

# Fit Indices And Reliability Measures For The Validation Of An Emotional-Psychological Well-Being Scale In Post-COVID-19 Virtual Educational Platforms

Jhimmy Alberth Quisocala Herrera<sup>1</sup>, Yeny Flora Condori Lazarte<sup>2</sup>, Carlos Alberto Ccama Polanco<sup>3</sup>

<sup>1</sup>Universidad Nacional del Altiplano, Perú, [jquisocala@unap.edu.pe](mailto:jquisocala@unap.edu.pe),

<sup>2</sup>Orcid ID: 0000-0001-5992-7204, [ycondori@unap.edu.pe](mailto:ycondori@unap.edu.pe)

<sup>3</sup>Universidad Nacional del Altiplano, Perú, [cccama@unap.edu.pe](mailto:cccama@unap.edu.pe)

---

## Abstract

**Introduction:** In the post-COVID-19 context, where the use of virtual platforms has become permanent, it is essential to implement reliable assessment tools to evaluate their impact on students' well-being. This study aimed to validate the Emotional-Psychological Well-Being Behaviors Scale in engineering students, to facilitate future interventions in this field.

**Methods:** A confirmatory factor analysis was conducted using maximum likelihood estimation with robust standard errors (MLM). Model fit was evaluated with standard indices—including the chi-square ratio, CFI, RMSEA, and SRMR—which confirmed the robustness of the proposed model.

**Results:** Internal consistency, assessed through Cronbach's alpha and McDonald's omega, demonstrated high reliability of the instrument.

**Discussion:** Unlike other studies reporting that 90% of students do not engage with virtual classrooms, our findings highlight the transversal and indispensable role of these platforms. The evaluation of well-being behaviors provides insight into areas for improvement within the system, positioning the instrument as a useful tool for academic management.

**Conclusions:** The scale proved to be a reliable and valid instrument for assessing well-being in virtual contexts, supporting its practical application in educational institutions to design and implement support programs tailored to the emotional and academic needs of university students.

**Keywords:** Emotional-psychological well-being, university students, fit indices, motivation, virtual platforms, post-COVID-19, satisfaction, scale validation.

---

## 1. INTRODUCTION

In the post-COVID-19 period, the emotional and psychological well-being of university students has acquired renewed importance, underscoring the essential role of virtual platforms in their educational processes. Particularly in engineering programs, these platforms have evolved into indispensable tools, generating increasing scholarly interest in validating instruments that accurately assess behaviors related to emotional-psychological well-being in this population. The validation of the Emotional-Psychological Well-Being Behaviors Scale is grounded in well-established theories of emotional health and examines the impact of virtual education on both the academic and personal lives of students. In this context, emotional and psychological well-being has emerged as a growing field of inquiry within psychological research, especially given the mediating influence of technology and shifts in physical activity dynamics within university settings.

According to Valencia and Álvarez (2023), evaluating psychological well-being requires consideration of key dimensions, such as future orientation, a critical aspect for students facing escalating academic and social pressures. Similarly, Ryff's model of psychological well-being emphasizes core components such as self-acceptance and purpose in life—elements central to balanced emotional health in higher education environments (Nogueira et al., 2023). Complementing this, Martínez-Alvarado et al. (2022) suggested that intrinsic motivation toward physical activity is linked to more robust psychological well-being, raising the possibility that physical activity may act as a mediator in the context of virtual platform use. This implies that students' psychological well-being depends not only on technological resources but also on their synergy with habits and motivations that transcend the digital sphere.

Well-being, as a domain of research, has attracted increasing attention, particularly in relation to specific populations such as university students (Valencia & Álvarez, 2023). In recent years, multiple studies have highlighted the relevance of psychological well-being in this group. A notable example is Sánchez-Álvarez et al. (2020), who reported a high prevalence of negative mood states among university students, stressing the urgent need for preventive interventions to enhance their emotional health. In line with this, Nogueira et al. (2023) provided empirical validation of the Psychological Well-Being Scale, reinforcing the need for accurate and context-sensitive measurement tools in university settings. Similarly, Villarrubia (2023) identified a positive correlation between physical activity and psychological well-being, suggesting that exercise not only contributes to overall health but also serves as a key protective factor against emotional health problems in students. On the other hand, the analysis by Tapullima-Mori and García (2022) shed light on the impact of virtual learning modalities on psychological well-being, highlighting the importance of considering how the conditions of virtual education environments emotionally affect university students.

Taken together, this body of research reinforces the importance of psychological well-being in this population while pointing to multiple areas for intervention and contextual factors that warrant deeper exploration. With the fundamental aim of validating the Emotional-Psychological Well-Being Behaviors Scale, the present study focused on the context of virtual platforms used by university students. This objective seeks to address existing gaps in the literature by providing both a theoretical and empirical framework that advances the understanding of psychological well-being dynamics in increasingly digitalized academic environments. By examining these aspects, the study aims not only to shed light on the determinants of students' emotional health but also to promote the development of effective strategies to foster well-being in this group—an endeavor particularly relevant in the post-pandemic era.

### **1.1 Emotional and Academic Well-Being**

The use of virtual platforms exerts a complex and multifaceted impact on students' emotional health and academic productivity, encompassing aspects that range from mood and concentration capacity to self-esteem and socialization. Specifically, this dimension addresses how virtual learning influences both emotional well-being and cognitive abilities, as well as academic performance. Previous research indicates that learning environments, including virtual ones, can significantly shape students' academic emotions, with direct repercussions on performance (Tan et al., 2021). During the COVID-19 pandemic, students reported elevated stress levels and difficulties maintaining concentration, which undermined their self-confidence and emotional well-being (Son et al., 2020). Indeed, the literature suggests that academic emotions—both positive and negative—play a crucial role in the learning process, and that emotional support is a determining factor for academic success (Ge, 2021; Kardambikis & Donne, 2022).

Within this context, virtual learning posed particular challenges, as many students struggled with technical difficulties and diminished emotional motivation, which significantly affected their performance (Ayadat et al., 2021; Babalola et al., 2023). Moreover, the development of emotional intelligence has been shown to correlate directly with improved academic outcomes; students who are able to recognize and regulate their emotions tend to achieve better results (Esquivel et al., 2023; Wang et al., 2023). Socialization and effective communication are also impacted in virtual environments, where the presence—or absence—of social connectedness can affect students' emotional-psychological well-being (Calizaya-López et al., 2023). Collectively, these findings underscore the importance of considering how digital learning environments influence critical dimensions of students' emotional health and academic success.

