# Propiedades psicométricas de una escala para medir la práctica docente universitaria en la modalidad híbrida

## Psychometric properties of scale to assess university teaching practice in hybrid modality

## Propriedades psicométricas de uma escala para mensurar a prática docente universitária na modalidade híbrida

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## Resumen

La educación híbrida, también conocida como *b-learning*, se concibe como una innovación que combina las ventajas del aprendizaje en línea con los beneficios del aula tradicional. Durante la pandemia en 2020, esta modalidad educativa experimentó un impulso significativo debido a que tuvo que ser empleada para mantener los procesos formativos y asegurar indicadores de permanencia durante la emergencia sanitaria. Por tal motivo, en la actualidad existe un interés creciente por recopilar información sobre este tipo de experiencias, ya que se proyecta que esta modalidad seguirá siendo una tendencia educativa. En consecuencia, esta investigación plantea la necesidad de analizar las propiedades psicométricas de una escala diseñada para medir la práctica docente universitaria en modalidad híbrida, dado que no existen instrumentos adaptados para ella. Para llevar a cabo este estudio, se seleccionó una muestra no probabilística de 395 estudiantes universitarios que cursaban asignaturas en modalidad híbrida, a quienes se les administró un cuestionario compuesto por 48 ítems, organizados en cinco dimensiones que describen la funcionalidad del *b-learning* en el contexto universitario. Los hallazgos revelan un modelo de tres factores que deben considerarse en las prácticas docentes en entornos híbridos: la gestión de la enseñanza basada en la comunicación, la facilitación de experiencias centradas en el aprendizaje y la planificación con orientación al aprendizaje autónomo. Además, la escala presentó resultados estadísticos que respaldan la validez del instrumento, pues se consiguieron valores aceptables en los índices de bondad de ajuste, así como la fiabilidad de los datos utilizados en el análisis. Por consiguiente, puede afirmarse que esta escala constituye un instrumento útil para evaluar la práctica docente en la modalidad híbrida.

**Palabras claves:** modalidad híbrida, instrumento de evaluación, práctica docente, gestión de la enseñanza, aprendizaje autónomo.

## Abstract

Hybrid education also known as b-learning it's conceived as a composite innovation, that combines the advantages of online learning with the benefits of traditional classroom. This type of education was promoted during Covid Pandemic in 2020, it was given the formative processes to achieve indicators overall student permanence during the sanitary emergency. Currently it's emphasized the need for information of application and result experiences, as it being considered a modality that will continue to be in trend. This investigation proposes the need to assess the psychometric properties of a scale to evaluate university teaching practice in hybrid modality, due to not existing an adequate instrument for it. For the study, there were selected 395 university students in a non-probabilistic way who were taking subjects in hybrid modality. A 48-item questionnaire was applied organized in five dimensions that describe the functionality of this modality in university education. The findings of the study show a model of three factors to consider in teaching practice in hybrid environments, which are: manage teaching through communication, facilitate experiences centered on learning and planning towards autonomous learning. The Scale displayed statistical results that support the validity of the instrument, presenting acceptable values in the goodness of fit index and the reliability of the information in the analysis, it can be determined that is a useful instrument to assess teaching practices in hybrid modality.

**Keywords:** Hybrid Modality; Evaluation Instrument; Teaching Practice; Teaching Management; Autonomous Learning.

## Resumo

A educação híbrida, também conhecida como b-learning, é concebida como uma inovação que combina as vantagens da aprendizagem online com os benefícios da sala de aula tradicional. Durante a pandemia de 2020, esta modalidade educacional teve um impulso significativo porque teve que ser utilizada para manter os processos de formação e garantir indicadores de permanência durante a emergência sanitária. Por esta razão, existe atualmente um interesse crescente em recolher informação sobre este tipo de experiências, uma vez que se projeta que esta modalidade continue a ser uma tendência educativa. Consequentemente, esta pesquisa levanta a necessidade de analisar as propriedades psicométricas de uma escala destinada a medir a prática docente universitária na modalidade híbrida, visto que não existem instrumentos adaptados para tal. Para a realização deste estudo foi selecionada uma amostra não probabilística de 395 estudantes universitários que cursavam disciplinas na

