

MENDIVE



REVISTA DE EDUCACIÓN

Translated from the original in Spanish

Original article

Learning styles in virtual teaching in university students

Estilos de aprendizaje en la enseñanza virtual en estudiantes universitarios

Estilos de aprendizagem no ensino virtual em estudantes universitários

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Received: June 18th, 2021.

Accepted: January 4th, 2022.

ABSTRACT

The present work has an objective to identify which learning styles predominate in the Statistics course, virtual university modality, third cycle. The study is quantitative and cross-sectional. For this, the CHAEA test was applied to 269 students from the Norbert Wiener University of Lima through the student's virtual platform. A descriptive analysis was carried out with the SPSS 24. The normality test of the scores obtained in each style was also applied and for the inferential analysis the non-parametric tests of Friedman and the Mann Whitney U were used. The highest average score was the Reflective style with 15.8 and the lowest was the Active style with 12.1 ($p < 0.01$). When evaluating the score of each student, the most predominant styles were Reflective (43.5%) and Theoretical (21.9%). Likewise, predominance in pairs of two styles was observed: Reflective-Theoretical (11.5%). A higher percentage of moderate preference was found in the Active, Reflective and Theoretical styles and a High preference in the Pragmatic style. There were no significant differences when comparing the styles by gender, faculty and type of student (validating and regular). In students under 20 years of age, the highest average was the Active style (12.7); while the Reflective style obtained the highest average in each gender, faculty, type of student and age group. The reliability of the CHAEA measured by the Kuder-Richardson coefficient was 0.803 and between the styles, 0.536 to 0.629.

Keywords: CHAEA questionnaire; virtual teaching; learning styles; university students, predominance.

RESUMEN

El presente trabajo tuvo como objetivo identificar qué estilos de aprendizaje predominan en el curso de Estadística, modalidad virtual universitaria, tercer ciclo. El estudio es de tipo cuantitativo y transversal. Para ello se aplicó el test CHAEA

a 269 estudantes de la Universidad "Norbert Wiener" de Lima mediante la plataforma virtual del estudiante. Se realizó un análisis descriptivo con el SPSS 24. También se aplicó la prueba de la normalidad de los puntajes obtenidos en cada estilo y para el análisis inferencial se utilizaron las pruebas no paramétricas de Friedman y la U de Mann Whitney. El puntaje promedio más alto fue el estilo Reflexivo con 15,8 y el menor fue el estilo Activo con 12,1 ($p < 0,01$). Al evaluar el puntaje de cada estudiante, los estilos más predominantes fueron el Reflexivo (43,5 %) y el Teórico (21,9 %). Asimismo, se observó predominancia en parejas de dos estilos: Reflexivo-Teórico (11,5 %). Se encontró un mayor porcentaje de preferencia moderada en los estilos Activo, Reflexivo y Teórico y una preferencia Alta en el estilo Pragmático. No se evidenciaron diferencias significativas al comparar los estilos por género, facultad y tipo de estudiante (convalidante y regular). En los estudiantes menores de 20 años, el mayor promedio fue el estilo Activo (12,7); mientras que el estilo Reflexivo obtuvo el mayor promedio en cada género, facultad, tipo de estudiante y grupo etario. La confiabilidad del CHAEA medido por el coeficiente Kuder-Richardson fue de 0,803 y entre los estilos, 0,536 a 0,629.

Palabras clave: cuestionario CHAEA; enseñanza virtual; estilos de aprendizaje; estudiantes universitarios; predominancia.

