 (14-24)	0.868
	Pandemic	20.1 ± 2.2 (19.5-20.6)	60 (16-24)	
	Total	**20.0 ± 2.1 (19.7-20.3)**	**201 (14-24)**	
Learning Support Strategies	Pre-pandemic	15.7 ± 2.2 (15.3-16.0)	141 (10-20)	0.479
	Pandemic	15.9 ± 2.4 (15.3-16.5)	60 (10-20)	
	Total	**15.7 ± 2.3 (15.4-16.0)**	**201 (10-20)**	
Study Habits	Pre-pandemic	6.7 ± 1.1 (6.5-6.9)	141 (4-8)	0.201
	Pandemic	6.5 ± 1.2 (6.2-6.8)	60 (3-8)	
	Total	**6.6 ± 1.2 (6.5-6.8)**	**201 (3-8)**	

Student's test for independent samples.
SD: Standard deviation
CI95%: 95% confidence interval
LL: Lower limit of the 95% confidence interval
UL: Upper limit of the 95% confidence interval

Table 4. ACRA items in which statistically significant changes are observed between study periods.

Items		Pre-pandemic	Pandemic	p value
		Frequency (%; CI95% LL-UL)	Frequency (%; CI95% LL-UL)	
Item 2	Strongly disagree	3 (2.1; 0.6 - 5.6)	0 (0.0; 0 - 0)	0.030
	Disagree	9 (6.4; 3.2 - 11.3)	1 (1.7; 0.2 - 7.5)	
	Agree	34 (24.1; 17.6 - 28.7)	24 (40.0; 32.3 - 52.6)*	
	Strongly agree	95 (67.4; 59.3 - 74.7)	35 (58.3; 45.7 - 70.2)	
Item 3	Strongly disagree	2 (1.4; 0.3 - 4.5)	0 (0.0; 0 - 0)	0.001
	Disagree	3 (2.1; 0.6 - 5.6)	4 (6.7; 2.3 - 15.1)	
	Agree	89 (63.1; 55 - 70.8)*	18 (30.0; 19.5 - 42.3)	
	Strongly agree	47 (33.3; 26 - 41.4)	38 (63.3; 50.7 - 74.7)*	
Item 8	Strongly disagree	2 (1.4; 0.3 - 2.5)	4 (6.7; 3.3 - 12.1)*	0.040
	Disagree	43 (30.5; 23.4 - 38.4)	13 (21.7; 12.7 - 33.3)	
	Agree	66 (46.8; 38.7 - 55)	23 (38.3; 26.8 - 50.9)	
	Strongly agree	30 (21.3; 15.1 - 28.6)	20 (33.3; 22.4 - 45.8)	

Chi square test, with Bonferroni post hoc
* Significant statistical difference, indicating a higher percentage between study periods.
CI95%LL: Lower limit of the 95% confidence interval
CI95%UL: Upper limit of the 95% confidence interval

- **Item 1, Cognitive Strategies and Learning Control Domain:** "In books, notes or other learning materials, I underline the words, data or phrases I consider most important in each paragraph."
- **Item 3, Cognitive Strategies and Learning Control Domain:** "I am aware of the importance of elaboration strategies, which require me to establish different kinds of associations among the contents of the study material (drawings or graphs, mental images, metaphors, self-questions, paraphrasing, etc.)."
- **Item 8, Learning Support Strategies Domain:** "I use personal resources to control my states of anxiety when they prevent me from concentrating better on studying."

Analysis of ACRA score according to gender

Analysis of the total group of students (n= 201) distributed according to gender showed significant differences (p=0.007). Analysis of domains showed significant differences between genders in the domains Cognitive and Learning Control Strategies (p= 0.008) and Learning Support Strategies (p=0.002). In all cases, females scored higher on average, expressing greater definition in the option selected for each item (Table 5). No statistical difference was observed in the Study Habits domain.

