

Learning Styles among students of three different Universities in Dentistry in Brazil:

Transversal study

Estilos de Aprendizagem entre estudantes de três diferentes Universidades de Odontologia no

Brasil: Estudo transversal

Estilos de Aprendizaje entre estudiantes de tres diferentes Universidades de Odontología en Brasil:

Estudio transversal

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Abstract

Learning styles indicate the ways and conditions in which students understand, retain, and memorize knowledge in a productive and responsive manner. One of the most widely used tools to assess learning styles is the VARK (Visual, Aural, Read/write, and Kinesthetic) questionnaire. To identify the learning styles of students enrolled in three different dentistry programs in Brazil by applying the VARK questionnaire. This cross-sectional study involved a sample of 340 undergraduate students enrolled in dentistry programs at the following institutions: Federal University of Minas Gerais (n=172), Pontifical Catholic University of Minas Gerais (n=100), and Pontifical Catholic University of Paraná (n=68). An online questionnaire was administered to the students via “Qualtrics XM 2020”, between May 2020 and September 2020. It comprised questions about the student’s demographic, socioeconomic, and academic characteristics. Their learning style was assessed by the VARK questionnaire. The chi-squared test and Z-test were used to analyze the relationship between learning styles, considering $p < 0.05$. The most frequent learning style category was found to be unimodal (80.2%), followed by bimodal (16.8%) and trimodal (9.4%). Most unimodal students were distributed throughout the kinesthetic (27.1%), auditory (23.8%), and writing/reading (20.0%) styles, and no statistically significant differences were found among the studied variables. The students enrolled in the three dentistry programs were predominantly unimodal, a finding that diverges from the existing literature. Additionally, a higher frequency of kinesthetic learners was found in the study sample, as verified in other studies.

Keywords: Learning; Teaching; Education.

Resumo

Os estilos de aprendizagem indicam as formas e condições em que os alunos compreendem, retêm e memorizam o conhecimento de forma produtiva e responsiva. Uma das ferramentas mais utilizadas para avaliar estilos de aprendizagem é o questionário VARK (Visual, Auditivo, Escrita/Leitura e Cinestésico). Foram avaliados os estilos de aprendizagem de alunos matriculados em três diferentes cursos de odontologia no Brasil por meio da aplicação do questionário VARK. Este estudo transversal envolveu uma amostra de 340 alunos de graduação matriculados em cursos de odontologia das seguintes instituições: Universidade Federal de Minas Gerais (n=172), Pontifícia Universidade Católica de Minas Gerais (n=100) e Pontifícia Universidade Católica do Paraná (n=68). Um questionário online foi aplicado aos alunos via “Qualtrics XM 2020”, entre maio de 2020 e setembro de 2020. Era composto por perguntas sobre características demográficas, socioeconômicas e acadêmicas do aluno. Seu estilo de aprendizagem foi avaliado pelo questionário VARK. O teste qui-quadrado e o teste Z foram utilizados para analisar a relação entre os estilos de aprendizagem, considerando $p < 0,05$. A categoria de estilo de aprendizagem mais frequente foi unimodal (80,2%), seguida de bimodal (16,8%) e trimodal (9,4%). A maioria dos alunos unimodais distribuiu-se pelos estilos cinestésico (27,1%), auditivo (23,8%) e escrita/leitura (20,0%), não havendo diferenças estatisticamente significativas entre as variáveis estudadas. Os alunos matriculados nos três cursos de odontologia eram predominantemente unimodais, achado que diverge da literatura existente. Além disso, foi encontrada maior frequência de estudantes cinestésicos na amostra do estudo, conforme verificado em outros estudos.

Palavras-chave: Aprendizagem; Ensino; Educação.