modalidade híbrida, aos quais foi aplicado um questionário composto por 48 itens, organizado em cinco dimensões que descrevem a funcionalidade do b-learning no contexto universitário. Os resultados revelam um modelo de três fatores que devem ser considerados nas práticas docentes em ambientes híbridos: a gestão do ensino baseada na comunicação, a facilitação de experiências focadas na aprendizagem e o planejamento voltado para a aprendizagem autônoma. Além disso, a escala apresentou resultados estatísticos que sustentam a validade do instrumento, uma vez que foram alcançados valores aceitáveis nos índices de qualidade de ajuste, bem como na confiabilidade dos dados utilizados na análise. Portanto, pode-se afirmar que esta escala constitui um instrumento útil para avaliar a prática docente na modalidade híbrida.

# Introduction

Since its origin in the 1990s, mainly in the United States (Avello and Duart, 2016), hybrid education - also known as *b- learning* - was conceived with the main purpose of addressing the inclusion and permanence of students in the educational system (UNESCO, 2023). According to Meydanlioglu and Arikan (2014), the hybrid modality combines the advantages of online learning with the benefits of the traditional classroom, which forces the student to alternate and combine in-person and virtual activities in their activity. UNESCO (2023) defines a hybrid model when it approaches a balance of 50% face-to-face and 50% remote teaching, which implies the adoption of different pedagogical approaches, such as virtuality, face-to-face and hybridization, each with their own teaching methods. This international organization also mentions hybridization as an integration of modalities or the intersection of virtuality and presence, and even refers to the term *bimodality* in its reports.

Now, due to the 2020 pandemic, which affected 94% of the world's student population (United Nations [UN], 2020), the need arose to implement hybrid education (UNESCO, 2023), which has served as a support to carry out a constant review of this topic in order to find empirical evidence that facilitates decision making.

For example, regarding the educational indicators of higher education (HE) in Mexico, it can be stated that coverage reached 31% during the 2020-2021 cycle, according to data reported by the Ministry of Public Education (SEP) (2021). , a figure that is notably

lower compared to advanced countries, where it ranges between 60% and 70% (Didriksson, 2019), while in relation to school dropouts, an increase was recorded, exceeding 7.9%. in the 2018-2019 cycle to 8.4% in the 2020-2021 cycle (SEP, 2021).

These indicators show the low percentage of people who access higher education and the risks associated with dropping out of school in Mexico. Consequently, the importance of incorporating innovative proposals—such as the hybrid modality—in the training processes is highlighted to guarantee access, permanence and graduation of students. In addition, the need to collect information on application experiences and results is emphasized, given that it is considered that this modality will continue to trend.

In accordance with this purpose, some authors refer to the dimensions on which evaluation in hybrid education should focus. Within this classification, classic dimensions such as planning, development and results are considered (Cabero *et al*., 2018). Likewise, there are proposals that include pedagogical, technical and didactic competencies (Marciniak, 2016), as well as domains necessary for the technological environment, such as disciplinary, content, technological and pedagogical knowledge (Cabero and Barroso, 2016; Mishra and Koehler, 2006 ). Likewise, Ortiz -López *et al*., (2021) have developed a model that proposes to evaluate teaching quality through dimensions such as the teaching function, teaching strategies, tutoring, and teaching materials and resources.

As can be seen, there are dimensions in teaching evaluation that remain constant over time, such as didactic and technological, to which tutoring is added. Similarly, in the teaching evaluation in hybrid mode, an integration of criteria is observed for both the virtual and in-person environments, which is reflected in proposals such as that of Smidt and Velázquez (2021), who incorporated dimensions such as design of materials, teaching-learning activities, interaction and evaluation methods, criteria that were merged from both modalities.