Analysis of scores during the pandemic (GE) differed significantly between genders (Table 6):

(a) Total score for the scale (p=0.033)

(b) The Control Strategies and Learning Acquisition

Table 5. Average scores on the ACRA scale (total score and domains) according to gender.

Dimension	Gender	Mean ± SD (CI95% LL - UL)	n (min -max)	p value
Total Score	Female	42.8 ± 4.1 (42.2-43.5)	153 (33-52)	0.007
	Male	41.0 ± 3.8 (39.9-42.1)	48 (33-51)	
	Total	**42.4 ± 4.1 (41.8-43.0)**	**201 (33-52)**	
Cognitive Strategies and Learning Control	Female	20.3 ± 2.2 (19.9-20.6)	153 (14-24)	0.008
	Male	19.3 ± 1.9 (18.8-19.9)	48 (16-24)	
	Total	**20.0 ± 2.1 (19.7-20.3)**	**201 (14-24)**	
Learning Support Strategies	Female	16.0 ± 2.2 (15.7-16.4)	153 (11-20)	0.002
	Male	14.8 ± 2.3 (14.2-15.5)	48 (10-19)	
	Total	**15.7 ± 2.3 (15.4-16.0)**	**201 (10-20)**	
Study Habits	Female	6.6 ± 1.2 (6.4-6.8)	153 (3-8)	0.149
	Male	6.9 ± 1.0 (6.6-7.2)	48 (4-8)	
	Total	**6.6 ± 1.2 (6.5-6.8)**	**201 (3-8)**	

Student's test for independent samples.
SD: Standard deviation
CI95%: 95% confidence interval
LL: Lower limit of the 95% confidence interval
UL: Upper limit of the 95% confidence interval
Comparison of student gender shows statistically significant differences in the total ACRA score, in Cognitive Strategies and Learning Control and in Learning Support Strategies, with females scoring higher. No statistical difference is observed in Study Habits.

Table 6. Average scores on the ACRA scale for the Total Score and in the Domains, according to gender for the pandemic group (GE)

Dimension Analyzed	Gender	Mean ± SD (CI95% LL - UL)	n (min -max)	p value
Total Score	Female	43.1 ± 4.4 (41.8-44.4)	48 (35-52)	0.033
	Male	40.0 ± 4.4 (37.2-42.8)	12 (33-48)	
	Total	**42.5 ± 4.5 (41.3-43.6)**	**60 (33-52)**	
Cognitive Strategies and Learning Control	Female	20.4 ± 2.1 (19.8-21.0)	48 (16-24)	0.035
	Male	18.9 ± 2.0 (17.7-20.2)	12 (16-23)	
	Total	**20.1 ± 2.2 (19.5-20.6)**	**60 (16-24)**	
Learning Support Strategies	Female	16.3 ± 2.3 (15.7-17.0)	48 (11-20)	0.007
	Male	14.3 ± 2.3 (12.8-15.7)	12 (10-18)	
	Total	**15.9 ± 2.4 (15.3-16.5)**	**60 (10-20)**	
Study Habits	Female	6.4 ± 1.3 (6.0-6.8)	48 (3-8)	0.279
	Male	6.8 ± 1.0 (6.2-7.5)	12 (5-8)	
	Total	**6.5 ± 1.2 (6.2-6.8)**	**60 (3-8)**	

Student's test for independent samples.
SD: Standard deviation
CI95%: 95% confidence interval
LL: Lower limit of the 95% confidence interval
UL: Upper limit of the 95% confidence interval

domain (p=0.035), and the Learning Support Strategies domain (p=0.007)

However, during the pre-pandemic period (GC), scores did not differ significantly between males and females.