Resumen

Los estilos de aprendizaje indican las formas y condiciones en las que los estudiantes entienden, retienen y memorizan el conocimiento de manera productiva y receptiva. Una de las herramientas más utilizadas para evaluar los estilos de aprendizaje es el cuestionario VARK (Visual, Auditivo, Escritura/Lectura, y Cinestésico). Fueron evaluados los estilos de aprendizaje de los estudiantes matriculados en tres diferentes programas de odontología en Brasil mediante la aplicación del cuestionario VARK. Este estudio transversal involucró una muestra de 340 estudiantes de pregrado matriculados en programas de odontología en las siguientes instituciones: Universidad Federal de Minas Gerais (n=172), Pontificia Universidad Católica de Minas Gerais (n=100) y Pontificia Universidad Católica de Paraná (n=68). Se administró un cuestionario en línea a los estudiantes a través de “Qualtrics XM 2020”, entre mayo de 2020 y septiembre de 2020. Constaba de preguntas sobre las características demográficas, socioeconómicas y académicas del estudiante. Su estilo de aprendizaje se evaluó mediante el cuestionario VARK. Para analizar la relación entre los estilos de aprendizaje se utilizó la prueba de chi-cuadrado y la prueba Z, considerando $p < 0,05$. La categoría de estilo de aprendizaje más frecuente resultó ser unimodal (80,2%), seguida de bimodal (16,8%) y trimodal (9,4%). La mayoría de los estudiantes unimodales se distribuyeron en los estilos cinestésico (27,1%), auditivo (23,8%) y escritura/lectura (20,0%), y no se encontraron diferencias estadísticamente significativas entre las variables estudiadas. Los estudiantes matriculados en los tres programas de odontología eran predominantemente unimodales, un hallazgo que difiere de la literatura existente. Además, se encontró una mayor frecuencia de estudiantes cinestésicos en la muestra del estudio, como se verificó en otros estudios.

Palabras clave: Aprendizaje; Enseñaza; Educación.

1. Introduction

The classroom is a setting consisting of diverse agents who possess individual characteristics related to the teaching and learning process (Al-Saud, 2013; Asiry et al., 2016). Learning styles indicate the ways and conditions in which students understand, retain, and memorize knowledge in a productive and responsive manner (Asiry, 2016; Grubb, 2016; AlQahtani et al., 2018; Alvim, 2020). Although no learning style is more advantageous than the other, every learner's manner of acquiring information is unique to them (Grubb, 2016; AlQahtani et al., 2016).

The VARK questionnaire was created by Professor N. Fleming at Lincoln University, New Zealand in 1998 (Al-Saud, 2013; Alvim, 2020). It is a data collection instrument that has been widely validated to assess learning styles and determine the sensory modalities of individual learning preferences in four categories: Visual (V), including learning through maps, spider diagrams, charts, graphs, flow charts, labelled diagrams, and all the symbolic arrows, circles, hierarchies and other devices, that people use to represent what could have been presented in words; Auditory (A), including learning through recordings and lectures; Reading/Writing (R), including learning by taking notes and writing summaries repeatedly; Kinesthetic (K), including learning through experience or practice (learning by doing). Additionally, the questionnaire also determines whether the learning style is multimodal, that is, a combination of the abovementioned learning styles. The results of the VARK questionnaire allow us to characterize a respondent's learning style as unimodal or multimodal. Multimodal learning style includes either a combination of two learning styles (bimodal), or a combination of three learning styles (trimodal), or a combination of all the modalities (quadrimodal) (Al-Saud, 2013; Aldosari et al., 2018; AlQahtani et al., 2018; Alvim, 2020). The information provided by the VARK questionnaire can not only help students to improve their learning abilities but also help teachers to recognize the different learning styles of students so that they can adapt and adjust their teaching methods, consequently improving their pedagogical practices (Al-Saud, 2013; Aldosari et al., 2018; AlQahtani et al., 2018; Jacaranda & Barriguete, 2019).

Students in medical, nursing, engineering, and other fields of knowledge in India (Khalid Mahmood et al., 2012; Kumar & Chacko, 2012; Grubb, 2016), the US (Asiry, 2016), Sri Lanka (Marcy, 2001), and Mexico (Morita et al., 2021) and students in dentistry programs in various countries such as Saudi Arabia (Al-Saud, 2013; Grubb, 2016; Aldosari et al., 2018; AlQahtani et al., 2018; Jacaranda & Barriguete, 2019), Iran (Alvim, 2020; Mozaffari et al., 2020), India (Nasiri et al., 2016; Qutieshat et al., 2021), and Mexico (Morita et al., 2021) took the VARK questionnaire. The results revealed that the students were multimodal (4%–50.6%) learners and that the unimodal learners preferred either the kinesthetic learning style (15.2%–49.2%) or auditory learning style (1%–50%) (Marcy, 2001; Kumar & Chacko, 2012; Al-Saud, 2013; Asiry, 2016; Grubb, 2016; Nasiri et al., 2016; Aldosari et al., 2018; AlQahtani et al., 2018; Parashar et al., 2018; Jacaranda & Barriguete, 2019; Alvim, 2020; Mozaffari et al., 2020; Morita et al., 2021; Qutieshat et al., 2021).

