

Learning styles in relation to academic performance in virtual modality of students of careers in the health area

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Abstract

Introduction: The COVID-19 pandemic has forced the adaptation of pedagogical processes, arising the necessity of adapt learning-teaching strategies. **Objective:** Identify the learning styles among the health area students of Bío-Bío University for virtual education in the COVID-19 pandemic context. **Method:** Through a stratified random sampling 409 students from the Nutrition and Dietetic, Nursing and Phonoaudiology career. The instrument used for determining the students learning style was "CHAEA-32". Additionally, a questionnaire was applied for the sociodemographic characterization. **Results:** The most frequent learning style among students was the Reflector (37.7%), followed by the Theorist (24.4%), the Activist (16.4%), Pragmatist (11.7%), and the Undefined (9.8%). There is no significant relation between learning styles, the variables "academic performance" and "sex", but with the "present year career", there is only a significant relation with the theorist and reflector style. **Discussion:** It is rewarding that the most frequent learning style be the reflector, as it is observed in face-to-face classes, the students show to be analytical, careful, watchful, in relation with the health area student profile. The results suggest the replicability in virtual context of some strategies used in face-to-face classes.

Keywords: Learning styles; Academic performance, Virtual modality; COVID-19; University students; Health

Estilos de aprendizaje en relación al rendimiento académico en modalidad virtual de estudiantes de carreras del área de la salud

Resumen

Introducción: La pandemia por coronavirus obligó a adaptar procesos pedagógicos, surgiendo la necesidad de adecuar estrategias de enseñanza y aprendizaje. **Objetivo:** Identificar los estilos de aprendizaje en educación virtual de estudiantes de carreras del área de salud de la Universidad del Bío-Bío, en contexto de pandemia por COVID-19. **Método:** Mediante un muestreo aleatorio estratificado se evaluó a 409 estudiantes de las carreras de Nutrición y Dietética, Enfermería y Fonoaudiología. El instrumento para determinar los estilos de aprendizaje fue "CHAEA-32". Además, se aplicó un cuestionario para caracterización sociodemográfica. **Resultados:** El estilo de aprendizaje más frecuente fue el Reflexivo (37.7%), seguido por el Teórico (24.4%), el Activo (16.4%), Pragmático (11.7%) y el Indefinido (9.8%). No existe relación significativa entre estilos de aprendizaje y las variables "rendimiento académico" y "sexo"; con la variable "carrera en curso" existe relación significativa sólo con los estilos

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Teórico y Reflexivo. **Discusión:** Es satisfactorio que el estilo de aprendizaje más frecuente sea el Reflexivo, tal como se suele observar en educación presencial, porque los estudiantes demuestran ser analíticos, prudentes y observadores, acorde con el perfil del estudiante del área de la salud. Los resultados sugieren la replicabilidad en contexto virtual de algunas estrategias usualmente empleadas en la presencialidad..

Palabras clave: Estilos de aprendizaje, Rendimiento Académico, Modalidad virtual, COVID-19, Estudiantes universitarios, Salud

Introduction

From birth, individuals are considered as beings that capture, store, and use information in their different daily activities, with the ability to remember what they have learned in previous experiences and use them when necessary ([Barría et al., 2019](#)). Throughout life, we learn and look for the best way to acquire knowledge, the one that is the easiest for everyone and conducive to learning ([Castro & Guzmán, 2017](#)). Teaching is the fundamental tool of education, with faculty transmitting knowledge and information to ensure that students learn through a teaching method. The latter involves the essential relationship between faculty and students, a process in which faculty organize students' activities on the object of study, resulting in students assimilating the knowledge taught ([Navarro & Samón, 2017](#)). The teaching-learning process, didactically articulated with its components, provides information, and offers learning mediating actions to students, guided by faculty ([Barcia & Carvajal, 2015](#)).

However, the coronavirus pandemic (COVID-19) caused an unprecedented crisis in all areas. In the education field, there was a massive suspension of face-to-face activities in all educational institutions from more than 190 countries. Many of the measures adopted by the countries of the region in response to the crisis were related to the suspension of face-to-face classes in higher education, resulting in the need to readapt pedagogical processes to the mandatory confinement. This change led to the need for distance education ([UNESCO International Institute for Higher Education in Latin America and the Caribbean \[IESALC\], 2020](#)),

which is an educational system or method of independent, non-face-to-face training mediated by various technologies. It involves a change in the traditional patterns of the teaching-learning process, both for faculty and students. With this method, there is no real-time direct relationship for faculty to guide the process, and student learning is more flexible since there is no physical coincidence in terms of place and time, requiring greater independence and self-regulation from students ([García et al., 2007](#)).