However, it is crucial to consider other variables of the hybrid model that have emerged in recent years due to the redefinitions that this modality has been experiencing. Indeed, when reviewing the literature on the hybrid modality, works have been detected that, as a consequence of their common findings, have been grouped into the following dimensions for the purposes of this research: (a) planning oriented towards autonomous learning, ( b) management of teaching based on communication, and (c) facilitation of experiences focused on learning.

### Plan with a focus on autonomous learning

Hybrid models have been identified as facilitators of increasing the self-directed learning capacity of students, as it has allowed them to advance at their own pace (Inter-American Development Bank [IDB], 2021). In fact, it has been concluded that student autonomy planning is a fundamental dimension that promotes their empowerment and active participation in the educational process (Limay, 2018).

This happens because in hybrid environments, students' personalized participation, as well as their autonomy and time management, are encouraged, which turns these characteristics into distinctive advantages of this modality (Romero *et al*., 2021). Furthermore, personalized hybrid learning environments offer an ideal framework to develop individual strategies that significantly expand their reach and effectiveness (Engel and Coll, 2022).

For this reason, the importance of designing sequences with strategies that promote student autonomy has been highlighted (De Vincenzi, 2020). Among these proposals are the case method and problem-based learning, which stimulate situated learning and student autonomy (Fullan, 2020). Likewise, it has been observed that learning formats based on multidisciplinary projects, specifically created for students who study them at home (in groups or individually), reinforce their capacity for autonomous learning (Arias *et al*., 2020).

### Manage teaching based on communication

Communication plays a crucial role in hybrid environments, which is why they offer a wide range of resources that allow joint activity and interaction between teachers and students, as well as between the students themselves (Engel and Coll, 2022 ). Indeed, teachers can encourage this communication using various specific tools - such as Microsoft Teams , Google Hangouts, Zoom, Radix, Webex, among others - which can be integrated into learning management platforms (Arias, *et al* ., 2020). To allow interaction and collaboration, either synchronously or asynchronously, between all participants in the educational process.

### Facilitates experiences focused on learning

Hybrid environments represent new opportunities, especially to more effectively address the needs of students and promote equity in learning (IDB, 2021). A main objective in this sense is to create student-centered experiences that are personalized, relevant and attractive, using technology as a tool to accelerate learning (Arias, *et al*., 2020). This includes

monitoring the individual trajectory of students to promptly identify those who may be at risk of dropping out of school.

In this context, the Technological Institute of Sonora (ITSON) - a public university located in the state of Sonora (Mexico), which has four units in the cities of Obregón, Guaymas, Empalme and Navojoa - has proposed to address the needs that have arisen. during the pandemic. To this end, it has provided students in all its educational programs with the option of taking subjects under a virtual model and, currently, through a hybrid model. This approach has allowed them to more flexibly continue their studies both in person and virtually.

However, despite the progress in the evaluation of teaching practice, there are still no adequate instruments to evaluate it in hybrid environments, since many focus on face-to-face teaching, and do not take into account the evaluation processes in non-conventional educational environments. (García *et al*., 2015). Furthermore, although characteristics of the hybrid model have been identified, few studies have focused on the generation of instruments to measure teaching practice specifically in this modality.

Therefore, the need arises to have measurement instruments that allow us to distinguish the dimensions of a hybrid methodology and that serve as a reference for teaching practices in this type of scenarios.

## Method and materials

### Participants

To participate in the study, 395 university-level students were selected in a non-probabilistic manner. The sample size was determined with a 95% confidence level (q = 95%) and a 5% margin of error (error = 5%). Of these students, 62% took subjects in the virtual-face-to-face modality, while 38% attended synchronous or remote sessions with the support of technological platforms. Regarding gender distribution, 26% were men, 71% were women, and 3% preferred not to reveal their gender. The age range of the participants was between 19 and 22 years old, and they belonged to various engineering and bachelor's degrees in the third, fifth, and seventh semesters.