In the search of international electronic research databases via keywords, no published papers on the application of the VARK questionnaire in undergraduate dentistry programs in Brazil were found in the indexed journals.

Therefore, it is essential for teachers to identify their students' learning styles in order to plan and modify the class format accordingly (Al-Saud, 2013; Grubb, 2016; Nasiri et al., 2016; Aldosari et al., 2018; Parashar et al., 2018; Mozaffari et al., 2020). This identification will also help teachers to resolve some situations and challenges in the teaching and learning process (Asiry, 2015; Grubb, 2016; AlQahtani et al., 2018; Jacaranda & Barriguete, 2019). It is relevant for students to become aware of their own learning styles; additionally, it is important for teachers to encourage them to become quadrimodal learners, since this mode improves learning abilities, consequently improving academic performance (Khalid Mahmood et al., 2012). Thus, this study is relevant as it contributes to the existing literature by employing a diagnosis of the students' learning styles

for a subsequent intervention.

This study hypothesizes there is a higher frequency of Brazilian dental students with a multimodal learning style as compared to dental students in other countries who predominantly have a kinesthetic learning style.

Finally, this study aimed to identify the learning styles of students enrolled in three different dentistry programs in Brazil by applying the VARK questionnaire.

2. Methodology

This cross-sectional study was approved by the Research Ethics Committee of Pontifical Catholic University of Paraná (PUCPR) under opinion no. 4.020.891.

The sample included students of all the undergraduate dentistry programs offered at Pontifical Catholic University of Minas Gerais (PUCMG) and the Faculty of Dentistry of Federal University of Minas Gerais (FAO UFMG), both located in the city of Belo Horizonte, Minas Gerais, in the Southeast region of Brazil, and the students of Pontifical Catholic University of Paraná (PUCPR), located in the state of Paraná in the South region of Brazil. The program coordinators of the three institutions were asked to provide information on the enrolled students by email, and the number of students was obtained: 752 students at PUCMG, 649 students at FAO UFMG, and 392 students at PUCPR. The institutions were chosen in terms of considering the convenience of conducting the study as these institutions participate in interinstitutional cooperation.

The sample size was calculated by considering a 5% alpha level, a 95% confidence level, and a 50% population variability p^*q^* . This resulted in 254 students from PUCMG, 242 students from FAO UFMG, and 194 students from PUCPR.

A questionnaire including questions of mixed type addressing students' socioeconomic data (ABEPE, 2018), course curriculum, and retention, which had been previously tested and validated, and the VARK questionnaire were prepared. The VARK questionnaire (version 7.8, in Portuguese), contains 16 multiple choice questions with four options each and the possibility of choosing multiple answers per question, promoting scores according to the student's learning styles. After assessing the responses, the distribution was determined and categorized as unimodal (V, A, R, or K); bimodal (VA, VR, VK, AR, AK, and RK); trimodal (VAR, VAK, VRK, and ARK); or quadrimodal (VARK). The Qualtrics platform was used to apply the questionnaires (Pentapati et al., 2015; Plataforma Qualtrics, 2020).

Between the months of May 2020 and September 2020, the program coordinators forwarded the link to access the questionnaire, the Informed Consent Form and an explanatory, motivational video about the study to the students via institutional emails, the Moodle platform, and WhatsApp class groups. This process was repeated with a new video for reinforcement every month over the course of the study.

As a means of feedback, the students received their measured results, and they had the option to download learning style techniques in PDF format (Samarakoon et al., 2013).

The data collected from the questionnaires were analyzed via SPSS® (IBM, version 25.0) software.

The independent variable in this study was the learning styles; the dependent variables were sex, Challenged Students, educational institution, perception of learning styles, and socioeconomic classification, current student semester, preparatory course for admission into the program.

To analyze the nominal variables, the nonparametric chi-squared test (χ^2) was adopted (2). The expected frequency was calculated for each cell, and the assumption suggests that no cell should have an expected frequency of less than 5. When this assumption was not met, Fisher's exact test was applied.