DISCUSSION

Learning strategies are a construct that includes cognitive, metacognitive, motivational and behavioral elements. Based on the hypothesis that cognitive processes for information processing are acquisition, encoding or storage, and retrieval, information processing strategies can be defined as "integrated sequences of mental procedures or activities that are activated to facilitate the acquisition, storage and/or use of information". This basic hypothesis is included in the theories about mental representation of knowledge of memory and in the "instructional" approach[12]. These theories hypothesize that the brain operates as if it were the outcome of three basic cognitive processes: a) acquisition, b) encoding or storage, and c) retrieval or evocation. In addition, other metacognitive, affective and social processes are needed, which are addressed by support strategies. Mental procedures or management strategies, called "micro strategies, learning tactics or study strategies", can be deduced from knowledge of the cognitive processes. The ACRA scale was developed based on this theoretical framework[13].

Today, distance learning and particularly the use of Information and Communication Technologies in the educational process have revealed the need to develop attitudes of autonomy, self-direction and self-regulation in the learning process by promoting **strategic learning**, where mental representation (learning) is related to relevance to everyday use and significance to the learner's context.

The results of the current study reveal moderate interest in participating among students in the GP group, and lower interest among students in the GE group, with significant differences between participation proportions (p=0.001). This may be interpreted as one of the expressions of consequences of the social impact of the pandemic challenge. These results were similar to those reported by Turkyilmaz et al.[14] in a study in which 22.6% of 1130 pre-doctoral students responded. Other studies achieved more representative responses[15].

Different aspects of the nature of the social impact caused by the pandemic were reported by Bhattacharya[16]. From a medical point of view, several examples showed the impact of the pandemic. Gondolesi et al.[17] showed a 55% reduction in liver transplants, mainly as a consequence of the high level of occupancy of hospital beds by COVID-19 patients. Navarro Rubio et al.[18] highlighted the impact of the pandemic on the level of healthcare and in other spheres of society, including response to the demands of the patients involved, their families and legal representatives.

Ali and Alharbi[19] say that there is an urgent need to educate the new generation in science and technology so that they are prepared to react to any disaster of this kind in the future. They recommend providing training for prevention and adequate management of essential resources for combatting COVID-19 or other potential risks. It may be conjectured that, to encourage students to respond to research for generating scientific evidence (SE), integrated validated instruments should be used, and training workshops should be provided to ensure competence in distinguishing between scientific evidence-based and non-evidence-based studies. Such competence would complement skills related to handling mobile technology, which young students usually have[20].

Analysis of the differences between genders

Strategic learning is promoted through self-regulation techniques and the adoption of those that adapt to (a) the student's learning style, (b) the student's context, (c) the requirements of each subject, and (d) the creation of the most appropriate learning setting to contribute to the efficacy of the process and the acquisition of general and specific competencies.

Although the differences recorded in the current study did not have an impact when the total population was analyzed, tendencies were found of greater preference by females to adopt learning strategies tending to metacognition in the LSS domain.

The preferences recognized in the answers to the ACRA scale may reflect greater commitment to cognitive and metacognitive strategies because they enable maintenance of an appropriate mental state for learning. They include strategies to foster motivation and concentration, reduce anxiety, focus attention on the task at hand and organize study time, among others.

Learning support strategies have indirect impact on the information to be learned, and their purpose is to improve the level of cognitive functioning. The differences found in the increase in strategies by females for the two periods (p=0.007) included in the current study have also been reported by other authors, mainly in the CSLC and LSS domains. Faria and Montaine[21] reported an interaction effect between gender and study outcomes over the course of academic degree studies, showing the existence of dynamic, effort-dependent conceptions; persistence, and other intelligence variables in women, while conceptions were more static in men. Studies on different academic performance have established that women students have better levels of academic motivation, especially during stages immediately prior to access to university.

In the university setting, consistent results have been found regarding the higher number of strategies used by female students. García-Garcia et al.[22] reported that most of the female students analyzed used more and better strategies for acquisition, retrieval and processing support, as well as encoding strategies, with greater use of information organizational techniques. Overall, these authors found that a higher percentage of female students used implicit strategies in the different processing phases, as a result of their prior experience. Among the supporting strategies, they highlight processing, higher level of metacognitive techniques in all senses (cognitive awareness and strategy adjustment), as well as better study planning and use of motivational-affective techniques. Rogers et al.[23] showed the differences regarding student motivational style based on sex, although depending on the type of learning, as was confirmed in our study by the significant differences found in females regarding preferences for item 8**,** specifically linked to motivational aspects.