Distance Education promotes interdisciplinarity, interactivity, and openness to the diversity of knowledge, opinions, and criteria. From the academic perspective, it promotes meaningful learning in which students constantly construct and reconstruct. From the technological perspective, Distance Education is based on the multiple possibilities offered by connectivity and technological media capacity for communicative interaction. This is due to the variety of digital tools that can be used in Distance Education, such as platforms, videos, documents, forums, chats, e-mails, and recordings. These allow students to learn through different teaching methods and thus enhance their active role in the construction of knowledge, where information and communication tools become particularly important to facilitate and ensure teaching quality and relevance ([Alonso et al., 2017](#)).

In this modality, students take control and become the protagonists of their learning process, as active, motivated, and committed individuals. Faculty conditions and capabilities to promote self-study are required, as well as students' autonomy and self-regulation, so they can control their learning process ([Alonso et al., 2017](#)). This is why it is necessary that faculty do not

lose sight of their role as facilitators and guides, since they are responsible in this modality for the design, organization, and control of the activities that facilitate the learning process through which students will construct knowledge ([García et al., 2007](#)).

The role of faculty in the use of virtual elements is essential for the creation of optimal learning environments that reduce anxiety and promote meaningful learning in contexts other than traditional ones. The use of technologies in the educational context is under review due to the importance of faculty having the necessary skills to face this technological change and being trained for their use, management, and subsequent implementation. Thus, their pedagogical strategies and resources should be based on the appropriation and integration of digital tools in educational planning ([Cruz, 2019](#)) to adapt to students' preferred learning styles.

In this context, students' Learning Styles assume a leading role because it is essential to know the characteristics of the future recipients of everything that faculty design and create to promote learning in their courses. Faculty are required to use appropriate instruments to identify students' different Learning Styles ([Ayala & Lozano, 2010](#)) to adjust the final course programming objectives.

It should be noted that the learning process is different, unique, and individual, with each student living the learning experience in one way or another throughout their life. In this experience, a series of accelerating or hindering internal and external factors come together, such as memory, motivation, and concentration. In education in general, as a learning stage, students must comply with different stages and requirements ([Cárdenas et al., 2017](#)), with the final result being measurable through each student's academic performance. This way, understanding the learning process acquires great importance for both faculty and students, since it allows identifying and recognizing the different ways of learning. These are known as Learning Styles, which are cognitive, affective, and physiological traits that serve as relatively stable indicators of how students perceive, interact, and respond to

their learning environments ([Alonso et al., 2012](#)). These are naturally chosen by individuals to maximize their own learning process. Identifying and recognizing them allows enhancing them and designing methodologies, planning, and curricular approaches that strengthen and facilitate the teaching-learning process.

It is essential to pay attention to all the aspects involved in the educational process, and not only to teaching and contents presented but also to students' educational and particular needs ([Martínez, 2009](#)). Knowledge of learning styles provides pedagogical approaches and imperative knowledge for students and faculty regarding their strengths or weaknesses in teaching and learning ([Baherimoghadam et al., 2021](#)).

This study takes theory of [Kolb \(1976\)](#) on learning styles as its starting point. According to his theory, learning first requires processing the information obtained. This is either based on a direct and concrete experience or on an abstract experience that comes from an external source. In the 1980s, [Honey & Mumford \(1986\)](#) developed another learning style system based on Kolb's theory, focused on the work and business context. According to them, each individual responds differently to learning situations. Such preferred attitudes and strategies arise from each individual's inner need to find the most convenient way to learn and optimize their performance. Later, Alonso (1994) adapted Honey and Mumford's questionnaire to the academic environment in Spanish, which is known today as CHAEA (Honey-Alonso Learning Styles Questionnaire).

It should be noted that most research describes students' learning styles in the face-to-face modality and very scarcely in the distance modality. This is because, since its beginnings, education has been characterized by a face-to-face modality, with a dynamic process of physical contact between students and faculty, in addition to the use of techniques and methods for the teaching-learning process to be effective. However, with the new world environment conditions, particularly with globalization and the irruption of new technologies ([Cárdenas et al., 2017](#)), and especially the COVID-19 pandemic

as noted above, education has found it necessary to include new tools. It has incorporated new modalities for training professionals, such as Distance Education or, more precisely, Emergency Remote Education, where educational institutions specialized in face-to-face teaching had to adapt their methodology in lockdown due to the contingency, using Distance Education foundations to teach remotely. Emergency Remote Education emerges as an alternative term to Distance Education. It is distinguished by being a temporary change in the teaching method due to pressing circumstances. Furthermore, it is not designed from the beginning to be delivered online (Hodges et al., 2020) because the virtual modality was implemented without planning time in the face of the sudden massive confinement. UNESCO estimates that approximately 1 billion students were affected by the closure of schools and universities due to the COVID-19 pandemic (Indra Hidalgo et al., 2021).