RESUMO

O presente trabalho teve como objetivo identificar quais os estilos de aprendizagem predominantes no curso de Estatística, modalidade universidade virtual, terceiro ciclo. O estudo é quantitativo e transversal. Para isso, o teste CHAEA foi aplicado em 269 estudantes da Universidade Norbert Wiener de Lima por meio da plataforma virtual do estudante. Foi realizada análise descritiva com o SPSS 24. O teste de normalidade dos escores obtidos em cada estilo também foi aplicado e os testes não paramétricos Friedman e Mann Whitney U para a análise

inferencial. O maior escore médio foi o estilo Reflexivo com 15,8 e o menor foi o estilo Activo com 12,1 ($p < 0,01$). Na avaliação da nota de cada aluno, os estilos mais predominantes foram Reflexivo (43,5%) e Teórico (21,9%). Da mesma forma, foi observada uma predominância em pares de dois estilos: Reflexivo-Teórico (11,5%). Observou-se maior porcentagem de preferência moderada nos estilos Activo, Reflexivo e Teórico e Alta preferência no estilo Pragmático. Não existe diferenças significativas na comparação dos estilos por gênero, corpo docente e tipo de aluno (validante e regular). Nos estudantes com menos de 20 anos, a maior média foi o estilo Activo (12,7); enquanto o estilo Reflexivo obteve a maior média em cada gênero, corpo docente, tipo de aluno e faixa etária. A confiabilidade do CHAEA medida pelo coeficiente de Kuder-Richardson foi de 0,803 e entre os estilos de 0,536 a 0,629.

Palavras-chave: questionário CHAEA; ensino virtual; estilos de aprendizagem; estudantes universitários; predominância.

INTRODUCTION

COVID-19 is a deadly virus that has spread globally. This situation forced several countries to initiate quarantine processes. For this reason, the Ministry of Education in Peru decided to suspend face-to-face classes in the educational system for the safety of the teacher, the student, and the administrative staff. These changes forced national and private institutions to carry out their academic activities virtually. These institutions were not prepared for this adaptation; however, SUNEDU (National Superintendence of Higher University Education), in this new virtual academic context, regulated changes in synchronous teaching. In other words, this model had repercussions not only in changes

of strategies of the curricular plan of the course and of the teacher; but the university students modified their learning styles in this new context.

The confinement and suspension of face-to-face educational activities due to COVID-19 had an impact on both professional training and changes in teaching strategies attached to the mandatory virtual modality. Consequently, approaches such as the "flipped classroom" have been promoted. These conjectural changes allowed virtual didactic strategies established in the virtual modality to enter this new space with greater emphasis. In addition, the professional labor demand has also impacted on the need for "remote work" or "tele work", since it has used information and communication technologies. This form of work has been imposed as a consequence of this virus in most workplaces. Similarly, this modality imposed by necessity is perceived as potentially efficient in normal post-COVID conditions. How does the new professional adapt to these changing conditions? Does knowing the most persistent learning styles in students help to better plan professional training? Will it have an impact on teaching strategies and the definition of professional competencies in the curricular plan?

The first studies of learning styles come from psychology. There are various approaches and classifications regarding these styles. One of the pioneers in proposing his theory of learning styles, in 1984, was the psychologist David Kolb. This author explains that each person has a particular way of learning. Likewise, it identifies five forms that condition learning styles: psychological type, chosen specialty, professional career, current job and adaptation capacities (Barros *et al.*, 2010). Similarly, Kolb argues that there are four learning styles: divergent (concrete and reflective), assimilative (abstract and reflective), convergent (abstract and active) and accommodating (concrete and active). Finally, Honey and Munford (1986) adapted Kolb's *Learning*

Style Questionnaire (LSQ) to Spanish (cited by Alonso *et al.*, 2012).