In situations where the chi-squared test was applied to more than two groups, the two-proportions Z-test was used to

evaluate statistically significant differences between the groups.

The value of α was considered as 5% for all the tests, that is, $p < 0.05$ to measure statistical significance.

3. Results

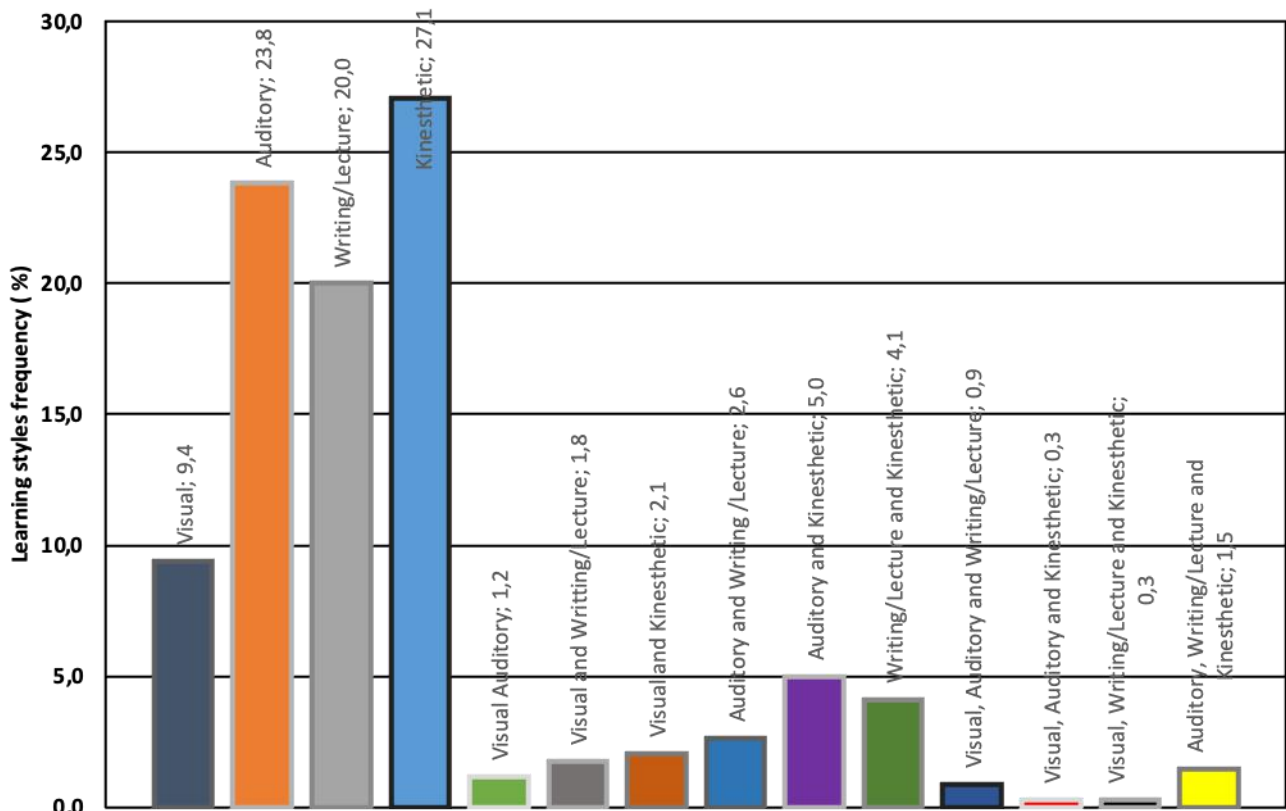
Only 500 (27.89%) of the 1793 students (100%) were invited to participate in the questionnaire survey. Of these, 131 students (7.31%) did not complete the questionnaire, and as 29 students (1.62%) did not identify as being enrolled in one of the colleges within the study, they were excluded. The final sample included 340 students (18.96%) who had completed the questionnaire items. The mean age of the students was 22.04 years (± 3.96), within the range of 18 and 46 years, and 303 students (89.12%) were under the age of 25.

