ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 11, Issue, 05, pp. 46724-46730, May, 2021
https://doi.org/10.37118/ijdr.21846.05.2021

RESEARCH ARTICLE OPEN ACCESS

LEARNING STYLES OF BRAZILIAN DENTAL UNDERGRADUATE STUDENTS BY VARK QUESTIONNAIRE

Márlio Ximenes Carlos*[1], Rui Barbosa de Brito Júnior[2], Rielson José Alves Cardoso[2], Rogério Heládio Lopes Motta[2], Mary Caroline Skelton Macedo[3], Fernando André Campos Viana[1], Danilo Lopes Ferreira Lima[4]and Sérgio Luís da Silva Pereira[4]

[1]Assistant Professor, School of Dentistry, University of Fortaleza, Fortaleza/CE, Brazil; [2]Professor, Faculty and Center for Dental Research São Leopoldo Mandic, Campinas/SP, Brazil; [3]Professor, Faculty of Dentistry of the University of São Paulo/SP, Brazil; [4]Full Professor, School of Dentistry, University of Fortaleza, Fortaleza/CE, Brazil

ARTICLE INFO

Article History:
Received 14th February, 2021
Received in revised form
10th March, 2021
Accepted 25th April, 2021
Published online 14th May, 2021

Key Words:
Age group; Learning preferences; Dental education; undergraduate students.

Corresponding author:
Márlio Ximenes Carlos,

ABSTRACT

The purpose of this study was to identify the learning styles of undergraduate dental students at private education institutions in the State of Ceará, Brazil, and the factors that influence their formation. 459 students participated in this study by answering the VARK questionnaire and filling out a sociodemographic form. Data were analyzed using Pearson's Chi-squared test and multinomial logistic regression. 46.40% of the participants were unimodal (n=213) and 53.60% were panmodal (n=246). The most prevalent learning style was the K (13.9%; n=64). First semester students were unimodal or bimodal, fourth semester students were trimodal or panmodal, and tenth semester students were unimodal, bimodal or panmodal ($p<0.05$). Students who attended daycare were unimodal or panmodal while those who went straight to school were bimodal or trimodal ($p<0.05$). There were no statistically significant differences in gender, age and maternal education level whether the student was taught how to read and write at home or at school ($p>0.05$). This occurred for the other variables: primary education/secondary education completed in public/private schools, sports or arts practices in childhood and adolescence ($p>0.05$). However, these preferences were not influenced by constitutional or external factors, except for students who attended daycare at preschool age.

Citation: Márlio Ximenes Carlos, Rui Barbosa de Brito Júnior, Rielson José Alves Cardoso, Rogério Heládio Lopes Motta, Mary Caroline Skelton Macedo, Fernando André Campos Viana1, Danilo Lopes Ferreira Lima and Sérgio Luís da Silva Pereira. 2021. "Learning styles of brazilian dental undergraduate students by vark questionnaire", *International Journal of Development Research*, 11, (04), 46724-46730.

INTRODUCTION

In the 21st century, dentists are required to acquire skills to face the job market, as highlighted by the American Dental Education Association (ADEA) (ADEA, 2015), and Brazilian curriculum guidelines[2]. Dentists should develop nonverbal and verbal communication skills and reading and writing skills. They should be able to collect, observe and interpret data for diagnosis, incorporate technological innovations, recognize their limitations and be flexible when it comes to changing circumstances (ADEA, 2015 and Brasil., 2002). The main pillar of schools is the promotion of learning. However, learning is an individual process and schools cannot determine when and how it will happen, nor can they determine its intensity. The only thing schools can do is create an environment conducive to learning (Woolfolk, 2007). The compatibility between learning style and mode of information delivery is conducive for understanding, processing, and retaining information (Fang, 2002). Learning style is a combination of cognitive and affective characteristics and physiological traits that indicate how a student perceives, interacts with, and responds to the learning environment (Whillier *et al*., 2014). There are many methods to measure learning styles, including the VARK questionnaire, which was developed from the literature on neurolinguistic programming by Neil Donald Fleming and Charles Bonwell. It is based on an information-processing model that generates a profile of how an individual prefers to learn (Fleming and Mills, 1992). The word VARK is formed by the initials of words that represent preferences for taking in information: "visual" (V) – figures, graphs, tables, diagrams and symbols; "Aural" (A) – listening to and paying attention to words, discussions and seminars, social groups; "Read/Write" (R) – written material, lecture notes, handouts; and "Kinesthetic" (K) – learning via senses, such as touch, hearing, smell, taste and sight (Whillier *et al*., 2014; Fleming, 1995 and Shenoy, 2013). The latter is used by students who prefer concrete real-world applications to understand things and who like experiential learning and physical interaction in the learning environment. Studies on learning styles have been developed in the field of dentistry worldwide (Shenoy, 2013; Murphy *et al*., 2004; Walji *et al*., 2010; Al-Saud, 2013; Akhlaghi *et al*., 2018; Aldosari *et al*., 2018; AlQahtani, 2018). However, most were performed in a