### **1.2 Satisfaction and Motivation in the Use of Virtual Platforms**

Satisfaction and motivation in the use of virtual platforms are key dimensions for understanding how these tools shape students' educational experiences. Students' satisfaction with the quality of education received and their motivation to engage with these platforms are decisive factors that profoundly influence their commitment and academic performance. Research has shown that the design and structure of learning platforms play a critical role in educational success; a well-structured platform can

optimize learning efficiency, foster collaboration, and facilitate effective feedback (Marques-Firmino et al., 2023).

Moreover, students' intrinsic motivation is a central component of their learning experience. Studies have identified that both the use of educational technologies and the perceived support from instructors are important predictors of student engagement, accounting for a significant portion of their level of involvement (Pazmiño Constante et al., 2024). The perception of a safe and supportive learning environment enhances student satisfaction, translating into higher academic performance (Méndez et al., 2022).

In addition, students' familiarity with technological tools and the ease of use of these platforms significantly influence their overall perception of the quality of the educational experience (Calbacho Contreras et al., 2021; Hinojosa Mamani et al., 2023). Innovative strategies such as gamification and collaborative learning have proven effective in enhancing motivation and satisfaction in virtual environments, as these methodologies encourage active and participatory learning (Calbacho Contreras et al., 2021; Serna Sánchez, 2021).

Taken together, these elements highlight the importance of an integral approach to the design and implementation of virtual learning platforms in order to optimize both student engagement and academic performance.

## 2. METHODOLOGY

This study aimed to validate the Emotional-Psychological Well-Being Behaviors Scale in the context of university students using virtual platforms. To achieve this objective, a methodological design based on confirmatory factor analysis (CFA) was implemented, building upon prior findings from a principal component analysis. This approach allows for the evaluation of the internal structure of the scale and the confirmation of the construct validity of the measure. Model parameters were estimated using maximum likelihood with robust standard errors (MLM), an appropriate method for data that do not follow a normal distribution. The goodness-of-fit indices employed to assess model adequacy included: (a) the chi-square ratio, which evaluates the discrepancy between the theoretical model and observed data; (b) the comparative fit index (CFI), estimated under a distribution-free approach for ordinal variables; (c) the root mean square error of approximation (RMSEA), which measures the closeness of fit relative to model complexity; and (d) the standardized root mean square residual (SRMR), which assesses the fit of residuals. To ensure internal consistency of the scale, Cronbach's alpha ( $\alpha$ ) and McDonald's omega ( $\omega$ ) coefficients were calculated, both of which confirmed that the items demonstrated acceptable levels of reliability. This integrative approach not only provides robust validation of the scale but also ensures that the instrument is reliable and suitable for future research on emotional-psychological well-being in virtual educational settings (Iparraguirre et al., 2022).

The study sample included 223 students enrolled in the Mechanical-Electrical Engineering program at a university in Peru, selected through incidental sampling. This approach implies that participants were chosen based on their availability and willingness to participate rather than through a randomized selection process. The inclusion criteria were: (a) being an actively enrolled university student, and (b) being a user of virtual platforms in the educational context. No specific exclusion criteria were established; however, it was acknowledged that the non-probabilistic nature of the sampling method may limit the representativeness of the general population of university students. This limitation restricts the generalizability of the findings but provides a valuable exploratory basis for future studies on emotional-psychological well-being and the use of virtual platforms in specific contexts (Astudillo et al., 2019).

It is important to recognize potential limitations in online survey research. Participants in online surveys may not accurately represent the general student population, as they often have stable internet access and a possible pre-existing interest in the topic (Vallejo-Sánchez & Pérez-García, 2015). Additionally, some respondents may provide insincere or misleading answers, which could compromise the validity of results. Another limitation is the absence of face-to-face interaction, which may reduce the depth and quality of the information collected, particularly in qualitative-oriented studies. These issues highlight

the challenges inherent in data collection within virtual environments and the need to consider complementary methods to strengthen interpretation (Espinoza et al., 2022).

Several strategies were implemented to mitigate potential biases in data collection. These included the use of control questions designed to detect inconsistent responses, helping to identify and filter out unreliable data. Emphasis was placed on the confidentiality of information provided, thereby encouraging honest participation. Upon completion of data collection, a descriptive analysis was performed on the scores obtained from the subscales of the Emotional-Psychological Well-Being Behaviors Scale. This analysis allowed for a more comprehensive understanding of students' emotional-psychological well-being in the context of virtual platforms.

The methodology thus provides a comprehensive account of the study design, detailing the selection and characteristics of the study population and sample, as well as inclusion and exclusion criteria. It also describes in detail the procedures and materials used for data collection, including the instrument and specific technologies applied, and outlines the statistical analysis methods and software employed. These methodological details ensure that other researchers may replicate the study and critically evaluate its rigor.

### **2.1. Instrument Design**

The development of the questionnaire for data collection was a fundamental process in this study, as it enabled the structured and precise capture of information regarding the variables of interest. To ensure the validity and reliability of the instrument, a series of rigorous steps were followed. First, the research objectives and the variables to be measured were clearly defined, grounded in theoretical constructs relevant to the topic under study, so that these definitions were accurately reflected in the questionnaire items.

Once the key variables had been identified, the questionnaire items were drafted with emphasis on clarity, conciseness, and relevance to the measured construct, avoiding ambiguous terminology or jargon that could confuse participants. Content validity was established through expert review, in line with established methodological practices (Pino, 2022).

Subsequently, a pilot test was conducted with a small group of participants representative of the target population. This phase allowed for the identification of potential comprehension problems in the items, facilitating the necessary adjustments to improve the clarity and precision of the questionnaire. After these revisions, data collection proceeded through online surveys, a practical and accessible method that has proven effective in educational contexts (Vértiz et al., 2015).

Nonetheless, some limitations were acknowledged, such as issues related to sample representativeness and the potential risk of insincere responses. These considerations underscore the importance of a rigorous instrument design and the adoption of additional measures to ensure the quality of the data collected (Jacó-Vilela et al., 2022).

### **2.2. Instrument Design**

The measurement scale used in this study consisted of a total of 16 items distributed across two main dimensions:

- **Emotional and Academic Well-Being:** This dimension included 11 items designed to evaluate aspects related to students' emotional state and academic performance within the context of virtual platform use.
- **Satisfaction and Motivation in the Use of Virtual Platforms:** Comprising 5 items, this dimension focused on measuring students' perceived satisfaction and their level of motivation when using these tools for learning.

This structure enables a comprehensive assessment of students' emotional-psychological well-being, taking into account both their emotional and academic experiences and their attitudes toward virtual platforms.