**Instrument**

The questionnaire was developed by the research team and consists of 48 items, organized into five dimensions or theoretical elements that describe the functionality of the hybrid modality in the university context (figure 1). The first dimension, called "Planning oriented towards student autonomy", is made up of 14 items, based on Fullan (2020). The second, titled "Teaching management based on communication", is made up of nine items, based on Ramírez and Ramírez (2019). The third addresses the "Use of digital resources and/or tools", with seven items, consulted in works by Area (2017) and Real (2019). The fourth dimension focuses on "Formative Evaluation", with eight items based on Medina and Deroncele (2019). Finally, the fifth dimension is about the "Guide role", with 10 items based on Ramírez and Ramírez (2019). The response options were as follows: totally agree (5), agree (4), neither agree nor disagree (3), disagree (2) and totally disagree (1).

**Figure 1.** Theoretical proposal of the hybrid model
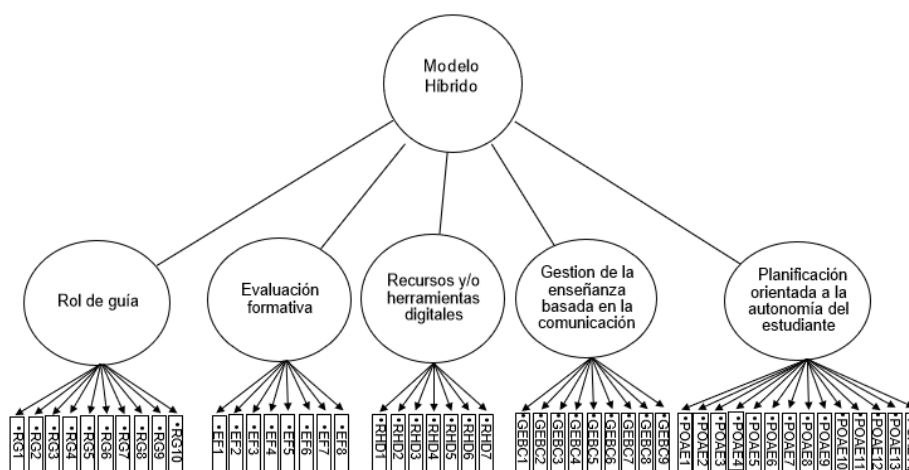


Source: self made

**Procedure**

Based on the aforementioned theoretical references, an operational table was developed for the construction of the instrument, which consists of five dimensions. After validating the content through expert judgment, the questionnaire was implemented using the Google Forms service. To do this, the link to the questionnaire was shared with the teachers

in charge of the student group so that each student could complete it individually. The instructions explained that the purpose of the questionnaire was to collect their perceptions about teaching practice in order to obtain information that would contribute to improving the teaching and learning processes associated with the hybrid modality.

The instrument was completed by students from the four university campuses over a period of 25 days. Then, the psychometric validity of the instrument was evaluated through an exploratory factor analysis (EFA), in which possible factors were extracted using principal component analysis, Varimax rotation and Bartlett's test, to verify its internal validity. Subsequently, the reliability of the instrument was demonstrated using McDonald's omega coefficient ($\Omega$).

The confirmatory factor analysis (CFA) was carried out using the AMOS program, for which the goodness of fit indices proposed by Valdés *et al*., (2019) were taken into account for educational research, including both absolute and incremental indices (Rojas-Torres, 2020). The absolute indices considered were X2 and its associated probability, the square root of the mean of squared residuals (SRMR) and the root of the mean square of the error of approximation (RMSEA). Incremental goodness-of-fit indices included the Tucker Lewis (TLI) and the comparative fit index (CFI). A model was initially attempted with the 4 factors obtained in the EFA; However, the goodness of fit indices and the modification indices suggested that one factor (pedagogical mediation strategies and tools) was not very relevant, so it was decided to eliminate it and carry out the CFA with three factors.