Honey and Alonso's model of learning styles (CHAEA) proposes four types of styles: Theoretical, Active, Pragmatic and Reflective. The Theorist adapts the facts to coherent structures in their rationality and objectivity. They are also students who synthesize and organize information. The Active seeks new goals, challenges and is always willing to get involved in his group. The Pragmatist values the positive aspect of new projects because he puts his ideas into practice. The Reflexive enjoys analyzing risk situations; that is, they collect data, analyze it before concluding something (Alonso *et al.*, 2012)

In the last decades, the investigations about what styles of learning predominate in the university students are wide; such is the case of Espinoza and Serrano (2019); Cardozo *et al.* (2018); Escanero-Marcén, Soria, Guerra-Sánchez and Silva (2018) and Cantú-Martínez and Rojas-Márquez (2018). The results of these articles show that the most preferred style is the Reflective style and, in some cases, the questionnaire was applied to both students and teachers, the result being, in the latter, Reflective. Finally, in the research by Espinoza Freire and Serrano Polo (2019), a low average of nine was evidenced in the Reflective style in students of the Technical University of Machala, Ecuador.

In addition, in the article by Cantú-Martínez and Rojas-Marquez (2018) they highlight that students not only prefer the Reflective style, but also the Pragmatic and this is consistent with professional preparation in the health area. Consequently, this research, like the others mentioned, confirms that students learn in different ways. Likewise, in the article by Pavón-Leyva and Leyva-Favier (2018), they showed that the predominant style in students of the Zoo technics specialty is the Reflective style and the least predominant the Active. Therefore, it is important to research their learning

styles. Finally, these investigations allow university teachers to improve their academic quality with pedagogical innovations.

In recent years, we have found research that relates learning styles to academic performance, as stated by Alducin-Ochoa (2017), Altamirano *et al.* (2019), Carrasco and Gonzales (2018), Escanero-Marcén *et al.* (2018) and Quichimbo *et al.* (2018). These works consider that a certain style is related to good academic performance. That is, the teacher, by knowing the learning styles of their students, will be able to design pedagogical tools that improve their academic performance.

On the other hand, studies were carried out to identify learning styles in different careers, such as Correa (2016) in Colombia; Vilorio *et al.* (2019) in India; Alves *et al.* (2018) in Portugal; and Jiménez Álvarez *et al.* (2019) in Ecuador.

The objective of this work is to identify which learning styles predominate in the Statistics course, virtual university modality, third cycle, at the Norbert Wiener University (Lima, Peru). For this, the CHAEA questionnaire was chosen; Lastly, it is important to elucidate certain terms such as predominance and preference for a better understanding of the research. According to the RAE, predominance means condition of what predominates; that is, prevail, preponderate; while preference has two entries: primacy, majority; and choice. Likewise, another word that needs to be specified is a handicap. This term consists of the validation of the studies approved in the institution of origin when a university student transfers from one academic institution to another.

MATERIALS AND METHODS

This study is quantitative, cross-sectional and non-experimental in design. The method used is descriptive. Study population: it was made up of 269 students, with ages ranging between 17 and 25 years; these met the following characteristics: inclusion criteria, university students of the Statistics course belonging to the third cycle of the "Norbert Wiener" University. The students answered the survey voluntarily. Exclusion criteria: university students of the Statistics course who are not part of the third cycle and those who voluntarily decided not to carry out the survey.

Instruments: the CHAEA test was applied to identify the learning styles used by students in the Statistics course. The application was made through the institution's virtual platform, the test was sent through this platform. The teachers explained about the voluntary filling of the test and, once completed, the students returned the instrument in the same way.

The IBM.SPSS 24 software and Excel 2019 were used for the descriptive analysis of the data and to measure the reliability of the instrument, measured by the Kuder-Richardson coefficient. The normality test of the scores obtained in each style was applied and the non-parametric Friedman and Man Whitney U tests were used for the inferential analysis.

RESULTS

Sample Description

The highest percentage of students enrolled in the Statistics course (table 1) belong to the Faculty of Health Sciences (61.0%), followed by Engineering and Business (21.2%), Law and Political Science (10%) and Pharmacy (7.8%). On the other hand, women (72.1%) have a higher percentage than men (27.9%). In this course it is verified that 48.3% are validation students, compared to 51.7% of regular students (non-validation students). Regarding the age group, the category *under 20 years* represents 46.5%.