Based on an overall analysis of the learning styles, the unimodal category was the most frequent at 80.2%, and the kinesthetic style (27.1%) was observed the most, followed by the auditory style (23.8%), the reading/writing learning style (20.0%), and the visual learning style (9.4%). The second most frequent category was bimodal (16.8%), and the third most frequent category was trimodal (3.0%). No student presented the quadrimodal style (GRAPH 1).

In the comparative analyses of the learning styles and modalities categories verified among the students of the three dentistry programs, no statistically significant differences were found ($p=0.344$) (TABLE 1).

No statistically significant relationship was observed between the learning styles and the variables of sex, educational institution, current student semester, preparatory course for admission into the program, Challenged Students, perception of learning style, and socioeconomic classification (TABLE 2).

Graphic 1. Relative frequency of the learning styles of students from three undergraduate dentistry courses, Brazil, 2020.



Fonte: Autores.

Table 1. comparative analysis of the variables of learning styles and the undergraduate course in Dentistry/Universities, Brazil, 2020.

		Universities		
		PUC Minas	PUCPR	UFMG
Learning Styles	Unimodal	80(80,0%) _a	54(79,4%) _a	139(80,8%) _a
	Bimodal	14(14,0%) _a	14(20,6%) _a	29(16,9%) _a
	Trimodal	6(6,0%) _a	0(0,0%) _a	4(2,3%) _a

Chi-square test: learning styles (p*0.344).

Fonte: Autores.

Table 2: Graph 1. Comparative analysis of the variables gender, undergraduate course/university, bond period, preparatory courses, retention in the curriculum path, perception of learning style and socioeconomic classification with the learning category variable, Brazil, 2020.

Variables		Learning categories		
		Unimodal	Bimodal	Trimodal
Gender	Female	226(82,8%)	45(78,9%)	9(90,0%)
	Male	47(17,2%)	12(21,1%)	1(10,0%)
University	PUCMG	80(29,3%)	14(24,6%)	6(60,0%)
	PUCPR	54(19,8%)	14(24,6%)	0(0,0%)
	FAO UFMG	139(50,9%)	29(50,9%)	4(40,0%)
Bonding period (2020/1)	1º to 3º	122 (44,7%)	18(31,6%)	2(20,0%)
	4º to 7º	110(40,3%)	26(45,6%)	5(50,0%)
	8º to 10º	41(15,0%)	13(22,8%)	3(30,0%)
Preparatory courses/ENEM	Yes	181(66,3%)	37(64,9%)	7(70,0%)
	No	92(33,7%)	20(35,1%)	3(30,0%)
Failed Students	Yes	27(9,9%)	5(8,8%)	1(10,0%)
	No	246(90,1%)	52(91,2%)	9(90,0%)
Perseption of learning styles	Yes	157(57,5%)	38(66,7%)	7(70,0%)
	No	116(42,5%)	19(33,3%)	3(30,0%)
Socioeconomic class	A	87 (31,9%)	24 (42,1%)	3 (30,0%)
	B	128 (46,9%)	25 (43,9%)	5 (50,0%)
	C	42 (15,4%)	8 (14,0%)	0 (0,0%)
	D-E	7 (2,6%)	0 (0,0%)	1 (10,0%)
	NR*	9 (3,3%)	0 (0,0%)	1 (10,0%)

Chi-square test: Gender (p*0.640), university (p*0.167), term (p*0.172), vestibular preparation (p*0.947), dependency (p*0.966), know your style (p*0.347) and socioeconomic class (p*0.227). *NR - Did not answer.

Fonte: Autores.

4. Discussion

Recognizing and applying learning styles are essential to the teaching and learning process because it allows students to develop their skills and abilities and enhance their academic performance (Marcy, 2001; Grubb, 2016; Alsosari et al., 2018; AlQuahtani et al., 2018; Parashar et al., 2018; Jacaranda & Barriguete, 2019; Alvim, 2020; Qutieshat et al., 2021). Thus, this study is relevant because it used the VARK questionnaire as a diagnostic tool to enable future interventions to increase the students' learning potential. This study is significant as there is no existing research on the learning styles of dental students in different institutions in Brazil by employing the VARK questionnaire. Of the learning styles addressed in this study, kinesthetic learning was the most frequently employed learning style among the students enrolled in the three dentistry programs and in the previous studies (Nasiri et al., 2016; Parashar et al., 2018; Morita et al., 2021), that partially confirms this study's hypothesis. The similarities between the reported frequencies reveal the same trends regardless of the countries of origin. Therefore, the kinesthetic style tends to be universally predominant among students, as demonstrated in the existing literature and in this study.