### 3. RESULTS

#### 3.1. Descriptive Statistics of the Items

According to the descriptive results presented in Table 1, based on responses from 224 participants, a comprehensive overview of students' satisfaction with the 16 questionnaire items was obtained. Item means ranged from 2.08 to 2.94, with medians around 3, suggesting a slight central tendency on the scale, although some items showed lower mean values, indicating potential areas of reduced satisfaction. Standard deviations, ranging from 1.20 to 1.38, reflected moderate variability in the responses, with greater dispersion observed in items V05, V13, and V14. This moderate variability suggests consistency in most responses, with specific items showing broader diversity in participants' perceptions.

Response skewness was predominantly positive, reaching a maximum of 0.96, indicating a mild clustering of responses toward lower values, though not to an extreme degree. Negative kurtosis across items suggested flatter distributions, implying that scores were more dispersed rather than concentrated around the mean. A favorable aspect was the overall homogeneity in data dispersion and the absence of missing values, which strengthens the reliability and robustness of the dataset for subsequent analyses.

This descriptive profile suggests that although participants tended to cluster around mid-range satisfaction values, certain items with higher variability warrant closer attention, as they reflect diverse perceptions among students.

Table 1. Descriptive Statistics of the Items, 2024

	V01	V02-T1	V03	V04-T2	V05	V06-T3	V07	V08	V09	V10-T4	V11	V12-T5	V13	V14	V15	V16
N	224	224	224	224	224	224	224	224	224	224	224	224	224	224	224	224
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean	2.46	2.6	2.62	2.79	2.94	2.76	2.58	2.49	2.08	2.61	2.61	2.9	2.85	2.83	2.58	2.38
Median	2	3	3	3	3	3	3	2	2	3	3	3	3	3	3	2
Standard deviation	1.26	1.2	1.27	1.2	1.38	1.28	1.31	1.25	1.24	1.28	1.26	1.23	1.33	1.31	1.3	1.32
Minimum	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Skewness	0.558	0.354	0.27	0.19	0.051	0.284	0.381	0.508	0.963	0.283	0.347	0.139	0.154	0.144	0.347	0.584
Std. error skewness	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163
Kurtosis	0.56	0.652	1.01	0.79	1.24	-0.98	0.89	0.665	0.082	0.974	0.86	0.821	1.02	1.03	0.95	0.86
Std. error kurtosis	0.324	0.324	0.324	0.324	0.324	0.324	0.324	0.324	0.324	0.324	0.324	0.324	0.324	0.324	0.324	0.324

Source: Own elaboration (2024)

### 3.2. Principal Component Analysis of the Items

The Principal Component Analysis (PCA) applied to the questionnaire data identified two significant components that group the variables according to participants' perceptions: Emotional-Academic Well-Being and Satisfaction-Motivation in the Use of Virtual Platforms. With the application of a Varimax rotation, the PCA revealed two main factors that organized the variables into distinct dimensions.

The first component showed high loadings for items such as V08, V09, V11, and V13, suggesting that these items share a common theme related to students' emotional and academic well-being. This clustering indicates that these items represent a key and cohesive dimension within the dataset. On the other hand, the second component grouped items such as V02, V04, and V12, also with high loadings, which appear to reflect a specific aspect related to satisfaction and motivation in the use of virtual platforms. This independent dimension highlights the relevance of these items in evaluating students' experiences in digital learning environments.

The uniqueness values of most variables were moderate, suggesting that the two-component model adequately captures the main variance in the data, although some items contain unique information that could be further explored. Overall, this two-component structure simplifies the analysis, providing a clear framework for interpreting item relationships and effectively reducing dataset complexity.

**Table 2. Principal Component Analysis of the Items**

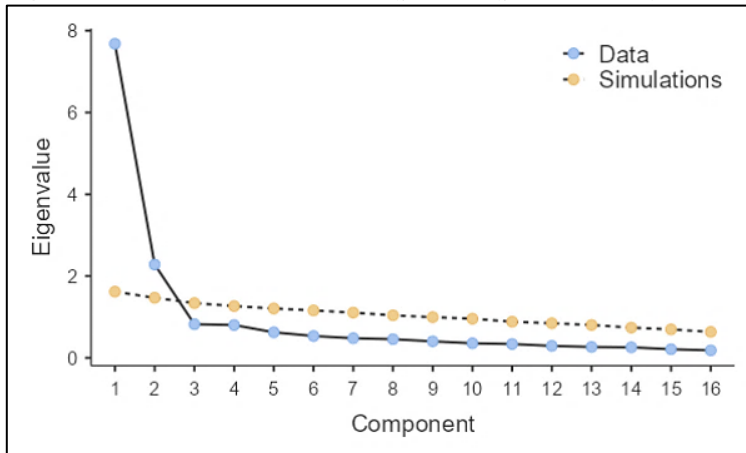
Component Loadings			
	Component		Uniqueness
	1	2	
V01	0.569	0.372	0.537
V02 - Transform 1		0.793	0.334
V03	0.652		0.508
V04 - Transform 2		0.851	0.244
V05	0.689		0.477
V06 - Transform 3		0.737	0.411
V07	0.682		0.509
V08	0.861		0.259
V09	0.798		0.349
V10 - Transform 4		0.786	0.352
V11	0.763		0.402
V12 - Transform 5		0.823	0.278
V13	0.774		0.355
V14	0.762		0.374
V15	0.719	0.423	0.304
V16	0.763		0.344
Note. 'varimax' rotation was used			

Source: Own elaboration (2024)

Figure 1, which presents the Scree Plot of the Principal Component Analysis (PCA), illustrates the proportion of variance explained by each component and facilitates the determination of the optimal number of components to retain. The plot shows a marked decline in explained variance between the first and second components, followed by a progressive stabilization—a typical pattern in this type of analysis. The “elbow” in the curve, where the slope flattens significantly after the second component,

suggests that the first two components capture the majority of the relevant variance in the dataset, whereas additional components contribute only marginally to the overall explanation. Based on this visualization, the retention of the first two components is confirmed as appropriate, allowing the model to be simplified without significant loss of information and enabling a more focused analysis of the main dimensions: emotional-academic well-being and satisfaction-motivation in the use of virtual platforms.

**Figure 1. Scree Plot of the Principal Component Analysis (PCA)**



Source: Own elaboration (2024)

### 3.3. Evaluation Indices and Confirmatory Factor Analysis of the Items

The Kaiser-Meyer-Olkin (KMO) index in this study, with an overall value of 0.924, indicated excellent sampling adequacy, suggesting that the dataset was highly suitable for factorial analysis. Values above 0.90 are considered excellent, further reinforcing the reliability of the data for this type of analysis. Examination of the individual measures of sampling adequacy (MSA) revealed that most variables presented values higher than 0.90. Notably, items V11 (0.956) and V09 (0.937) showed the highest scores, suggesting that they are particularly well-suited for analysis and contribute valuable information to the construct under evaluation.