single institution, and none of them in our country. In addition, there are scarce studies evaluating the influence of previous school factors and artistic/sports activities on learning styles. Understanding the strengths and weaknesses of undergraduate dentistry students, based on individual preferences, can favor the construction of a curriculum that respects differences and promotes students' engagement for learning. So, the purpose of this study was to identify the learning styles of undergraduate dental students from private higher education institutions in the State of Ceará, Brazil, using the VARK questionnaire, and verify the factors that influence their formation.

METHODOLOGY

Ethics

The research project was approved by a research ethics committee (Approval No. 1.356.286 and 1.548.603) and permission to use the questionnaire was obtained from its developer via e-mail to Mr. Neil Donald Fleming.

Study population and sample

The sample consisted of undergraduate dental students from private institutions in the State of Ceará enrolled in the first, fourth and tenth semesters. These institutions were chosen for being similar and easy-to-access education institutions. The semesters were chosen to allow identification of the learning style associated with a moment in the student's training. The first semester refers to the high school learning style, the fourth to the beginning of clinical activities, and the tenth to the student's graduation. Of the existing institutions, only three institutions fulfilled the requirements, named Institution A, B and C. Data were collected on campi in December 2015. In all, 511 questionnaires were answered in a population of 613 students. However, the sample consisted of 459 questionnaires, corresponding to a 75% response rate. Exclusion criteria were failure to give written informed consent, age <18 years, and missing responses.

Research instrument

We used a printed version of the questionnaire (Annex A) following the developers' recommendations to increase participants' adherence. We used the version 7.1 translated into Portuguese retrieved from http://vark-learn.com/home-portuguese/. The questionnaire contained 16 multiple choice questions with 4 response options. Students could choose more than one response that best represented their preference. A sociodemographic data form accompanied the VARK questionnaire.

Data collection

After being informed about the objective of the study, the students signed the consent form and were identified by a code. They received the VARK questionnaire with instructions for answering it and a sociodemographic data form. The questionnaires were processed by people other than those who collected them and who did not have access to the participants' identification at http://vark-learn.com/home-portuguese/. The number of responses for the 4 preference modalities – visual, aural, read/write or kinesthetic – was obtained. These results were organized in a spreadsheet and sent to Vark Learn Limited in New Zealand to identify learning styles using the standard VARK algorithm. The styles were represented by the codes: V mild, V strong, V very strong, A mild, A strong, A very strong, R mild, R strong, R very strong, K mild, K strong, K very strong, VA, VR, VK, AR, AK, RK, VAR, VAK, VRK, ARK, VARK type one, VARK type two, VARK transition, totaling 25 options. These codes were grouped into unimodal (V mild, V strong, V very strong, A mild, A strong, A very strong, R mild, R strong, R very strong, K mild, K strong, K very strong), bimodal (VA, VR, VK, AR, AK, RK), trimodal (VAR, VAK, VRK, ARK) and panmodal (VARK type one, VARK type two, VARK transition). These codes can also be grouped into unimodal and polymodal (bimodal+trimodal+ panmodal). Such groupings aimed to provide an "n" that would allow statistical analysis.

DATA ANALYSIS

This is a quantitative descriptive cross-sectional study. The data were tabulated in Microsoft Excel (Microsoft Corp., USA) and exported to the Statistical Package for the Social Sciences – SPSS 17.0 (SPSS Inc., Chicago, USA) using a significance level of 5%. The findings were described as absolute and percentage figures and analyzed using Pearson's Chi-squared test and Multinomial Logistic Regression.