There are elements that affect educational quality during Remote Emergency Education, such as the hindering of contact between students and faculty due to the lack of face-to-face interaction, limiting collaboration to social networks or other online tools; the lack of efficient time management when students are at home all day; and possible task overload for faculty who have not been able to prepare sufficient content because of time (Indra Hidalgo et al., 2021). In this sense, the different learning styles should be considered, since there are students who adapt better to unexpected changes than others due to the different digital competencies and the autonomy demanded by this new context (Indra Hidalgo et al., 2021).

This is why it is essential for faculty to know students' Learning Styles in the Distance Education modality. The aim is to adapt teaching methods according to the styles that best represent students and contribute positively to the academic training process, without prejudice to the fact that the autonomy granted to students within this modality eventually allows them to adapt to other Learning Styles different from the one naturally adopted (Chaves, 2017).

Previous studies tend to show that the reflector

learning style prevails among university students in distance education, as in a study conducted in Brazil (Costa et al., 2020a), and also in the face-to-face modality as observed in a study conducted in Nicaragua (Solano et al., 2020). In a study conducted in a Brazilian university, Costa et al. (2020b) document a limited correlation between behavior and learning styles in higher education.

In Peru, during Remote Emergency Education, Contreras and Ramirez (2022) found no significant relationship between learning styles and academic performance; while Parra et al. (2017), Tinitana et al. (2020), and Alonso-Martín et al. (2021) agree that there are no statistically significant relationships between learning styles and academic performance; and Alonso-Martín et al. (2021) agree that there are no statistically significant relationships between study programs and most learning styles.

In a systematic literature review, Du et al. (2013) observed that the knowledge acquisition process in distance learning has not been affected to a great extent, and that equivalent effects or improvements have even been perceived in many cases. In short, the results of this research are of utmost importance to observe students' behavior in the virtual modality and contrast them with the background on learning styles in the face-to-face modality. This way, it will be possible to document differences or similarities in terms of making decisions on the development of new strategies or the emulation of face-to-face strategies in a virtual context.

This study aims to identify the learning styles manifested by Health students of Universidad del Bío-Bío during the virtual modality period (this term is used to avoid the ambiguity between the "Distance Education" and "Emergency Remote Education" concepts) imposed by the COVID-19 pandemic. In addition, the study seeks to explore how these learning styles are related to students' academic performance and sociodemographic factors, such as sex and present year career.

In order to achieve the study objective, the following hypotheses are proposed for testing:

- The Reflector learning style is the most frequent among health students at Universidad del Bío-Bío.

- There are statistically significant differences among learning style scores according to academic performance.
- There are statistically significant differences among learning style scores according to present year career.
- There are statistically significant differences among learning style scores according to sex.

Method

Design

This study follows a quantitative approach with a non-experimental design. It is descriptive and correlational, cross-sectional, and retrospective.

Participants

The unit of analysis was composed of students from three health programs at Universidad del Bío-Bío, taught at the Fernando May campus in the city of Chillán. These programs are Nutrition and Dietetics, Nursing, and Phonoaudiology. From a population of 512 students, according to figures provided by the university's Admissions and Academic Records Department, a total sample of 409 students was evaluated through stratified random sampling (Table 1).

Table 1.
Study Population and Sample

Study Program	Population (N)	Sample (n)
Nursing	195	168
Nutrition and Dietetics	157	109
Phonoaudiology	160	132
Total	512	409

To establish the sample, the following inclusion criteria were used: being current students in the Nutrition and Dietetics, Nursing, and Phonoaudiology programs at Universidad del Bío-Bío during the 2022 academic year; being students in the second, third, and fourth year of their respective programs; and having signed an

informed consent form. In addition, the following exclusion criteria were used: not being a regular student in the 2022 academic year; being a first- or final-year student of the corresponding curriculum; and not having given the consent to participate in the study.

Instruments

A simplified version of the "Honey-Alonso Learning Styles Questionnaire" was used as an instrument.