Table 1- Descriptive variables of students enrolled in the virtual modality of the Statistics course at a private university in Lima

Variable	Category	Frequency	%
Faculty	Health Sciences	164	61.0
	Law and Political Science	27	10.0
	Engineering and Business	57	21.2
	Pharmacy	21	7.8
Sex	Feminine	194	72.1
	Male	75	27.9
Age group	Less than 20 years	125	46.5
	From 20 to 24 years old	63	23.4
	25 to 29 years	38	14.1
	From 30 years to more	43	16.0
Validating	YES	130	48.3
	NO	139	51.7

Learning Styles (GPA)

On the average values of the different learning styles (table 2), the style with the highest average was Reflective (15.8)

followed by Theoretical (15.1) and Pragmatic (13.9); however, the Active style (12.1) had the lowest average.

Table 2- Average values and preference of learning styles

Style	Half	Minimum	Maximum	Standard deviation
Active	12.1	2.0	20.0	3.0
Reflective	15.8	4.0	20.0	2.4
Theoretical	15.1	9.0	20.0	2.5
Pragmatic	13.9	6.0	20.0	2.7

To determine if there are significant differences between the means, the Kolmogorov-Smirnov normality test was first performed. This test showed that the averages in the four styles did not present a normal distribution ($p < 0.01$). Consequently, the Friedman test was applied to compare averages of related samples with respect to learning styles. This test rejects the null hypothesis because $p < 0.01$.

After applying the pair wise comparison test, the null hypothesis was rejected ($p < 0.01$), with the exception of the Theoretical-Reflective style pair ($p < 0.05$). Consequently, it is stated that there are significant differences between the averages regarding the four learning styles (see table 2), the Reflective style being higher and the Active style lower (see table 3).

Table 3- Pair comparison test of the average values of the learning styles

Sample1-Sample2	Contrast statistic	S.I.G	Next Adjust
Active-Pragmatic	-0.699	0.000	0.000
Active-Theoretical	-1,294	0.000	0.000
Active-Reflective	-1.628	0.000	0.000
Pragmatic-Theoretical	0.595	0.000	0.000
Pragmatic-Reflective	0.929	0.000	0.000
Theoretical-Reflective	0.335	0.003	0.016

Each row tests the null hypothesis that the distributions for Sample 1 and Sample 2 are the same. Asymptotic significances are shown (two-tailed tests). The significance level is 0.05 (rejection of the hypothesis). Significance values have been adjusted using the Bonferroni correction for various tests.

Predominance of learning styles

To obtain the predominant style, the scores obtained from the students in each learning style were added (see table 4). The predominant style was the Reflexive style (43%), followed by the Theoretical style (21.9%), then the Pragmatic style (6.7%). Meanwhile, the Active style (4.8%) is the least predominant among the students. On the other hand, a predominance was observed in pairs of two styles: the highest percentage corresponds to the Reflexive-Theoretical (11.5%), then the Pragmatic-Theoretical (5.2%), Reflexive-Pragmatic (4.5%), Active-Theoretical (1.5%) and the one with less predominance, Active-Pragmatic (0.4%).

Table 4- Most predominant styles

Predominant styles	Frequency	%
Reflexive	117	43.5
Theoretical	59	21.9
Theoretical Reflective	31	11.5
Pragmatic	18	6.7
Active	13	4.8
Reflective Pragmatic	12	4.5
Theoretical Pragmatist	14	5.2
Theoretical Asset	4	1.5
Pragmatic Active	one	0.4
Total	270	100

Learning styles according to preferences and sex

According to the preferences in the learning styles, it is evident that the Theoretical style (49.4%) presents the Very high preference; in the High preference, the Pragmatic style stands out (29.7%); in the Moderate, the reflective style (61.0%); in the Low preference, the theoretical style (1.5%) and in the Very Low preference, the theoretical style (0.0%).