RESULTS

The study sample consisted of 459 properly answered questionnaires. Some sociodemographic data forms were left blank by some respondents, thus causing the "n" to vary in the analysis of the association of VARK results with sociodemographic variables. This variation was not observed for the variables "institution of origin" or "semester". The population size was estimated using Epi Info statcalc (Centers for Disease Control and Prevention, USA). Each variable should present a minimum of 205 responses to achieve a 95% confidence interval. None of the questions presented a confidence interval below that. The form included four age groups: 18-25 years; 26-34 years; 35-44 years; and $\geq$ 45 years. In all, 385 respondents were aged 18-25 years, 46 were aged 26-34 years, 3 were aged 35-44 years, and 1 was $\geq$ 45 years old. A total of 24 respondents did not inform their age. The statistical analysis considered only two age groups: 18-25 years and >25 years. The students of Semester-1 were predominantly unimodal or bimodal and those from Semester-4 were trimodal or panmodal and Semester-10 were predominantly unimodal, bimodal or panmodal ($p < 0.001$). The most students included in the study were women (18-25 years old), with no statistical differences between sex ($p = 0.847$) or age groups ($p = 0.155$). The maternal education level most prevalent was Higher education for all groups, and this variable did not altered prevalence of learning types ($p = 0.724$). Daycare was most prevalent in unimodal and panmodal students than school ($p = 0.042$). Literacy setting was predominantly in school for the four groups ($p = 0.282$), the Primary and secondary education was in Private school ($p = 0.823$ and $p = 0.839$, respectively), most students equally had sports/arts practice in the childhood ($p = 0.783$), practice Physical activity ($p = 0.500$) and no practice arts currently ($p = 0.425$) (Table 1). Table 2 shows the association of the learning styles, grouped into two categories, with 11 of the variables. Only the variable institution of origin was not included in the analysis. Students enrolled in the fourth semester were 2 times more likely to present a polymodal style than those enrolled in the tenth semester. Polymodal students were significantly most prevalent in Semester-4 students ($p = 0.010$). Table 3 shows the association of the learning styles, grouped into four categories, with 11 of the variables. Only the variable institution of origin was not included in the analysis. There were two important associations: students enrolled in the first semester were predominantly unimodal or bimodal, students enrolled in the fourth semester were either trimodal or panmodal, those enrolled in the tenth semester were either unimodal, bimodal or panmodal, those who attended daycare were either unimodal or panmodal, and those who went straight to regular school were either bimodal or trimodal ($p<0.05$). The other variables did not differ significantly ($p>0.05$). Table 4 shows the association of the learning styles, grouped into 25 types, with academic semester. The AK style in the first semester, the ARK style in the fourth semester, and the AK and K mild in the tenth semester were significantly different in relation to the other styles ($p<0.05$). V strong, V very Strong and VA styles were not observed.

DISCUSSION

This study focused on a population that has not been addressed in the literature: Brazilian undergraduate dental students. We sought to identify their learning styles using the VARK questionnaire and their

Table 1. Association of participants' learning styles, grouped into four categories, with the variables: semester, gender, age, maternal education level, daycare attendance, literacy setting, primary education, secondary education, sport and/or arts practice in the childhood, current sports practice, current arts practice

	Classification				
	Unimodal	Bimodal	Trimodal	Panmodal	p-value
Semester					
S-1	69*	33*	13	16	<0.001
	32.4%	35.1%	17.3%	20.8%	
S-4	78	33	49*	41*	
	36.6%	35.1%	65.3%	53.2%	
S-10	66*	28*	13	20*	
	31.0%	29.8%	17.3%	26.0%	
Gender					
Men	54	29	20	21	0.847
	26.7%	31.5%	29.9%	27.6%	
	Classification				
	Unimodal	Bimodal	Trimodal	Panmodal	p-value
Women	148	63	47	55	
	73.3%	68.5%	70.1%	72.4%	
Age					
18-25 years	177	76	60	72	0.155
	88.1%	83.5%	89.6%	94.7%	
Over 25 years	24	15	7	4	
	11.9%	16.5%	10.4%	5.3%	
Maternal education level					
Primary education	23	12	10	4	0.724
	11.5%	13.2%	14.9%	5.3%	
Secondary education	53	22	22	23	
	26.5%	24.2%	32.8%	30.3%	
Higher education	79	36	21	32	
	39.5%	39.6%	31.3%	42.1%	
Graduate studies	45	21	14	17	
	22.5%	23.1%	20.9%	22.4%	
Daycare X School					
Daycare	41*	9	8	18*	0.042
	22.2%	11.5%	12.7%	26.9%	
School	144	69*	55*	49	
	77.8%	88.5%	87.3%	73.1%	
Literacy setting					
Home	1	3	2	2	0.282
	0.5%	3.3%	3.0%	2.7%	
School	199	88	65	73	
	99.5%	96.7%	97.0%	97.3%	
Primary education					
Public school	49	22	13	18	0.823
	24.5%	23.9%	19.4%	24.0%	
Private school	127	61	48	52	
	63.5%	66.3%	71.6%	69.3%	
Both	24	9	6	5	
	12.0%	9.8%	9.0%	6.7%	
	Classification				
	Unimodal	Bimodal	Trimodal	Panmodal	p-value
Secondary education					
Public school	54	25	17	23	0.839
	27.1%	27.5%	25.8%	31.5%	
Private school	128	57	42	47	
	64.3%	62.6%	63.6%	64.4%	
Both	17	9	7	3	
	8.5%	9.9%	10.6%	4.1%	
Sports/arts practice in the childhood					
Yes	148	68	53	58	0.783
	73.6%	73.9%	79.1%	77.3%	
No	53	24	14	17	
	26.4%	26.1%	20.9%	22.7%	
Physical activity					
Yes	102	43	30	43	0.500
	50.7%	47.3%	44.8%	56.6%	
No	99	48	37	33	
	49.3%	52.7%	55.2%	43.4%	
Arts					
Yes	13	5	6	9	0.425
	6.6%	5.7%	9.1%	11.8%	
No	184	82	60	67	
	93.4%	94.3%	90.9%	88.2%	