This version is called CHAEA-32 and was developed by [Vega & Patiño \(2013\)](#). It is an abbreviation of 80-item CHAEA, with an instrument of 32 items organized on a Likert scale (from 0 to 5) that manage to reflect the 4 dimensions to be evaluated (8 Activist, 7 Reflector, 8 Theorist, and 9 Pragmatist style items). The authors reduced the length of the original scale, proposing a simplification of the instrument with high discriminant capacity, high factorial validity, and less time required to collect information ([Costa et al., 2020](#)). In addition, it showed high reliability, with Cronbach's α values $> .70$ for each of the dimensions.

To determine students' academic performance, information was obtained from the students' academic records, and their grades were categorized ordinarily by ranks.

The CHAEA-32 Questionnaire, supplemented with sociodemographic characterization questions and the informed consent form, was administered during face-to-face class sessions, with the prior authorization of the corresponding program directors and with students' voluntary participation, safeguarding participants' confidentiality, and dignity.

Procedure

Result interpretation involved using the scales developed by [Honey & Mumford \(1986\)](#) and later adapted by [Alonso & Gallego \(2000\)](#), in which scores are categorized by ranges according to percentages, classifying the top 10% as "very high" preference; the next 20% as "high"; the next 40% as "moderate"; the next 20% as "low"; and, finally, the last 10% is classified as "very low" preference (see Table 2).

Those cases where the four learning styles registered only low or very low preference were classified as "Undefined" style. Table 3 shows the classification modality according to the students' scores for each of the styles, in which student 5 is considered as "Undefined."

Another relevant aspect was the identification of students who, according to their score, adhere to more than one style, as student 4. In this case, the average of the answers for each scale was used as tiebreaker. The student in question obtained an average of 3.25 in the Activist learning style scale and an average of 4.43 for the Reflector style. Therefore, it is finally determined that the preferred style in this case is Reflector.

To extrapolate the CHAEA-32 scale to the study context, its content validity was evaluated by experts, who are professionals with graduate degrees and work as university faculty. The instrument was sent to 5 experts so that they could evaluate its relevance and clarity. There was a high level of agreement in positive responses for each of the items in both dimensions, as shown in

Table 4. For this validation, relevance is defined as the coherence between the item and the type of respondent.

To measure internal consistency in terms of expert agreement on item clarity, Cronbach's α was applied, resulting in $\alpha = .951$. That is, it is a reliable scale in this aspect. For the reliability evaluation, this statistic could not be applied due to a negative average covariance violating reliability model assumptions. This is explained by a low variability in the items, reflected in the percentages showing almost total expert agreement regarding relevance. In addition, Cronbach's α was applied to the study sample, obtaining a result of $\alpha = .853$, which statistically corroborates scale reliability.

Data Analysis

A descriptive univariate analysis was performed based on the calculation of frequencies and percentages for each preferred learning style, as established in Table 3, to determine the predominant style among health students.

Table 2.

Interpretation Scales for Converting the Score Obtained in Each CHAEA-32 Scale to a Preference Category

	Pragmatist	Activist	Theorist	Reflector
Minimum score	14	6	14	7
Maximum score	43	38	40	35
Very high - 10%	38 - 43	31 - 38	37 - 40	33 - 35
High - 20%	34 - 37	26 - 30	33 - 36	30 - 32
Moderate - 40%	27 - 33	20 - 25	27 - 32	25 - 29
Low - 20%	23 - 26	15 - 19	23 - 26	20 - 24
Very low - 10%	14 - 22	6 - 14	14 - 22	7 - 19

Note. Adapted from Alonso et al. (2012).

Table 3.

Example of Student Classification

Student	Pragmatist Preference	Activist Preference	Theorist Preference	Reflector Preference	Preferred LS
Student 1	Moderate	Low	Low	Very Low	Pragmatist
Student 2	Low	Very Low	Low	High	Reflector
Student 3	Moderate	Very High	High	Moderate	Activist
Student 4	Moderate	High	Moderate	High	Activist-Reflector
Student 5	Very Low	Low	Low	Low	Undefined

Note. Classification criteria adopted by Costa et al. (2020) and Betancourt et al. (2021); LS: Learning style.