As the data did not present a normal distribution, the non-parametric Mann Whitney U test was performed, which shows that the average is higher in men than in women in the Reflective ($p < 0.05$), Theoretical ($p < 0.01$) and Pragmatic ($p < 0.05$). No differences were found in the Active style among both sexes.

Table 5 shows the results of the Friedman test, where the Reflective style had a higher average ($p < 0.01$), both in men (16.2) and in women (15.6).

Table 5- Friedman test of the averages of learning styles in each gender of student

Gender	Active	Reflective	Theoretical	Pragmatic	Contrast statistics	S.I.G
Female	12.0	15.6	14.8	13.6	171,408	0.000
Male	12.3	16.2	15.9	14.4	99,051	0.000

Learning styles by type of student

No significant differences were found in the averages between regular and validating students (who have made an external transfer from another university) in any of the styles (table 6).

Table 6- Mann-Whitney U test of averages of learning styles by type of student

Style	Validating	Regular	Mann-Whitney U	S.I.G.
Active	11.8	12.4	5297.0	0.119
Reflective	15.8	15.8	4804.5	0.771
Theoretical	15.1	15.1	4488.0	0.598
Pragmatic	13.7	14.0	4,988.5	0.445

Learning styles by age group

When applying the Kruskal-Wallis test, no significant differences were found between the reflective, theoretical and pragmatic styles by age group. However, significant differences were obtained in the Active style ($p < 0.05$): under 20 years old (12.7), from 20 to 24 years old (11.7), from 25 to 29 years old (12.2), 30 years and over (11.1).

Likewise, it was found that the Reflective style had the highest average in all age groups, according to the Friedman test ($p < 0.01$) and the lowest in the Active style.

In relation to the reliability of the instrument, the Cronbach's Alpha test was applied in the SPSS and a lower reliability was found in the Reflective style (0.505).

DISCUSSION

Table 2 shows a higher average in the Reflective style (15.8). This result coincides with the research carried out by Cardozo, Molano-Sotelo, Moreno-Jiménez, Vera-Rivera and Peña-Vega (2018). Although the research students at Wiener University are university students with traditional careers, they coincide with the same style in university students of day and night sports training at the CENDA University Corporation. However, in the article by Correa (2016), the results obtained were slightly higher in first-semester students of the Administration program of a public university in the city of Popayán; by Viloría, Gonzalez and Lezama (2019) with students of different careers from the University of Mumbai in India; by Alducin-Ochoa (2017) with students of the first year of Building Engineering (University of Seville) and by Escanero-Marcén, Soria, Guerra-Sánchez, and Silva (2018) with students enrolled in the subject of Physiology III, of the first semester of the University of Zaragoza.

Other works can be found in Alves, Miranda, Morais and Melaré (2018), in two public higher education schools in Portugal; Carrasco-Cifuentes and González-Méndez (2018), with students of Psychology from the Autonomous University of Chile. The high averages, in the reflective style, in the vast majority of universities, reveal that university students have those characteristics of being "thoughtful, conscientious, receptive, analytical and exhaustive" (Alonso *et al.*, 2012) and even more so in a virtual teaching like the one in this research. However, in the research by Espinoza Freire and Serrano Polo (2019), a low average of nine was evidenced in the Reflective style in students of the Technical University of Machala, Ecuador.

According to the percentage, in the scales established by Alonso (2012) a greater moderate preference was found in the Active

style. This result agrees with several investigations in university students in which the Active style had a higher percentage of students in the moderate preference (Alves *et al.*, 2018; Correa Correa, 2016; Jiménez Álvarez *et al.*, 2019). These results differ with the Very high preference in the Active style found by Espinoza Freire and Serrano Polo (2019) and the High preference in the Active style evidenced by Quichimbo *et al.* (2018).

The Moderate preference was detected, in a higher percentage, in the works of several researchers (Alves *et al.*, 2018; Correa Correa, 2016; Jiménez Álvarez *et al.*, 2019; Quichimbo *et al.*, 2018) and they do not agree with the preference Very high in the Reflective style found by Espinoza Freire and Serrano Polo (2019).