Legend: *p<0.05, data described as absolute frequencies and percentage values

Table 2 - Association of participants' learning styles, grouped into two categories, with the variables: semester, gender, age, maternal education level, daycare attendance, literacy setting, primary education, secondary education, sport and/or arts practice in the childhood, current sports practice, current arts practice

	Classification		Bivariate Analysis	Multivariate Analysis			
	Unimodal	Polymodal	p-value[a]	p-value[b]	OR	95%CI	
Semester							
S-1	69*	62	0.016	0.813	1.08	0.58	2.00
	32.4%	25.2%					
S-4	78	123*†		0.010	2.04	1.18	3.53
	36.6%	50.0%					
S-10	66*†	61					
	31.0%	24.8%					
Gender							
Men	54	70	0.480	0.830	1.06	0.64	1.75
	26.7%	29.8%					
Women	148	165					
	73.3%	70.2%					
Age							
18-25 years	177	208	0.787	0.942	1.03	0.51	2.08
	88.1%	88.9%					
Over 25 years	24	26					
	11.9%	11.1%					
Maternal education level							
Primary education	23	26	0.698	0.763	1.13	0.50	2.58
	11.5%	11.1%					
Secondary education	53	67					
	26.5%	28.6%					
Higher education	79	89					
	39.5%	38.0%					
Graduate studies	45	52					
	22.5%	22.2%					
Daycare X School							
Daycare	41	35	0.202	0.212	0.70	0.40	1.22
	22.2%	16.8%					
School	144	173					
	77.8%	83.2%					
	Classification		Bivariate Analysis	Multivariate Analysis			
	Unimodal	Polymodal	p-value[a]	p-value[b]	OR	95%CI	
Literacy setting							
Home	1	7	0.054	0.294	3.24	0.36	29.10
	0.5%	3.0%					
School	199	226					
	99.5%	97.0%					
Primary education							
Public school	49	53	0.390	0.841	1.10	0.44	2.77
	24.5%	22.6%					
Private school	127	161					
	63.5%	68.8%					
Both	24	20					
	12.0%	8.5%					
Secondary education							
Public school	54	65	0.965	0.835	1.11	0.40	3.07
	27.1%	28.3%					
Private school	128	146					
	64.3%	63.5%					
Both	17	19					
	8.5%	8.3%					
Sports/arts practice in the childhood							
Yes	148	179	0.491	0.935	0.98	0.58	1.64
	73.6%	76.5%					
No	53	55					
	26.4%	23.5%					
Physical activity							
Yes	102	116	0.807	0.707	0.92	0.59	1.43
	50.7%	49.6%					
No	99	118					
	49.3%	50.4%					
Arts							
Yes	13	20	0.411	0.575	1.26	0.56	2.81
	6.6%	8.7%					
No	184	209					
	93.4%	91.3%					

Legend: *p<0.05, Chi-squared test; †p<0.05 Multinomial Logistic Regression. Data described as absolute frequencies and percentage values

Table 3. Association of participants' learning styles, grouped into four categories and in twenty-five types, with the institution of origin