Table 4.
Percentage of Expert Agreement on Item Relevance and Clarity

Item no.	Relevance	Clarity	Item no.	Relevance	Clarity
Item 1	100%	60%	Item 17	100%	60%
Item 2	80%	80%	Item 18	100%	80%
Item 3	100%	60%	Item 19	100%	100%
Item 4	100%	100%	Item 20	100%	60%
Item 5	100%	80%	Item 21	100%	100%
Item 6	100%	100%	Item 22	100%	60%
Item 7	80%	60%	Item 23	100%	80%
Item 8	100%	80%	Item 24	100%	80%
Item 9	100%	80%	Item 25	100%	100%
Item 10	100%	80%	Item 26	100%	100%
Item 11	100%	100%	Item 27	100%	80%
Item 12	100%	100%	Item 28	100%	80%
Item 13	100%	80%	Item 29	100%	60%
Item 14	100%	60%	Item 30	80%	100%
Item 15	100%	80%	Item 31	100%	100%
Item 16	100%	60%	Item 32	100%	80%

Note: The values correspond to the percentage of experts who responded positively to item relevance and clarity. Items with a percentage lower than 80% underwent minor modifications as to form based on qualitative observations from the experts.

In addition, the measures of central tendency and variability for each Learning Style are presented. To calculate them, a numerical value is assigned to each category on the scale (0 = Fully disagree; 1 = Slightly agree; 2 = Somewhat agree; 3 = Quite agree; 4 = Strongly agree; 5 = Fully agree). This technique is widely used when the variables are represented on Likert-type scales, since the data, by their ordinal nature, possess a mathematical property that allows them to be treated as approximations to interval data for analytical purposes.

For the bivariate statistical analysis, T-Student and Mann-Whitney U were used to relate learning styles with student sex, in addition to ANOVA and Kruskal-Wallis H to relate learning styles with present year career and academic performance, after testing for variable normality, all with a 95% confidence level ($p < .05$). The analysis software used was the SPSS statistical package version 24.

Results

According to the interpretation scales, the most frequent learning style among Nutrition and Dietetics, Nursing, and Phonoaudiology students was Reflector (38.1%), followed by the Theorist (24.4%), Activist (16.1%), Pragmatist (11.5%), and Undefined (9.8%) styles, with the latter composed of those who cannot be identified with any learning style. Table 5 shows the descriptive statistics for each learning style.

To relate learning styles to the “academic performance,” “present year program,” and “sex” variables, the normality of data distribution was first evaluated by means of the Kolmogorov-Smirnov test. It was determined that the Activist learning style score had a normal distribution and the other three did not have a normal distribution, as shown in Table 6.

As shown in Table 7, based on the non-

parametric Kruskal-Wallis H-test ($p < .05$), no significant differences were found in the Pragmatist, Theorist, and Reflector learning style scores according to academic performance, nor for the Activist style scores by means of the parametric ANOVA test ($p < .05$).

However, if a 90% confidence level ($p < .10$) were considered for the Theorist learning style, there would be a significant difference in their scores according to academic performance as it tends to increase slightly in the highest categories. This is shown in Table 7 and Table 8, which, based on 391 valid cases, shows the frequency of learning styles in the four recoded academic performance categories. Table 8 shows that the Reflector learning style was the most frequent in all performance categories despite the slight increase of the Theorist Style in the highest categories.

Based on the non-parametric Kruskal-Wallis H test ($p < .05$), there are significant differences in the Theorist and Reflector learning style scores according to the study program; however, this

test is not significant for the Pragmatist style. Meanwhile, the parametric ANOVA test ($p < .05$) shows no significant differences in the Activist style scores according to the study program. This information is synthesized in Table 9.

To analyze the differences observed by study program in the Theorist and Reflector learning styles, the Bonferroni Post Hoc test was developed for multiple comparisons ($p < .05$). Table 10 shows that the Theorist learning style scores of the Nutrition and Dietetics program differ significantly from those of the Nursing, and Phonoaudiology programs. Meanwhile, the Reflector style scores show significant differences only between Nutrition and Dietetics and Phonoaudiology, with Nursing being the archetypal program with values similar to the total sample.

However, when measuring the effect size by means of the eta-squared coefficient, it is observed that the established relationships are weak. For the Reflector style score, the eta-squared value related to the Nutrition and

Table 5.
Descriptive Statistics for Learning Style Preference

	Moderate		High		Very High		Total		Mean	SD	Asymmetry
	N	(%)	N	(%)	N	(%)	N	(%)			
Pragmatist	13	3.2%	16	3.9%	18	4.4%	47	11.5%	3.26	0.65	0.13
Activist	20	4.9%	30	7.3%	16	3.9%	66	16.1%	2.74	0.76	0.05
Theorist	52	12.7%	33	8.1%	15	3.7%	100	24.4%	3.60	0.64	-0.13
Reflector	82	20.0%	35	8.6%	39	9.5%	156	38.1%	3.70	0.72	-0.05
Undefined							40	9.8%			

Note. SD: Standard deviation.