In the Theoretical style, the highest percentage of preference was Very High, different from the Moderate preference reported by other researchers (Alves *et al.*, 2018; Jiménez Álvarez *et al.*, 2019; Quichimbo *et al.*, 2018). Likewise, they differ from the High preference by Quichimbo *et al.* (2018).

In the Pragmatic style, a higher Moderate preference was found, coinciding with the results of other research carried out on university students (Correa Correa, 2016; Jiménez Álvarez *et al.*, 2019), and different from the High preference found by Quichimbo *et al.* (2018) and Alves *et al.* (2018).

The results of table 6 show that there were students with similar scores in two styles: Reflexive-Theoretical (higher percentage) and Pragmatic-Theoretical. Additionally, combinations of Active-Pragmatic, Reflexive-Pragmatic and Theoretical-Pragmatic styles were found. These results could be explained, in the case of virtual teaching, in which students orient their preference to two styles: in particular Reflexive and

Theoretical, and not towards Active or Pragmatic. This virtual teaching allows instant interaction between teachers and students; because the network allows constant communication and, above all, that both participants are located in different contexts.

Regarding the gender variable, significant differences were found in the averages of the Reflective, Theoretical and Pragmatic styles, not so in the Active style. In other university students, no significant differences were found between men and women (Alducin-Ochoa, 2017; Cantú-Martínez and Rojas-Márquez, 2018; Jiménez Álvarez *et al.*, 2019). In both feminine and masculine, the Reflective style is the one that obtained the highest average and, in the lowest average, the Active ($p < 0.01$).

In the age groups, significant differences were found in the averages of the styles in students under 20 years of age, with the Active style being lower (12.7) and the Reflective style higher (16.0). These similar results were found in the research by Alducín-Ochoa (2017): Active (11.50) and Reflective (15.81) style. In other age groups there are no significant differences were found. This means that young people accommodate their styles and differentiate one from another according to the context, in this case, virtual. In each age group, the Reflective style had the highest average ($p < 0.01$).

In students enrolled in the Statistics course, no differences were found in styles between students from other universities (validating) and regular university students. The style with the highest average was reflective and the lowest was Active in each type of student.

The analysis of the reliability of the CHAEA instrument was carried out, as well as for each dimension. At a general level, the instrument had a high reliability (0.803), similar to that found by Escanero *et*

al. (Escanero-Marcen *et al.*, 2018), with a reliability of 0.802. These results differ from the 0.725 of Alducin (2017). The reliability of the Active and Pragmatic styles was similar to that reported by Alonso *et al.* (2012).

The results obtained will allow a better definition of the teaching strategies to be applied, in line with the prevailing learning styles, contrast the learning styles in the context of virtual teaching to extrapolate the analysis to the new working conditions in the confinement and post-confinement stages, with which professional skills in the University's curricular design can be updated much better.

In the virtual teaching of the Statistics course, a higher average was found in the general score of the Reflective learning style (15.8) of the students and the lowest average was the Active style. No differences were found between women and men; however, it was found that the highest average was of the Reflective style and the lowest of the Active style, in both sexes. The highest percentage of moderate preference was in the Active, Reflective and Theoretical styles and a High preference in the Pragmatic style.

No significant differences were found between the four faculties, or between validating students and regular students. Only the Active style showed significant differences between age groups, the average being higher in students under 20 years of age.

According to the score achieved by each style in the students, a greater predominance of the Reflective style (43.5%) was found, followed by the Theoretical style (21.9%). Likewise, in 11.5% of the total sample, the Reflexive and Theoretical styles predominated in the same student they represented.

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Conflict of interests:

The authors declare that they have no conflicts of interest.

Authors' contribution:

The authors have participated in the writing of the work and analysis of the documents.



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