	Institution			
	A	B	C	p-value
Classification				
Unimodal	64	19	130	0.371
	48.1%	42.2%	46.3%	
Bimodal	29	14	51	
	21.8%	31.1%	18.1%	
Trimodal	23	5	47	
	17.3%	11.1%	16.7%	
Panmodal	17	7	53	
	12.8%	15.6%	18.9%	
VARK Standard Algorithm				
A *mild*	16	4	26	0.886
	12.0%	8.9%	9.3%	
A *Strong*	6	0	12	
	4.5%	0.0%	4.3%	
A *very Strong*	2	0	5	
	1.5%	0.0%	1.8%	
AK	13	8	25	
	9.8%	17.8%	8.9%	
AR	6	1	6	
	4.5%	2.2%	2.1%	
ARK	17	5	36	
	12.8%	11.1%	12.8%	
K *mild*	19	8	37	
	14.3%	17.8%	13.2%	
K *Strong*	10	4	20	
	7.5%	8.9%	7.1%	
	Institution			
	A	B	C	p-value
K *very Strong*	2	1	6	
	1.5%	2.2%	2.1%	
R *mild*	5	1	16	
	3.8%	2.2%	5.7%	
R *Strong*	2	1	4	
	1.5%	2.2%	1.4%	
R *very Strong*	1	0	1	
	0.8%	0.0%	0.4%	
RK	7	3	17	
	5.3%	6.7%	6.0%	
V *mild*	1	0	3	
	0.8%	0.0%	1.1%	
VAK	4	0	6	
	3.0%	0.0%	2.1%	
VAR	1	0	0	
	0.8%	0.0%	0.0%	
VARK *transition*	0	1	12	
	0.0%	2.2%	4.3%	
VARK *type one*	13	5	33	
	9.8%	11.1%	11.7%	
VARK *type two*	4	1	8	
	3.0%	2.2%	2.8%	
VK	3	2	1	
	2.3%	4.4%	0.4%	
VR	0	0	2	
	0.0%	0.0%	0.7%	
VRK	1	0	5	
	0.8%	0.0%	1.8%	

Legend: *p<0.05, Chi-squared test; Data described as absolute frequencies and percentage values.

association with variables that could be part of their undergraduate training and which could affect higher education. We chose to use the VARK questionnaire with dental students because dentists are required to be hands on and hence need to explore the principles of andragogy (Bertolami, 2001), metacognition and kinesthesia. The questionnaire is concise, easy to understand and complete, and it is freely available in Portuguese online. The use of a printed questionnaire containing multiple choice questions instead of an online questionnaire did not eliminate the problems associated with the effects of the context, ordering of items and context balancing (Wainer H, Lewis, 1989). The choice of the order of questions and their items in this study was random. The fact that the respondent could choose more than one item is a psychometric problem when it comes to measuring the reliability of the questionnaire (Shenoy, 2013). The study population was homogeneous. It consisted of only undergraduate dental students from three different private institutions in three different municipalities. It was not possible to assess the diversity of races, cultures or social strata. They were not significantly associated with learning styles. It should be noted that the most studies in the field of Dentistry cited in this article were conducted in only one institution. In our study, 213 participants were unimodal (46.40%) and 246 were polymodal (53.60%). The findings are in agreement with other studies on dental students which have also used the learning style of VARK[8,9,10,11,13,14,17,18,19]. Polymodal learning styles are common among apprentices[9,15].

Table 4. Association of participants' learning styles, grouped into twenty-five types, with the semester in which the participants were enrolled