In contrast, item V04, with a score of 0.878, exhibited the lowest adequacy value among the variables, although it still remained within the acceptable range. This finding indicates a slight difference in its adequacy compared with the other items, but not to a degree that would negatively affect the analysis. Overall, the high global KMO value and consistently elevated individual scores confirm that the data are robust and that the Principal Component Analysis (PCA) is likely to identify meaningful relationships among the variables, supporting the validity of the proposed model.

This level of sampling adequacy is essential to ensure that the factorial analysis is effective and that the conclusions drawn are both interpretable and applicable in practical contexts. Collectively, these results reinforce the strength of the dataset and suggest that the variables are significantly interrelated, thus providing a reliable foundation for subsequent analyses.

Table 3. Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy for the Items

KMO Measure of Sampling Adequacy	
	MSA
Overall	0.924
V01	0.937
V02 - Transform 1	0.915
V03	0.918

V04 - Transform 2	0.878
V05	0.918
V06 - Transform 3	0.922
V07	0.918
V08	0.921
V09	0.937
V10 - Transform 4	0.936
V11	0.956
V12 - Transform 5	0.895
V13	0.939
V14	0.945
V15	0.931
V16	0.912

Source: Own elaboration (2024)

The Bartlett's Test of Sphericity was applied to evaluate whether the correlations among the items were sufficiently high to justify a factorial analysis. In this study, a  $\chi^2$  value of 2239 with 120 degrees of freedom and a p-value less than .001 was obtained. These results indicate that the correlation matrix is not an identity matrix, given the highly significant p-value. This finding suggests the presence of significant correlations among the items, thereby confirming that the data are suitable for factor analysis.

In other words, Bartlett's Test supports the feasibility of conducting factorial analysis, as the correlations among variables are not null, thus allowing and justifying dimensionality reduction. Taken together with the high KMO index, this result reinforces the appropriateness of the data for analysis, ensuring that the relationships among variables can be meaningfully and systematically explored.

Table 4. Bartlett's Test of Sphericity

Bartlett's Test of Sphericity		
$\chi^2$	df	p
2239	120	<.001

Source: Own elaboration (2024)

Bartlett's Test of Sphericity was significant ( $\chi^2 = 2239$ ,  $df = 120$ ,  $p < .001$ ), confirming that significant correlations exist among the variables and that the data are suitable for factor analysis, thus justifying dimensionality reduction. This result, together with the high and consistent factor loadings observed in the Confirmatory Factor Analysis (CFA), supports the two-factor model as an accurate representation of the underlying dimensions in the dataset.

Although the exact fit ( $\chi^2 = 316$ ,  $df = 103$ ,  $p < .001$ ) indicates some discrepancy between the model and the observed correlation matrix, such results are common in large samples and do not compromise the validity of the model. Rather, they suggest a reasonable fit that captures the most relevant relationships among the items, ensuring that the model effectively reflects the core dimensions of emotional-academic well-being and satisfaction-motivation in the use of virtual platforms.

These findings provide confidence in the interpretation of results, as the model adequately fits the data and offers a solid foundation for subsequent analyses.

Table 5. Test for Exact Fit

Test for Exact Fit		
$\chi^2$	df	p

316	103	<.001
-----	-----	-------

Source: Own elaboration (2024)

The Confirmatory Factor Analysis (CFA) revealed a two-factor structure with high and consistent factor loadings across all items, indicating a strong association between each item and its corresponding factor. In Factor 1, which included items such as V01, V03, V05, and V16, factor loadings ranged from 0.784 to 1.065. In Factor 2, composed of items such as V02 – Transform 1 and V04 – Transform 2, loadings varied between 0.915 and 1.008. These elevated loadings, together with low standard errors, suggest that both factors are well defined and effectively represent the construct under study.

The consistency of the factor loadings strengthens the validity of the model, confirming that the two-factor structure is stable and appropriate for capturing the underlying dimensions of emotional-academic well-being and satisfaction-motivation in the use of virtual platforms. Taken together, these results indicate that the model is robust and reliable, providing a solid foundation for interpretation and practical application in academic and emotional health contexts.

Table 6. Confirmatory Factor Analysis (CFA) of the Items

Factor Loadings			
Factor	Indicator	Estimate	SE
Factor 1	V01	0.784	0.0773
	V03	0.829	0.0774
	V05	0.934	0.0834
	V07	0.856	0.0799
	V08	0.981	0.0709
	V09	0.955	0.0713
	V11	0.925	0.0737
	V13	1.033	0.0756
	V14	1.008	0.0746
	V15	1.056	0.0729
	V16	1.065	0.0743
Factor 2	V02	- 0.915	0.0709
	Transform 1		
	V04	- 1.008	0.0670
	Transform 2		
	V06	- 0.916	0.0773
	Transform 3		
	V10	- 0.956	0.0760
	Transform 4		
	V12	- 0.998	0.0705
	Transform 5		

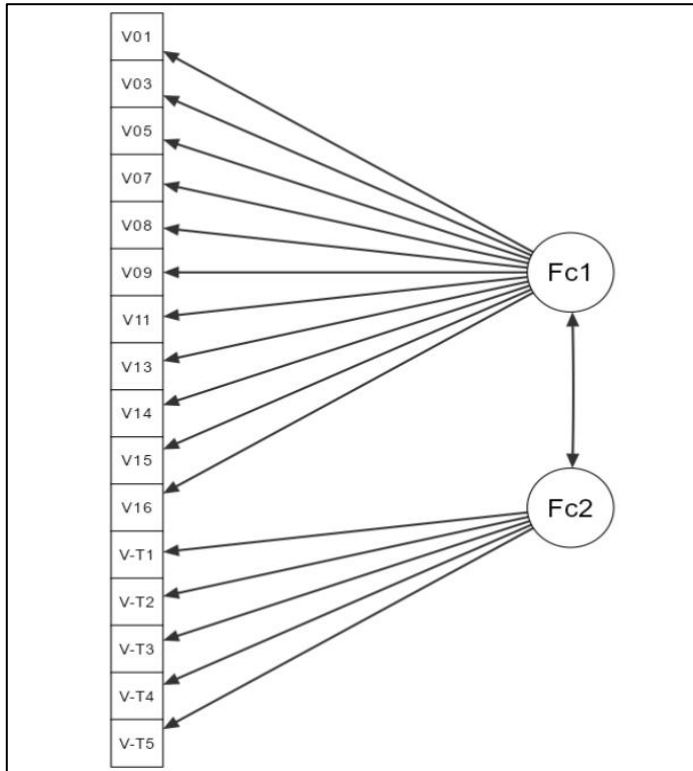
Source: Own elaboration (2024)