# Results

The exploratory factor analysis (EFA) of the scale identified four factors of the five originally proposed by the researchers, which explained 73.1% of the variance. The Varimax orthogonal rotation validated the importance of the four components in measuring the changes in the hybrid model, identifying the following components: communication-based teaching management (GEBC), student autonomy-oriented planning (POAE), student-centered experiences (ECE) and pedagogical mediation strategies and tools (EHMP). The reliability of the instrument was demonstrated by McDonald's omega coefficient ($\Omega$), which showed high internal consistency rates of .977.

In relation to the values of the sampling adequacy test in the instrument analyses, values were obtained that are within the expected standards: the Kaiser-Meyer- Olkin measure of sampling adequacy was .972 and the Bartlett sphericity test yielded a chi-square of 15305.487 ( df = 1128, Sig. = .000).

Table 1 shows that students agree with the teaching practices carried out by teachers in the hybrid modality. However, the skewness and kurtosis values suggest the existence of non-normality in the distribution of item scores. Negative skewness indicates a one-sided distribution that extends toward more negative values, while kurtosis with positive coefficients indicates that there is a greater concentration of the data around the mean.

**Table 1.** Mean, standard deviation, skewness and kurtosis of the indicators

| Items | Min. | Max. | M | OF | Asymmetry | Kurtosis |
|---|---|---|---|---|---|---|
| Communication-based teaching management Establish interaction with us to promote participation through forums, social networks and/or chats. | 1 | 5 | 4.40 | .883 | -1,793 | 3,347 |
| Encourages collaborative work in face-to-face or remote sessions. | 1 | 5 | 4.43 | .811 | -1,857 | 4,442 |
| It provides us with spaces so that in teams or individually we can reflect and organize ideas about tasks or projects. | 1 | 5 | 4.42 | .856 | -1,885 | 4,093 |
| Provides support or advice through different means of virtual and in-person communication. | 1 | 5 | 4.44 | .824 | -1,924 | 4,523 |
| Ensures understanding of the concepts and procedures addressed. | 1 | 5 | 4.43 | .823 | -1,883 | 4,498 |
| Facilitates communication through groups on social networks (Facebook, WhatsApp, etc.) | 1 | 5 | 4.48 | .791 | -1977 | 4,904 |
| Communicates in class fluently, with an audible voice and correct diction. | 1 | 5 | 4.53 | .784 | -2,253 | 6,297 |
| It uses multimedia technology (videos, conferences, presentations, etc.) to access support material. | 1 | 5 | 4.53 | .741 | -2,037 | 5,556 |
| In face-to-face sessions, he uses technological tools effectively, such as a smart board, projector, computer, etc. | 1 | 5 | 4.45 | .809 | -1,871 | 4,271 |
| It gives us feedback (gives us observations of improvement) on the tasks on a weekly or biweekly basis, as the course progresses. | 1 | 5 | 4.28 | .960 | -1,550 | 2,376 |
| Consider our doubts to make changes or adjustments in subsequent class sessions. | 1 | 5 | 4.34 | .900 | -1,653 | 2,977 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Moderates participation, both in face-to-face and remote environments. | 1 | 5 | 4.40 | .814 | -1,792 | 4,227 |
| Planning aimed at student autonomy | | | | | | |
| He showed the content of the subject in an attractive way, linked to our interests and motivations. | 1 | 5 | 4.33 | .923 | -1,761 | 3,319 |
| It provides us with materials in various formats (readings, videos, audios, links) that promote autonomy for the exploration of content and activities. | 1 | 5 | 4.45 | .852 | -2019 | 4,646 |
| We carry out activities such as case studies and problem solving. | 1 | 5 | 4.42 | .794 | -1,793 | 4,285 |
| The course sequence allows us to explore autonomously to access the content (readings, short videos, links to websites). | 1 | 5 | 4.37 | .831 | -1,747 | 4,006 |
| It includes a virtual communication space to exchange opinions outside of in-person or remote sessions. | 1 | 5 | 4.36 | .865 | -1,617 | 2,959 |
| We can enter and/or navigate the platform or applications without the need for the teacher's accompaniment. | 1 | 5 | 4.46 | .787 | -1,824 | 4,344 |
| The instructions on the platform are clear, coherent and precise, making it easier for us to carry out the activities or tasks. | 1 | 5 | 4.42 | .803 | -1,696 | 3,720 |
| Student-centered experiences | | | | | | |
| It asks us to carry out collaborative projects (in teams). | 1 | 5 | 4.48 | .801 | -2,062 | 5,338 |
| We are requested to present projects in person, remotely or by video recording. | 1 | 5 | 4.40 | .829 | -1,795 | 4,032 |
| The teacher provides us with collaborative technological tools to work as a team (Google Drive, Canva , Miro, Padlet , etc.). | 1 | 5 | 4.42 | .873 | -1,934 | 4,213 |