	Semester			
VARK Standard Algorithm	1st semester	4th semester	10th semester	p-value
A *mild*	17	20	9	<0.001
	13.0%	10.0%	7.1%	
A *Strong*	7	8	3	
	5.3%	4.0%	2.4%	
A *very Strong*	3	2	2	
	2.3%	1.0%	1.6%	
AK	18*	15	13*	
	13.7%	7.5%	10.2%	
AR	7	5	1	
	5.3%	2.5%	0.8%	
ARK	10	39*	9	
	7.6%	19.4%	7.1%	
K *mild*	18	17	29*	
	13.7%	8.5%	22.8%	
K *Strong*	11	11	12	
	8.4%	5.5%	9.4%	
K *very Strong*	5	2	2	
	3.8%	1.0%	1.6%	
R *mild*	4	14	4	
	3.1%	7.0%	3.1%	
R *Strong*	2	3	2	
	1.5%	1.5%	1.6%	
R *very Strong*	1	1	0	
	0.8%	0.5%	0.0%	
RK	4	12	11	
	3.1%	6.0%	8.7%	
V *mild*	1	0	3	
	0.8%	0.0%	2.4%	
VAK	3	5	2	
	2.3%	2.5%	1.6%	
VAR	0	1	0	
	0.0%	0.5%	0.0%	
VARK *transition*	0	12	1	
	0.0%	6.0%	0.8%	
VARK *type one*	13	20	18	
	9.9%	10.0%	14.2%	
	Semester			
VARK Standard Algorithm	1st semester	4th semester	10th semester	p-value
VARK *type two*	3	9	1	
	2.3%	4.5%	0.8%	
VK	3	1	2	
	2.3%	0.5%	1.6%	
VR	1	0	1	
	0.8%	0.0%	0.8%	
VRK	0	4	2	
	0.0%	2.0%	1.6%	

Legend: Legend: *p<0.05, Chi-squared test; Data described as absolute frequencies and percentage values.

Like in the study by Murphy *et al*. (2004), our sample consisted of students enrolled in the first, second and fifth years of the course, which allowed to assess potential adaptive processes in the face of curricular and evaluative needs. The predominance of unimodal or

bimodal learning styles, in the first semester, namely "Read/Write" suggests that students start higher education without being adult learners, because they come from a teacher-centered teaching in high school, not developing all your self-study potential in different learning styles (Murphy et al., 2004; AlQahtani et al., 2018). In addition, during the initial years of dental school, the curriculum usually comprise diverse theory-based subjects with limited practical skills (AlQahtani et al., 2018). In a similar manner, Saran *et al*. (2015) founded that most first-year students preferred polymodal learning style, which differs from our study. However, it is worth mentioning that the sample was composed of only twenty students, which can be configured in a selection bias, making it difficult to compare with our data. The predominance of polymodal students in the fourth semester was expected because of the older age of the participants and their need to adapt to the curricular requirements in the transition from the basic cycle to the pre-professional cycle, when learning activities are diverse (Murphy, 2004 and Pashler et al., 2008). Shah *et al* (2013), in a sample of 200 students, compared two dentistry teaching institutions in Saudi Arabia and also observed a predominance of the polymodal style, but no comparison was made between the different semesters, not allowing to evaluate a possible evolution of these learning processes through the course, as observed in our study. As dental students progress through academic years in dental school, there is an increased on practical and hands-on training, which may affect the dental students learning style (Aldosari et al., 2018).

In this issue, Aldosari *et al*. (2018) and AlQahtani *et al*. (2018) also observed that the preference was the polymodal style but found no difference between the students throughout the course, different from that observed in our study. The smallest sample and the fact that it was performed only in an educational institution could be explain these differences. As in our study, Deshpande *et al* (2018)[19] compared three dental institutions in India and observed that final year students preferred the polymodal style. This finding was unexpected, however, this greater diversity of learning styles throughout the course could favor achieving multidimensional learning objectives in the training of the dentist, according to the Brazilian curriculum guidelines (Brasil, 2002). Our sample presented 22 of the 25 learning styles. The distribution of the styles among the participants shows human diversity. This finding has a central role in justifying the need to adapt methodologies to each student and value their individualities. In contrast, the human being can mobilize multiple resources to overcome some disability (Akhlaghi et al., 2018). The most prevalent learning styles were K mild (13.9%, n=64), ARK (12.6%, n=58), VARK type one (11.1%, n=51), A mild (10.0%, n=46 and AK (10.0%, n=46). The styles AK and K mild were the most prevalent in the first semester. ARK was most prevalent in the fourth semester and K mild was most prevalent in the tenth semester. In the study by Walji *et al*. (2010), the most prevalent styles were VARK and K. Shenoy *et al*. (2013) found VARK as the most prevalent style and Al-Saud (2013) found A and VARK as the most prevalent styles. These findings are in line with our study, but minor differences were founded. The difference in sample size, teaching methods and the fact that the comparison was made between the different semesters, unlike these other studies, may explain the differences founded.