These students, who were primarily under the age of 25, constitute a population that is immersed in a reality of digital accessibility. In this reality that is characterized by inclusion, there is a constant interaction with simulated reality, which reflects the students' demand for agility and practicality in their lives, including in education. Based on these observations, this population group fits the description of Generation Z (Samarakoom et al., 2013).

Although there were a few students over the age of 25 in the sample of this study, implying other generations, these students also employed the kinesthetic style the most, like studies (Nasiri et al., 2016; Parashar et al., 2018) addressing Generation Y.

The greater frequency of the kinesthetic style among students may be related to the profile of the student who chooses to enroll in the dentistry program, and which is reinforced by the teaching practices employed in these programs. Dental practice places an emphasis on practical training and manual dexterity so that one may acquire the skills and abilities required by the profession. In other words, the method of learning by doing or learning to learn, seeing, and doing is used to secure students' learning of the technique (Shah et al., 2013; Shenoy et al., 2013). Kinesthetic learners may be in the first stage to becoming quadrimodal learners since they employ a mixture of sensory functions for their knowledge (Parashar et al., 2018). Accordingly, the restorative dentistry learning models are emphasized to the detriment of a humanistic, reflexive, critical, integral education with practices integrated into social reality, which triggers other learning styles (Morita et al., 2021).

While this study found a higher frequency of the unimodal category among the students of the three dentistry programs, a higher frequency of the multimodal category was observed among the students in Saudi Arabia (Al-Saud, 2013; Grubb, 2016; Alsosari et al., 2018; AlQuahtani et al., 2018; Jacaranda & Barriguete, 2019), Iran (Alvim, 2020; Mozaffari et al., 2020), and India (Qutieshat et al., 2021). The authors of these previous studies did not comment on the reasons why the students were classified into the multimodal category. One possible explanation for this finding may be the educational systems of these countries that stimulate students to use a combination of learning styles prior to their entry into higher education.

Learning styles can change over time based on lived experiences and can help students adapt better to new situations (Nasiri et al., 2016). This study reinforces this perspective considering that in the context of the COVID-19 pandemic, students have been attending classes remotely, which reinforces the need for adaptation and the assimilation of new pedagogical methods that can recruit more than one learning style (Shqaidef et al., 2021; Vark questionnaire, 2020). It is essential for all the agents involved in the teaching and learning process to be committed to recognizing their limitations and accomplishments and to strive for an integral application of the quadrimodal category, building students' resilience and adaptation in their learning autonomy, as indicated (Kumar & Chacko, 2012; Alsosari et al., 2018; Alvim, 2020).

More extensive and regionally comprehensive studies are needed to observe the reality of the learning styles of dental

students in Brazil since this study was limited to students enrolled in three different dentistry programs, two from the Southeast region and one from the South region of Brazil. These regions have the highest concentration of dentistry programs in the country, and these regions also enjoy more favorable geopolitical and socioeconomic conditions as compared to other regions of Brazil (Vark, 2020).

There were limitations to this study, such as the current context of the COVID-19 pandemic and the strategic decision to send the link to the questionnaire to the students via their institutional coordination departments, leading to a smaller number of participants in relation to the sample calculation. Another limitation of this study was that the VARK questionnaire was designed to measure students' sensory preferences; however, it did not consider other aspects such as their motivation or commitment to learning (Parashar et al., 2018). Despite these limitations, this study is the only one of its kind to be conducted in Brazil, as verified in international research databases.

The ethical contribution of this study was the pedagogical feedback provided to the educational institutions through the results on the students' learning styles. These findings can help professors of the institutions to reflect on their teaching practices, adapt, adjust, and renew individual and collective teaching methods, and encourage the three undergraduate programs to cater for different learning styles in their political-pedagogical proposals (PPP) for the programs to stimulate multimodal learning among the students.

5. Conclusion

The kinesthetic learning style was observed most often among the students of the three different programs in this study, followed by the auditory and writing/reading learning styles. In other words, the unimodal category predominated equally among students in the three institutions. A low frequency of the bimodal and trimodal categories was observed among the students of the three programs, and no student was observed to belong to the quadrimodal category (VARK).

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