The Confirmatory Factor Analysis (CFA) diagram illustrates a well-defined two-factor model, in which **Factor 1 (Fc1)** groups variables V01, V03, V05, V07, V08, V09, V11, V13, V14, V15, and V16, while **Factor 2 (Fc2)** includes the transformed variables V-T1 through V-T5. The unidirectional arrows connecting each variable to its respective factor indicate the factor loading, that is, the degree of association of each variable with the factor it represents. The bidirectional arrow connecting Fc1 and Fc2 denotes a significant covariance between the two factors, suggesting that although they represent distinct dimensions (emotional-academic well-being and satisfaction-motivation in the use of virtual platforms), they maintain a moderate relationship.

This relationship indicates that both dimensions may form part of a broader construct encompassing well-being in the digital academic context. The model provides a clear organization of the variables into

two dimensions, which facilitates the interpretation of their relationships and supports the overall structure of the analysis. By presenting the variables in this way, the diagram offers a strong visual foundation for understanding how key aspects of emotional-academic well-being and satisfaction with the use of virtual platforms interrelate in students' academic lives.

**Figure 2.** Confirmatory Factor Analysis (CFA) Two-Factor Model



Source: Own elaboration (2024)

The covariance results between factors in the model confirm a significant relationship between Factor 1 and Factor 2, with a covariance value of 0.534 and a standard error of 0.0548. This yielded a Z statistic of 9.75 and a p-value less than .001, indicating a positive and statistically significant correlation between the two factors. This moderate relationship suggests that, although they represent distinct dimensions—emotional-academic well-being and satisfaction-motivation in the use of virtual platforms—both factors are interconnected.

The fixed covariance values of 1.000 for each factor with itself are imposed to standardize the model and therefore do not provide additional information about factor interactions. Nevertheless, the significant covariance between factors supports the notion that they may be grouped within a broader, overarching construct. This interrelationship is particularly relevant for interpreting the results, as it suggests that the factors capture specific dimensions of well-being in the academic context, while still maintaining a degree of global cohesion within the overall structure.

**Table 7.** Factor Covariances

Factor Covariances		Estimate	SE	Z	p
Factor 1	Factor 1	1.000 <sup>a</sup>			
	Factor 2	0.534	0.0548	9.75	<.001
Factor 2	Factor 2	1.000 <sup>a</sup>			

<sup>a</sup> fixed parameter

Source: Own elaboration (2024)

The fit indices of the Confirmatory Factor Analysis (CFA) indicate a reasonable fit of the two-factor model to the data. The CFI of 0.903 and the TLI of 0.887 are close to the acceptable threshold of 0.90, suggesting a fairly adequate, though not optimal, fit. The SRMR of 0.0588 indicates good fit, as values below 0.08 are generally considered reflective of a model that adequately represents the observed data. However, the RMSEA of 0.0962, with a 90% confidence interval ranging from 0.0842 to 0.108, points to a moderate fit, suggesting that while the model is acceptable, it is not ideal. This RMSEA value indicates that further refinements to the model may improve its alignment with the data.

The AIC (10006) and BIC (10173) values provide useful benchmarks for future comparisons with alternative models, helping to identify potential improvements in fit. Overall, these indicators suggest that the two-factor model is adequate for representing the underlying dimensions of emotional-academic well-being and satisfaction-motivation in the use of virtual platforms, though it may benefit from additional adjustments. This reinforces the utility of the current model, while also highlighting areas where it could be refined to achieve a more precise and reliable representation of the data.

Table 8. Model Fit Indices

Fit Measures							
CFI	TLI	SRMR	RMSEA	RMSEA 90% CI		AIC	BIC
				Lower	Upper		
0.903	0.887	0.0588	0.0962	0.0842	0.108	10006	10173

Source: Own elaboration (2024)

### 3.4. Reliability Analysis

The reliability of the scale was evaluated using Cronbach's alpha and McDonald's omega, two measures that estimate the internal consistency of items. An alpha greater than 0.70 is generally considered indicative of good internal consistency, while omega provides a complementary estimation that may be more accurate in certain contexts, particularly when items display heterogeneous factor loadings (Viladrich et al., 2017).

Table 9 shows the results for Factor 1, which demonstrated excellent internal consistency, with a Cronbach's alpha of 0.918 and a McDonald's omega of 0.919. These values indicate that the items are highly consistent with one another, ensuring that they reliably measure the same underlying construct. The high reliability indices for both alpha and omega confirm that the scale is adequate for capturing the studied phenomenon within Factor 1, providing robustness and stability to the measurement instrument in this dimension.

Table 9. Scale Reliability Statistics - Factor 1

Scale Reliability Statistics		
	Cronbach's $\alpha$	McDonald's $\omega$
scale	0.918	0.919

Source: Own elaboration (2024)

Table 10 shows that each item in Factor 1 contributed substantially to the scale, with item-total correlations ranging from 0.598 to 0.770. These values demonstrate that each item maintains a strong relationship with the overall construct, reinforcing its relevance for measurement. Furthermore, Cronbach's alpha and McDonald's omega values remained high (between 0.906 and 0.916) even if any single item were removed, suggesting that the scale preserves its reliability without requiring modifications. Collectively, these statistics confirm that all items are consistent and adequate for accurately and coherently capturing the construct represented by Factor 1, ensuring reliable measurement of this key dimension.

**Table 10.** Item Reliability Statistics – Factor 1

Item Reliability Statistics				
			If item dropped	
	SD	Item-rest correlation	Cronbach's $\alpha$	McDonald's $\omega$
V01	1.26	0.598	0.915	0.916
V03	1.27	0.653	0.912	0.914
V05	1.38	0.660	0.912	0.913
V07	1.31	0.624	0.914	0.915
V09	1.24	0.719	0.909	0.91
V11	1.26	0.700	0.910	0.911
V13	1.33	0.741	0.907	0.908
V14	1.31	0.728	0.908	0.909
V15	1.3	0.770	0.906	0.906
V16	1.32	0.754	0.907	0.907

Source: Own elaboration (2024)

Table 11 shows that the scale corresponding to Factor 2 demonstrated high internal consistency, with a Cronbach's alpha of 0.882 and a McDonald's omega of **0.883**. These values indicate that the items in the scale are coherent with one another, providing a reliable measurement of the construct associated with Factor 2.