The learning styles in our study were not significantly associated with gender or age, which is in agreement with most studies. The dental literature showed a lack of concern about such variables since the studied samples did not present a significant variation in this aspect. Two studies demonstrated a significant difference in gender, in which males preferred the unimodal style, while females preferred the bimodal and polymodal styles (Aldosari et al., 2018; Couto et al., 2015). However, in these studies just one third of the sample was composed of women, which may have caused an interpretation bias. We sought to identify new factors that influenced the formation of learning styles and checked for association with the educational path taken by the students: whether or not they attended daycare, whether literacy occurred at home or school, and whether they completed primary/secondary education in public or private schools or both. The approach to this educational path was based on two hypotheses: the first was that the early entry of the person into the educational system would provide stimuli at an early age and thus affect other moments in life and the formation of learning styles; the second hypothesis was that the differences between public and private education systems could give rise to differences in the formation of styles. There was a statistically significant difference in relation to daycare attendance: the students who attended daycare were significantly unimodal or panmodal and those who went straight to regular school were significantly bimodal or trimodal. The scientific committee of the Science for Childhood Center (2014) stated that quality daycare and preschool have positive effects on development as they enhance children's performance in standardized exams and school performance, which will also have a positive impact on future economic conditions. Further specific approach is needed to understand the impact of preschool on learning styles. The variable "maternal education level" was included in our study due to its impact on children's education and performance (AlQahtani, 2018). However, these variables were not significantly associated. Previous or current sports/arts practice was assessed to identify whether multiple intelligences would have an impact on learning styles (Aldosari, 2018).

However, we found no statistically significant associations. The discussion on "learning styles" is extensive and conceptually confusing and conflicting. It has been addressed by professionals from different backgrounds who have sought to develop the theory or its applications. However, the importance of the issue for the learning community and parents is undeniable. This is due to the association of this theme with the possibility of promoting learning, seeking self-knowledge, recognizing the individual as unique due to the unique characteristics identified in the questionnaires, and holding the educational system, schools and the teacher responsible for students' failure since they do not provide the learning method best suited to them (Akhlaghi, 2018). According to Hawk & Shah (2007), learning preference is a component of the broader concept of personality. On the other hand, Felder & Brent (2005) argue that one learning style is neither preferable nor inferior to another, but is simply different, with different characteristic strengths and weaknesses. The main driver of scientific discussion is the search for proof of the hypothesis that when a student with a specific characteristic is exposed to methods that take advantage of it he/she will have a better performance compared with those who do not have the same characteristic. In this point of view Mozaffari *et al*. (2020) observed no significant relationship between learning style and academic achievement, unlike another studies (Nuzhat et al., 2011 and Couto, 2015).

However, longitudinal studies with a heterogeneous sample and studies with twins are scarce (Akhlaghi et al., 2018; Kozhevnikov, 2007 and Coffield, 2004). This study opens space for reflection on learning methodologies and points to the need for further research on students' motivation and metacognition. It is important to emphasize that research on learning styles is not intended to fit individuals into certain educational models. In fact, it is intended to unlock the full potential of the human brain through self-knowledge. Further specific approach to this issue is needed to assess whether – and to what extent – this phenomenon occurs. The path is not mapped, but the principles that will guide it seem obvious: to understand the weaknesses and strengths of undergraduate dental students; the technically prepared teacher must master the theories and techniques of education and be flexible and capable to adapt; and curriculum must acknowledge everyone as equal and create conditions so that different people can flourish in the academic environment.

CONCLUSION

Most of the participants exhibited panmodal learning styles and reported more than one style of learning, with a greater number of styles in the last semester of the course. However, these preferences were not influenced by constitutional or external factors, except for students who attended daycare at preschool age.

REFERENCES

Akhlaghi N, Mirkazemi H, Jafarzade M, Akhlaghi N. Does learning style preferences influence academic performance among dental students in Isfahan, Iran? J Educ Eval Health Prof 2018; 15:8-http://doi.org/10.3352/jeehp.2018.15.8.

Aldosari MA, Aljabaa AH, Al-Sehaibany FS, Albarakati SF. Learning style preferences of dental students at a single institution in Riyadh, Saudi Arabia, evaluated using the VARK questionnaire. Adv Med Educ Pract. 2018;9:179-86.

AlQahtani N, AlMoammar K, Taher S, AlBarakati S, AlKofide E. (2018) Learning preferences among dental students using the VARK questionnaire: A comparison between different academic levels and gender. J Pak Med Assoc, 68(1), pp. 59-64.

Al-Saud LMS. (2013) Learning style preferences of first-year dental students at King Saud University in Riyadh, Saudi Arabia: Influence of gender and GPA. J Dental Educ77(3), pp. 1371-1378.