Table 6.
Kolmogorov-Smirnov Normality Test for Learning Styles

	Significance
Pragmatist	.000
Activist	.011*
Theorist	.000
Reflector	.000

Note. * $p > .01$

Dietetics and Phonoaudiology programs is 0.04. For the Theorist style score, the eta-squared value related to the Nutrition and Dietetics and Phonoaudiology programs is 0.03, while this value reaches 0.02 in relation to the Nursing and Nutrition and Dietetics programs.

Table 11 shows the frequency of learning styles for the three programs under study, showing that the Reflector learning style is the predominant

one in all of them.

Regarding the distribution by sex of the students who participated in the study, the majority identified themselves as women (83.1%). Table 12 shows the frequency of learning styles by sex, showing that the Reflector style prevails in both categories.

Finally, based on the non-parametric Mann-Whitney U test ($p < .05$), there are no significant

Table 7.
ANOVA and Kruskal-Wallis H Tests for Each Learning Style according to Academic Performance

	Performance	Mean	SD	Asymmetry	ANOVA	Kruskal-Wallis H
Pragmatist	Low	3.22	0.73	0.73		.715
	Medium Low	3.24	0.62	0.20		
	Medium High	3.31	0.66	0.01		
	High	3.27	0.70	0.16		
Activist	Low	2.72	0.85	0.40	.635	
	Medium Low	2.70	0.83	0.01		
	Medium High	2.81	0.76	-0.04		
	High	2.71	0.65	0.16		
Theorist	Low	3.47	0.68	0.70		.056
	Medium Low	3.51	0.67	0.05		
	Medium High	3.62	0.64	-0.21		
	High	3.74	0.61	-0.54		
Reflector	Low	3.87	0.71	0.07		.483
	Medium Low	3.62	0.76	-0.32		
	Medium High	3.72	0.69	-0.58		
	High	3.74	0.72	-0.89		

Note: Low: average 4.0 to 5.0; Medium Low: average 5.1 to 5.5; Medium High: average 5.6 to 6.0; High: (≥ 6.1); SD: Standard deviation.

Table 8.
Learning Style Distribution according to Academic Performance in Second- to Fifth-Year Nutrition and Dietetics, Nursing, and Phonoaudiology Students

	Low	Medium Low	Medium High	High
Pragmatist	2 (10.5%)	14 (11.6%)	23 (13.3%)	7 (9.0%)
Activist	2 (10.5%)	22 (18.2%)	28 (16.2%)	11 (14.1%)
Theorist	2 (10.5%)	26 (21.5%)	43 (24.9%)	24 (30.8%)
Reflector	10 (52.6%)	44 (36.4%)	66 (38.2%)	29 (37.2%)
Undefined	3 (15.8%)	15 (12.4)	13 (7.5%)	7 (9.0%)

Note: Low: average 4.0 to 5.0; Medium Low: average 5.1 to 5.5; Medium High: average 5.6 to 6.0; High: (≥ 6.1)

differences in the Pragmatist, Theorist, and Reflector learning style scores according to sex, as well as in the Activist style scores by means of the parametric T-Student test ($p < .05$). This information is synthesized in Table 13.

Discussion and Conclusions

The most frequent learning style among health students at Universidad del Bío-Bío during the distance education modality period caused by the pandemic (or Emergency Remote Education) was the reflector style, with 38.1% of preference. This result is consistent with what [Costa et al. \(2020\)](#) obtained in Brazil, where the reflector

style is the predominant one among distance education students. In the School of Medical Sciences in Nicaragua, the reflector learning style also prevails although the scope of that research was applied to students who attended face-to-face classes ([Solano et al., 2020](#)).

According to the results, students with a reflector style predominate. They prioritize observation over action and tend to analyze experiences by looking at different aspects, gathering information and analyzing prudently before deciding ([Costa et al., 2020](#)). The second biggest group are students who have a theorist style, with 24.4% of preference. They use complex theories to focus on problems, using logical thinking that allows them to analyze and synthesize information, in search of rationality

Table 9.

ANOVA and Kruskal-Wallis H Tests for Each Learning Style according to Present Year Program

	Program	Mean	SD	Asymmetry	ANOVA	Kruskal-Wallis H
Pragmatist	Nursing	3.29	0.66	0.05		
	Nutrition and Dietetics	3.18	0.64	0.36		.264
	Phonoaudiology	3.30	0.64	0.04		
Activist	Nursing	2.74	0.76	0.12		
	Nutrition and Dietetics	2.66	0.77	0.16	.341	
	Phonoaudiology	2.81	0.75	-0.14		
Theorist	Nursing	3.63	0.65	-0.20		
	Nutrition and Dietetics	3.45	0.63	0.02		.020*
	Phonoaudiology	3.68	0.63	-0.17		
Reflector	Nursing	3.69	0.70	-0.63		
	Nutrition and Dietetics	3.53	0.69	-0.37		.002**
	Phonoaudiology	3.83	0.73	-0.56		

Note. SD: Standard deviation. ** $p < .01$; * $p < .05$

Table 10.