Women students have been reported to make greater use of regulatory learning strategies[22] and study organization and planning strategies. These results are confirmed in the current study by the significant differences recorded for female students during the pandemic for items 9 and 11 of domain LSS[24].

The increase in certain records of the strategies and techniques identified as instrumental to significant learning acquisition and favorable to metacognition are unknown factors in the evidence in the field of education. More in-depth knowledge of these strategies, complemented by neuroscience studies, should be considered when designing teaching strategies. Based on Gardner's theory of multiple intelligences, Collins[25] claims that different parts of the brain are responsible for competencies that everyone possesses to some degree. These multiple intelligences could be used as strategies to improve learning.

A recent study on animals by Chen et al.[26] found that sex is a proxy for multiple genetic and endocrine influences on behavior, including how environments are sampled. Differences have also been analyzed according to gender in student and graduate perception regarding visual, aural, read/write and kinesthetic (VARK) learning styles and outcomes in examinations, with significant association between perceived VARK mode and outcomes in examinations[27–29].

Analysis of learning methods and techniques

It is important to use methods to complement expository teaching methods, such as problem-solving, case studies, use of questions, class discussion, projects, cooperative work, student participation and commitment, and to use formative assessment methods to complement summative assessment and provide feedback to the student[30]. Choe et al.[31] reported a high degree of satisfaction when Mayer's principles of multimedia learning were applied.

Turkyilmaz et al.[14] assessed the influence of e-learning on dental education as perceived by predoctoral dental students. That study found that the most important factor for online applications influencing academic performance was the "**organization and logic of content**" (54%). Their results indicated that e-learning may successfully be used in a dental school curriculum to enhance students' perceptions of fundamental concepts, and to enable students to apply this knowledge to clinical cases. The outcomes seem to agree with our study, which was conducted on mid-level dentistry students. It is essential to conduct further research on mid-level dental students' preferences regarding social networks, online applications and databases, in order to include e-learning in course subjects. In our study, during the pandemic period, when students increased their use of e-learning strategies, females scored significantly higher than males in the CSLC and LSS domains.

Abbasi et al.[15] analyzed perception of and satisfaction

with the use of e-learning during the pandemic in 11 countries with different development categories, revealing preference for the use of Zoom (41%), and reporting interference in e-learning due to problems with Internet. Most participants agreed that e-learning was satisfactory for acquiring knowledge, but not effective for acquiring clinical and technical skills.

As the COVID-19 lockdown eases, there is a need to improve e-learning methods. Blended experiences are recommended for students in the field of healthcare. Some alternatives are the development of problem-based learning[32], challenge-based learning, or disruptive methods such as gamification. Seidlein et al.[33] claim that complementary gamified e-learning tools are promising, considering the different levels of knowledge among students and the changing behavior of learning. Turner et al.[34] stated that the differences in answers between millennial students and their teachers need to be overcome regarding the use of case studies, study guides and group work. Interdisciplinary work combining social psychology and cognitive neuroscience would enable understanding in terms of interactions at social, cognitive and neuronal levels.

CONCLUSIONS

The significant differences in the preferences expressed by students and identified in the domains and items of the abridged ACRA scale during the different learning periods do not show significant impact on the total score for the abridged ACRA scale. The study identified trends towards an increase in the score and consequently greater use of techniques included in the domains related to metacognition, especially among women. It may be conjectured that there is potential neutralization of the impact created by the methodological shift between the two periods (face-to-face and e-learning) as a result of the implicit adaptability, latent in students, regarding digital methodology, which enables them to adapt to learning in challenging situations, as shown by the increase in some of the items in domains CLCS and LSS.

DECLARATION OF CONFLICTING INTERESTS

The authors declare no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

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