American Dental Education Association. ADEA competencies for the new general dentist. (2015) J Dental Educ.79(7), pp.813-816.

Bertolami CN. (2001) Rationalizing the dental curriculum in light of current disease prevalence and patient demand for treatment: form vs. content. J Dent Educ, 65(8):725-735.

Brasil. Conselho Nacional de Educação. Resolução CNE/CES 3, de 19 de fevereiro de 2002. Institui diretrizes curriculares nacionais do curso de graduação em Odontologia. Diário Oficial da União, Brasília (DF); (2002) mar 4; Seção 1: 10

Coffield F, Moseley D, Hall E, Ecclestone K. (2004) Learning styles and pedagogy in post-16 learning: A systematic and critical review. London, UK: Learning and skills research centre.

Couto LB, Bestetti RB, Restini CBA, Faria-Jr M, Romão GS. (2015) Brazilian medical students' perceptions of expert versus non-expert facilitators in a (non) problem-based learning environment. Med Educ Online. 20: 26893 – http://dx.doi.org/10.3402/meo.v20.26893.

Deshpande AN, Pradhan HC, Sikda M *et al*. (2018) Learning Styles among Dental Undergraduates and Postgraduates—VARK Scale Study. Research & Reviews: A Journal of Dentistry. 9(2), pp1-8.

Fang AL. (2002). Utilization of learning styles in dental curriculum development. N Y State Dent J 68(8), pp. 34-38.

Felder RM, Brent R. (2005)Understanding student differences. J Eng Educ;94(1), pp.57-72.

Fleming ND, Mills C. (1992). Not another inventory, rather a catalyst for reflection. To Improve the Academy. Acad Res Fac Instructional Organ Dev, 11(1), pp.137-149.

Fleming ND. (1995) I´m different, not dumb. Modes of presentation (VARK) in the tertiary classroom. In: Zelmer A. Research and development in higher education, proceeddings of the 1995 Annual Conference of the Higher Education and Research Development Society of Australasia (HERDSA), HERDSA. 18(3), pp.308-313.

Hawk TF, Shah AJ. (2007). Using learning style instruments to enhance student learning. Decis Sci J Innovat Educ (1);5, pp.1-19.

Kozhevnikov M. (2007). Cognitive styles in the context of modern psychology: Toward an integrated framework of cognitive style. Psychol Bulletin, 133(3), pp.464-481.

Mozaffari HR, Janatolmakan M, Sharifi R, Ghandinejad F, Andayeshgar B, Khatony A (2020). The Relationship Between the VARK Learning Styles and Academic Achievement in Dental Students. Adv Med Educ Pract;11, pp.15-19.

Murphy RJ, Gray AS, Straja SR, Bogert MC. (2004) Student learning preferences and teaching implications. J Dent Educ, 68(8), pp.859-866.

Nuzhat A, Salem R, Quadri M, Al-Hamdan N. (2011) Learning style preferences of medical students: a single-institute experience from Saudi Arabia. Int J Med Educ. 2(1), pp.70-73.

Pashler H, McDaniel M, Rohrer D, Bjork R. (2008) Learning styles: concepts and evidence. Psychol Sci Public Interest.9(3), pp.105-119.

Saran R, Kumar S, Pentapati KC (2015). Assessment of learning preferences among dental students using Visual, Aural, Read-Write, Kinesthetic questionnaire: An institutional experience. J Dent Res Rev; 2, pp.:10-12.

Shah K, Ahmed J, Shenoy N, N Srikant. (2013). How different are students and their learning styles? Int J Res Med Sci;1:212-215. DOI: 10.5455/2320-6012.ijrms20130808

Shenoy N, Shenoy KA, U.P R. (2013) The perceptual preferences in learning among dental students in clinical subjects. J Clin Diagn Res.7(8), pp. 1683-1685.

Wainer H, Lewis C. (1989) Toward a psychometrics for testlets. Princeton: Educational Testing Service.

Walji MF, O'Neil PN, Koeppen RG. (2010) Relationships between dental students' personality types and learning preferences. J Dent Educ;74(2), pp.162-163.

Whillier S, Lystad RP, Abi-Arrage D, McPhie C, Jonhston S, Williams C *et al*.(2014) The learning style preferences of chiropractic students: a cross-sectional study. J Chiropr Educ;28(1), pp 21-27.

Woolfolk A. (2007) Educational psychology. 10th ed. Boston, MA: Pearson Educational, Inc.

****