Bonferroni Post Hoc Test for Theorist and Reflector Learning Styles according to Present Year Program

	Theorist (sign.)	Reflector (sign.)
Nutrition and Dietetics		
Nursing	.023*	.175
Nutrition and Dietetics		
Phonoaudiology	.008**	.001**
Nursing		
Phonoaudiology	.581	.165

Note. ** $p < .01$; * $p < .05$

and objectivity (Costa et al., 2020). To a lesser extent, there are students with an activist style (16.1%), who are open to new experiences and enjoy doing activities all the time, thinking spontaneously and in the short term (Costa et al., 2020). Finally, students with a pragmatist style (11.5%) seek to put their ideas into practice, working quickly, directly, and effectively to implement them (Costa et al., 2020).

In line with Costa et al. (2020), this study identified a fifth category to classify students who did not show any predominant learning style, which was called "Undefined." Students with an undefined style (9.8%) presented only "Very low" or "Low" scores for the four learning styles.

It is observed that, in the case of health students from Universidad del Bío-Bío, there is no statistically significant relationship between

Table 11.
Learning Style Distribution according to Present Year Program

	Nursing	Nutrition and Dietetics	Phonoaudiology
Pragmatist	18 (10.7%)	17 (15.6%)	13 (9.8%)
Activist	29 (17.3%)	19 (17.4%)	19 (14.4%)
Theorist	44 (26.2%)	25 (22.9%)	31 (23.5%)
Reflector	64 (38.1%)	31 (28.4%)	59 (44.7%)
Undefined	13 (7.7%)	17 (15.6%)	10 (7.6%)

Table 12.
Learning Style Distribution according to Sex

	Male	Female
Pragmático	8 (11.6%)	40 (11.8%)
Activo	11 (15.9%)	56 (16.5%)
Teórico	12 (17.4%)	88 (25.9%)
Reflexivo	34 (49.3%)	120 (35.3%)
Indefinido	4 (5.8%)	36 (10.6%)

Table 13.
T-Student and Mann-Whitney U Tests for Each Learning Style according to Student Sex

	Sex	Mean	SD	Asymmetry	T-Student (next.)	Mann Whitney U (next)
Pragmatist	Male	3.30	0.57	0.26		.622
	Female	3.26	0.67	0.12		
Activist	Male	2.70	0.71	-0.04	.606	
	Female	2.75	0.77	0.06		
Theorist	Male	3.54	0.62	-0.14		.430
	Female	3.61	0.65	-0.13		
Reflector	Male	3.82	0.67	-0.21		.181
	Female	3.67	0.72	-0.53		

Note. SD: Standard Deviation

their learning style scores and academic performance. This is similar to what has been documented by other authors who have studied learning styles in distance education within different contexts. For example, Costa et al. (2020b) applied the CHAEA-32 questionnaire in a higher education institution in Brazil and found that there is a low linear correlation between behavioral variables and learning styles, whose linear regression model had a very low coefficient of determination ($R^2 = .033$). Despite not directly referring to academic performance, behavior is theoretically associated with student performance since the model includes variables such as the frequency of access to files or platform resources for study.

The results converge with those reported by [Contreras & Ramírez \(2022\)](#), who conducted a study at Universidad de Ciencias y Humanidades in Peru during the Emergency Remote Education period due to the COVID-19 pandemic. They did not find a significant relationship between learning styles and academic performance after obtaining a chi-square of 9.7305 ($p = .365$). It should be noted that they used a different instrument, David Kolb's Learning Styles Questionnaire, which marks the origin of the CHAEA questionnaire and its later simplified version. Honey and Mumford adapted and reformulated this concept to create the Learning Styles Questionnaire (LSQ), which in turn was readapted by Catalina Alonso for the Spanish academic context through the CHAEA instrument.

In sum, the results are consistent with the findings of [Costa et al. \(2020b\)](#) and [Contreras & Ramírez \(2022\)](#). However, they differ from what [Blumen et al. \(2011\)](#) documented in two private universities in Lima, with students attending distance education classes. They observed a statistically significant positive relationship between learning styles and academic performance.

In that study, undergraduate students with a theorist style performed better. Meanwhile, graduate students with reflector and pragmatist learning styles showed better performance.