The high reliability reflected in both indices confirms that the scale is appropriate for accurately and consistently assessing the phenomenon under study, ensuring that item responses reliably represent the underlying construct. These results reinforce the adequacy of the scale for capturing the dimension measured by Factor 2, adding precision and robustness to the analysis.

**Table 12.** Item Reliability Statistics – Factor 2

Scale Reliability Statistics		
	Cronbach's $\alpha$	McDonald's $\omega$
Scale	0.882	0.883

Source: Own elaboration (2024)

The study successfully validated the scale of emotional and academic well-being in university students using virtual platforms, identifying two key dimensions: Emotional-Academic Well-Being and Satisfaction-Motivation in the Use of Virtual Platforms. With a sample of 223 engineering students in Peru, a Confirmatory Factor Analysis (CFA) was conducted, yielding an overall KMO index of 0.924, which indicates excellent sampling adequacy, and a highly significant Bartlett's test of sphericity ( $\chi^2 = 2239$ ,  $df = 120$ ,  $p < .001$ ).

The factorial analysis revealed two well-defined factors: Factor 1 with loadings ranging from 0.784 to 1.065, and Factor 2 with loadings between 0.915 and 1.008. In addition, a significant covariance was found between the two factors (0.534,  $p < .001$ ), suggesting a moderate relationship between the dimensions. Fit indices such as the CFI = 0.903 and SRMR = 0.0588 indicated a reasonable model fit, confirming that the factorial structure was appropriate for the data.

The scale also demonstrated high reliability, with Cronbach's alpha coefficients of 0.918 for Factor 1 and 0.882 for Factor 2. These findings show that the scale is a reliable and robust tool for measuring emotional and academic well-being constructs in virtual environments. Its application can facilitate the implementation of support strategies in educational contexts, tailored to the emotional and motivational needs of students in digital learning settings.

#### 4. DISCUSSION

The scale developed to assess psychological well-being in engineering students who use virtual platforms for learning highlighted two key dimensions: Emotional-Academic Well-Being and Satisfaction-Motivation in the Use of Virtual Platforms. The confirmatory factor analysis (CFA) with a sample of 223 engineering students in Peru, applying maximum likelihood estimation and fit indices such as CFI and RMSEA, demonstrated strong internal consistency and confirmed the relevance of the scale for measuring well-being constructs in virtual learning contexts. These findings suggest that the instrument can serve as a useful tool for future interventions in the management of virtual learning systems for university students. The implications extend to broader educational practices, highlighting how institutions of higher education may adopt the scale to improve both the emotional and academic well-being of their students.

Monroy et al. (2018) conducted a study in Mexico with the purpose of evaluating the use of virtual classrooms in higher education through descriptive surveys. The main conclusion was that more than 90% of students did not use virtual classrooms, contrasting with UNESCO's recommendations on their effectiveness. Unlike the present study, Monroy et al. did not address the emotional impact of this lack of use. Their divergent results suggest a resistance to adopting virtual platforms that could negatively affect students' emotional-psychological well-being, emphasizing the need for further research on the reasons behind low adoption and its consequences for student well-being.

Similarly, Sharrab et al. (2023) proposed the use of advanced technologies such as AI-based immersive classrooms and virtual reality (VR). Their methodological design involved a literature review and the development of a conceptual model. The study concluded that emerging technologies, particularly artificial intelligence, VR, and high-speed 6G Internet, have the potential to transform classroom interaction. However, the study did not evaluate the implications of such technologies on well-being, which only partially aligns with the present research, as both focus on the use of technological innovations in educational contexts.

In another study, Al-Qahtani (2019) explored the role of computer-mediated systems such as virtual classes, investigating the perceptions of both teachers and students. Using questionnaires, the findings revealed generally positive attitudes toward teaching and learning through virtual EFL classes, underscoring the role of technology in fostering supportive learning environments.

Campillo-Ferrer & Martínez-Miralles (2021) investigated the effects of a flipped classroom system on higher education students at the University of Murcia during the 2020–2021 academic year. Surveys were administered, and the results were analyzed with descriptive statistics and non-parametric tests, showing statistically significant differences between pre- and post-tests in students' perceptions of learning and motivation during the pandemic.

Likewise, Laoha & Piriyaawong (2018) developed a flipped classroom model using a virtual classroom system. Their research consisted of four stages: literature review, front-end analysis, instructional design, and creation of an evaluation tool. The results indicated that the proposed model improved students' problem-solving skills, as evaluated by five experts, who identified the instructional design as particularly suitable. This finding is convergent with the present study, as both emphasize the utility of virtual classroom systems in enhancing learning outcomes.

Overall, the results of this study converge with prior research that underscores the potential of virtual learning systems to foster both academic performance and emotional well-being. However, the divergences observed—particularly regarding adoption rates and the emotional implications of virtual platforms—highlight the need for further investigations to contextualize how such systems influence students' academic lives and psychological health in different educational environments.

#### 5. CONCLUSIONS

In response to the research objective of validating the Emotional-Psychological Well-Being Behaviors Scale, this study successfully established the validity and reliability of the instrument in the context of university students who use virtual platforms. This original research applied a confirmatory factor analysis (CFA), grounded in a prior exploratory analysis, to verify the structure and consistency of the

instrument. Maximum likelihood estimation with robust standard errors (MLM) was employed, a method appropriate even under non-strict normality conditions. The fit indices applied—including the chi-square ratio, comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR)—confirmed the robustness of the proposed model. Reliability was assessed using Cronbach's alpha ( $\alpha$ ) and McDonald's omega ( $\omega$ ), both indicating high internal consistency across the dimensions of the scale.

The Principal Component Analysis (PCA) was fundamental in identifying two principal components that explained the interrelationships among the questionnaire variables. This structure not only enabled a deeper understanding of participants' perceptions but also provided a solid foundation for future research. The highlighted components allowed for the identification of key areas of emotional well-being and satisfaction in the use of virtual platforms, offering guidance for developing and implementing intervention strategies in the most relevant dimensions. These results emphasize the importance of a structured approach to evaluating well-being in digital educational contexts, promoting the practical application of findings within academic and student support settings.