This lack of relationship is attributable to the transversal predominance of the reflector learning style, since a significant proportion

of students expressed this preference, without discriminating by academic performance. The learning style that gathered more students in all performance categories was the reflector one, without prejudice to a slight upward trend shown by the Theorist style in the highest performance.

The predominance of the reflector learning style is also observed in the segmentation by sex and present year study program. This learning style predominates among male and female students, and no statistically significant relationship is observed in convergence with previous research in face-to-face ([Acevedo & Rocha, 2011](#); [Parra et al., 2017](#); [Alonso-Martin et al., 2021](#)) and virtual ([Gómez et al., 2017](#)) contexts. Furthermore, in the Nutrition and Dietetics, Nursing, and Phonoaudiology programs, the reflector learning style also predominates, with no statistically significant relationship in most of the learning styles, as previous evidence has shown ([Parra et al., 2017](#); [Tinitana et al., 2020](#); [Alonso-Martin et al., 2021](#)). However, this study shows divergent evidence regarding significant differences in Theorist Style scores between Nutrition and Dietetics and the other two programs, as well as significant differences in Reflector Style scores between Nutrition and Dietetics and Phonoaudiology. In this case, Nursing is the archetype program, with an intermediate score that does not differ significantly from the other two programs and assimilates with the scores of the total sample in the Reflector Style.

The differences described in the Theorist and Reflector Style scores, according to study programs, exist from the statistical significance perspective. However, the effect size is very low, and the relationship between the program and the score in these styles is therefore weak. In this sense, previous studies show diverse information that may agree or inconsistent with the results of this research.

In their study conducted in health programs at Universidad de Antofagasta, Chile, [Acuña et al. \(2009\)](#) consistently found that reflector style values are significantly different between programs; however, no significant differences were found in the theorist style. Converging

with this study, [Alonso-Martin et al. \(2021\)](#) found significant differences in the reflector and theorist styles according to study program in Spanish universities, although in disciplines different from this study. On the other hand, [Parra et al. \(2017\)](#) documented that, in health programs at Universidad de la Frontera, Chile, despite the differences in preference degree percentages for learning styles between programs, these are not significant, similar to what was observed in Cartagena, Colombia, with engineering programs ([Yacub et al. 2018](#)).

For future research, it is relevant to delve into the Nutrition and Dietetics program behavior regarding the determinants of students' preferred learning styles, considering that it tends to differ from Nursing and Phonoaudiology, at least in the Theorist and Reflector styles. Likewise, it is interesting to continue exploring the relationship between study programs and learning style scores. This is because research shows dissimilar results, given that learning styles may influence study program choice or, alternatively, that during a study program certain learning styles are developed. Evidently, it is necessary to be aware of results limitations in terms of statistical significance, effect size, and contextual particularities in the discipline in which students develop and geographic and sociodemographic aspects.

The lack of relationship between learning styles and academic performance, as well as the predominance of the reflector learning style, has been reported in several previous studies, either in the distance education modality as in this research, or in the face-to-face one.

This provides favorable arguments for extrapolating the face-to-face teaching logic to the virtual context as long as there are feasibility conditions (good internet connection, efficient virtual resources, and pertinent logistical conditions). In fact, there is evidence that web-based distance learning has produced equivalent or better effects on knowledge acquisition among health students ([Du et al., 2013](#)).

As a limitation of the learning styles theory, it should be pointed out that the associated collection instruments contain questions that

generate a high degree of resistance to being answered negatively ([Du et al., 2013](#)), as is the case of CHAEA-32. However, at the time of applying the instrument, emphasis was placed on the importance of answer sincerity and confidentiality to cushion this possible bias. On the other hand, authors such as [Kirschner \(2017\)](#) and [Knoll et al. \(2017\)](#) are resilient to the learning styles paradigm since the instrument focuses on student preference. The authors argue that there is a big difference between how someone prefers to learn and what leads to effective learning.

Although learning styles give importance to student preference, they are, together with the study of cognitive skills and other behavioral variables associated with physiological, physical, or mental conditions ([Costa et al., 2020](#)), an excellent indicator for the implementation of novel teaching methodologies that adapt to students' needs. This occurs especially in a new educational context in which the e-learning methodology continues to grow, and the emergency remote education applied during the COVID-19 pandemic had a great impact on the curricula of many educational institutions. Consequently, various virtual teaching resources are here to stay, such as virtual classrooms in the event of contingencies, the use of educational blogs, the use of software for virtual clinical simulation, meetings between faculty and students through virtual meeting platforms, among others.

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