The implications of this work are significant, as it provides a validated tool that can be used in future studies to evaluate students' emotional-psychological well-being in virtual environments. The scale is not only a useful resource for academics and researchers but may also guide educational institutions in designing support programs tailored to students' emotional needs. However, future research should address the limitations identified, including the representativeness of the sample and the possibility of insincere responses. To improve external validity, it would be beneficial to test the scale in different educational contexts and more diverse populations. Furthermore, investigating the relationship between emotional well-being and other factors, such as academic performance and social interaction in virtual platforms, would provide a more holistic understanding of how these environments influence students' psychological well-being.

By addressing these areas, future research can contribute to a deeper understanding of the dynamics between virtual platform use and emotional well-being, facilitating the development of strategies that foster healthier and more effective learning environments. This may include the implementation of additional resources, training for instructors in emotional-psychological well-being, and the design of interventions that promote a more integrative and sustainable educational experience.

The findings of this study provide significant evidence for the validation of the Emotional-Psychological Well-Being Behaviors Scale in the context of virtual platforms among university students. Nonetheless, it is important to acknowledge certain limitations that affect the generalizability of the results. First, the sample consisted of participants who voluntarily chose to respond to the online survey, limiting the representativeness of the overall student population. It is likely that respondents had regular internet access and a particular interest in the topic, introducing potential self-selection bias. This may hinder extrapolation to students with limited technology access or lower motivation to participate in such studies. Future research would benefit from including more diverse samples in terms of academic disciplines and socioeconomic backgrounds, which would allow exploration of whether the observed relationships hold in other groups and educational settings.

Considering these limitations, the findings nevertheless provide a solid foundation for understanding emotional-psychological well-being in virtual learning environments, although they should be interpreted with caution regarding their applicability to the general student population.

## 6. REFERENCES

- Al-Qahtani, M. H. (2019). Teachers' and Students' Perceptions of Virtual Classes and the Effectiveness of Virtual Classes in Enhancing Communication Skills. *Arab World English Journal*, 1, 223–240. <https://doi.org/10.24093/awej/efl1.16>
- Astudillo, T. M. P., Chévez, P. F., & Oviedo, V. Y. (2019). La Exclusión Social y las Tecnologías de la Información y la Comunicación: Una Visión Estadística de su Relación en la Educación Superior. *Liminar Estudios Sociales Y Humanísticos*, XVIII(1), 177–193. <https://doi.org/10.29043/liminar.v18i1.721>
- Ayadat, T., Khasawneh, M. A., Chowdhury, S. R., Nayeemuddin, M., Ahmed, D., & Asiz, A. (2021). Effects of students' home environment, tools, and technology used on online learning experience in a civil engineering program. *International Journal of Information and Education Technology*, 11(8), 356–367. <https://doi.org/10.18178/ijiet.2021.11.8.1535>

- Babalola, E. O., Adeyoola, I. A., & Omolafe, E. V. (2023). Virtual Learning as A Determinant of Students Academic Performance in University of Ilorin During COVID-19 Pandemic. *Journal of Digital Learning and Education*, 3(3), 243–253. <https://doi.org/10.52562/jdle.v3i3.593>
- Calbacho Contreras, V., Díaz Larenas, C., Orsini Sánchez, C., Torres Martínez, P., & Díaz Narváez, V. (2021). Gamification: innovation in the classroom to encourage motivation. 10, 55–64. <https://doi.org/doi.org/10.29035/rce.10.55>
- Calizaya-López, J., De la Vega-Calizaya, J., Zapata-Delgado, F. M., Cervantes-Rivera, R., Alvarez-Salinas, L., Aleman-Vilca, Y., Miaury-Vilca, A. R., & Carita-Choquecahua, A. (2023). Social presence of university students in virtual teaching-learning environments in times of Covid-19. *Innovation Experiences in Tertiary Education in Latin America*, 23(12), 32–42. <https://doi.org/doi.org/10.33423/jhetp.v23i12.6235>
- Campillo-Ferrer, J. M., & Martínez-Miralles, P. (2021). Effectiveness of the Flipped Classroom Model on Students' Self-Reported Motivation and Learning During the COVID-19 Pandemic. *Humanities and Social Sciences Communications*, 8(1), 1–9. <https://doi.org/10.1057/s41599-021-00860-4>
- Espinoza, A. R., Saavedra, D. M., & Vilchez, J. S. (2022). Construcción y Validación de una Escala de Tolerancia a la Frustración para Estudiantes Universitarios. *Apuntes Universitarios*, 12(2), 17–35. <https://doi.org/10.17162/au.v12i2.1031>
- Esquivel, F. A., Aranda, C. B. C., López, I. L. de la G., Castillo, O. R., Moreno, S. E. R., Claudio, J. L. N., Orozco, R. M., & Flores, V. A. S. (2023). Socioemotional aspects in the school trajectory and effects on academic performance. *Revista Caribeña de Ciencias Sociales*, 12(5), 2007–2020. <https://doi.org/10.55905/rcssv12n5-001>
- Ge, X. (2021). Emotion matters for academic success: Implications of the Article by Jarrell, Harley, Lajoie, and Naismith (2017) for creating nurturing and supportive learning environments to help students manage their emotions. *Educational Technology Research and Development*, 69(1), 67–70. <https://doi.org/10.1007/s11423-020-09925-8>
- Hinojosa Mamani, J., Mamani Gamarra, J. E., Machaca Avilés, M. T., Zela Paricahua, M., & Neira Cutipa, O. L. (2023). Plataformas virtuales y aprendizaje basado en competencias en la educación superior universitaria, Puno - Perú. *LATAM Revista Latinoamericana de Ciencias Sociales y Humanidades*, 4(2), 5338–5353. <https://doi.org/10.56712/latam.v4i2.985>
- Iparraguirre, Y. N. E., Rosario, Q. F. J., & Oblea, D. M. O. (2022). Análisis Factorial Confirmatorio E Invarianza Factorial De La Escala APGAR - Familiar en Adultos Mayores Limeños. *Revista De Investigación En Psicología*, 25(2), 73–87. <https://doi.org/10.15381/rinvp.v25i2.22864>
- Jacó-Vilela, A. M., Vasconcellos, G. N. T. M. A., & Degani-Carneiro, F. (2022). La Revista Puertorriqueña De Psicología Y La Historia De La Psicología en Puerto Rico. *Revista Puertorriqueña De Psicología*, 33(1), 44–59. <https://doi.org/10.55611/reprs.3301.04>
- Kardambikis, P., & Donne, V. (2022). Impact of COVID and the Emergence of Social Emotional Learning on Education Majors. *Social Sciences*, 11(12:584). <https://doi.org/10.3390/socsci11120584>
- Laoha, R., & Piriyasurawong, P. (2018). The Instructional Design Flipped Mastery Classroom Model Using Virtual Classroom System With Problem-Based Toward Problem Solving Ability. *International Journal of E-Education E-Business E-Management and E-Learning*, 8(1), 18–25. <https://doi.org/10.17706/ijeeee.2018.8.1.18-25>
- Marques-Firmino, A., Tafur-Méndez, F. J., & Almao-Malvacias, V. A. (2023). Rediseño de MODVS para Mejorar Los Procesos de Enseñanza- Aprendizaje en el Tecnológico Universitario EuroAmericano. 8(5), 70–87. <https://doi.org/doi.org/10.33386/593dp.2023.5.1933>
- Martínez-Alvarado, J. R., Guillén, F., Aguiar Palacios, L. H., Magallanes Rodríguez, A. G., & Campuzano, A. (2022). Predictores del Bienestar Psicológico en Estudiantes Universitarios Mexicanos Físicamente Activos. *Cuadernos De Psicología Del Deporte*, 22(3), 227–237. <https://doi.org/10.6018/cpd.355641>
- Méndez, C. C. R., Almache, C. W. R., & Gallegos, B. M. F. (2022). Motivación y satisfacción: variables psicológicas influyentes en el rendimiento académico virtual. *Revista Scientific*, 7(24), 37–55. <https://doi.org/10.29394/scientific.issn.2542-2987.2022.7.24.2.37-55>
- Monroy, A., Hernández, I. A., & Jiménez, M. (2018). Digital classrooms in higher education: The case of Mexico. *Formación Universitaria*, 11(5), 93–104. <https://doi.org/10.4067/S0718-50062018000500093>
- Nogueira, C., Alcaide, R. M., & Meier, L. K. (2023). Evaluación de la Escala de Bienestar Psicológico de Ryff para Estudiantes Universitarios. *Revista Iberoamericana De Diagnóstico Y Evaluación - E Avaliação Psicológica*, 4(70), 161–173. <https://doi.org/10.21865/ridep70.4.12>
- Pazmiño Constante, P. G., Romero Pacheco, D. E., Roldán Saltos, Y. del R., Ceballos Torres, C. C., & Alcívar Cedeño, R. A. (2024). Impacto del uso de tecnologías educativas en la motivación y el compromiso estudiantil durante el proceso de aprendizaje. *LATAM Revista Latinoamericana de Ciencias Sociales y Humanidades*, 5(4), 199–211. <https://doi.org/10.56712/latam.v5i4.2240>
- Pino, B. P. (2022). Psicología Positiva Organizacional en Los Docentes De Innova Schools - Región 5. *Horizontes Revista de Investigación En Ciencias de La Educación*, 6(22), 297–310. <https://doi.org/10.33996/revistahorizontes.v6i22.337>
- Sánchez-Álvarez, N., Rey, L., & Extremera, N. (2020). Más Allá Del Papel De Los Recursos Personales Positivos en El Bienestar De Estudiantes Universitarios Españoles: ¿importa La Inteligencia Emocional? Know and Share Psychology, 1(4), 91–101. <https://doi.org/10.25115/kasp.v1i4.4336>
- Serna Sánchez, A. P. (2021). Impacto de la utilización de simulaciones virtuales en física sobre la motivación intrínseca en estudiantes de bachillerato. *Presencia Universitaria*, 9(18), 32–43. <https://doi.org/https://doi.org/10.29105/pu9.18-3>

- Sharrab, Y., Almutiri, N. T., Tarawneh, M., Alzyoud, F. Y., Al-Ghuwairi, A.-R., & Al-Fraihat, D. (2023). Toward Smart and Immersive Classroom Based on AI, VR, and 6G. *Revista Internacional de Tecnologías Emergentes En El Aprendizaje*, 18(2), 4-16. <https://doi.org/10.3991/ijet.v18i02.35997>
- Son, C., Hegde, S., Smith, A., Wang, X., & Sasangohar, F. (2020). Effects of COVID-19 on college students' mental health in the United States: Interview survey study. *Journal of Medical Internet Research*, 22(9), 1-14. <https://doi.org/10.2196/21279>
- Tan, J., Mao, J., Jiang, Y., & Gao, M. (2021). The influence of academic emotions on learning effects: A systematic review. *International Journal of Environmental Research and Public Health*, 18(18), 1-19. <https://doi.org/10.3390/ijerph18189678>
- Tapullima-Mori, C., & García, G. R. (2022). Procrastinación Académica Y Bienestar Psicológico en Estudiantes Universitarios Durante Las Clases Virtuales. *Sapienza International Journal of Interdisciplinary Studies*, 3(1), 96-105. <https://doi.org/10.51798/sijis.v3i1.210>
- Valencia, P. D., & Álvarez, N. R. (2023). Análisis de la Escala de Bienestar Psicológico para Adultos Usando El Modelo de Respuesta Graduada. *Revista Argentina De Ciencias Del Comportamiento*, 15(1), 57-69. <https://doi.org/10.32348/1852.4206.v15.n1.32224>
- Vallejo-Sánchez, B., & Pérez-García, A. M. (2015). Positividad y Afrontamiento en Pacientes con Trastorno Adaptativo. *Anales de Psicología*, 31(2), 462-471. <https://doi.org/10.6018/analesps.31.2.176631>
- Vértiz, C. B. O., Cardoso, J. D., & Bobadilla, B. S. (2015). Estilos de Aprendizaje. Caso Estudiantes de Psicología del Centro Universitario UAEM Temascaltepec / Learning Styles. Case Psychology Students of the University Center UAEM Temascaltepec. *Ricsh Revista Iberoamericana De Las Ciencias Sociales Y Humanísticas*, 4(7). <https://doi.org/10.23913/ricsh.v4i7.33>
- Viladrich, C., Angulo-Brunet, A., & Doval, E. (2017). Un viaje alrededor de alfa y omega para estimar la fiabilidad de consistencia interna. *Anales de Psicología*, 33(3), 755-782. <https://doi.org/10.6018/analesps.33.3.268401>
- Villarrubia, M. D., Natera, M. Z., & Milet, C. (2023). Bienestar Psicológico, Malestar Psicológico Y Estado Emocional en Estudiantes Universitarios Según Su Nivel De Actividad Física. *Revista De Investigación En Psicología*, 26(1), 97-115. <https://doi.org/10.15381/rinvp.v26i1.24733>
- Wang, Y., Xia, M., Guo, W., Xu, F., & Zhao, Y. (2023). Academic performance under COVID-19: The role of online learning readiness and emotional competence. *Current Psychology*, 42(34), 30562-30575. <https://doi.org/10.1007/s12144-022-02699-7>