| | Min | Max | M | SD | | |
|---|---|---|---|---|---|---|
| Use different technological tools to rate learning products (forums, assignments, projects, exhibitions, exams, etc.). | 1 | 5 | 4.44 | .817 | -1,916 | 4,574 |
| Use various ways to evaluate our learning (checklists, rubrics, exams, projects, etc.). | 1 | 5 | 4.44 | .773 | -1,773 | 4,260 |
| It uses various tools that allow us to discover different ways of learning. | 1 | 5 | 4.44 | .842 | -1,959 | 4,525 |
| It suggests other sources of reference (books, videos, articles, spaces, people, materials and/or tools) that enrich what we have learned. | 1 | 5 | 4.39 | .843 | -1,778 | 3,932 |
| | | | | | | |

Note: Min= minimum; Max= maximum; M= average; SD= standard deviation.

Source: self made

Subsequently, three confirmatory factor analyzes were carried out to test the following models (Table 2):

a) First-order four-factor model: This considered the four factors identified in the exploratory factor analysis of the pilot sample. However, the factor called "Pedagogical mediation strategies and tools" (EHMP) did not present a good fit, so it was decided to eliminate it.

b) Model of three first-order factors: In this the factors of "Management of teaching based on communication" (GEBC), "Student-centered experiences" (ECE) and "Autonomy-oriented planning" were taken into consideration. of the student" (POAE).

c) Adjusted first-order three-factor model: In this, some items that did not present a good fit in the previous model were eliminated, which yielded an adjusted version of the three-factor model.

**Table 2.** Goodness of fit indices of the analyzed models

| Proposed model | X2 | *Gl* | *p* | SRMR | RMSEA (90% CI) | TLI | CFI |
|---|---|---|---|---|---|---|---|
| a) First-order 4-factor model. | 3586.89 | 1074 | ,000 | 0.03 | 0.08 (.07 - .08) | .87 | .87 |
| b) First-order 3-factor model. | 2601.06 | 776 | ,000 | 0.02 | 0.08 (.07 - .08) | .89 | .89 |
| c) First-order 3-factor model (adjusted). | 706.09 | 291 | .001 | 0.02 | 0.06 (.06 - .07) | .95 | .96 |

Source: self made

The confirmatory factor analysis of the adjusted model (see figure 2) proved the validity of the scale, since it obtained acceptable values in the absolute goodness of fit indices ($X2 = 706.09$ [ df = 291; p = 0.001], SRMR = 0.019, RMSEA = 0.060, 90% CI [.055 - .066]), as well as in the incremental goodness-of-fit indices (TLI = .95; CFI = 0.96).

Factor 1, called "Management of teaching based on communication" (GEBC), is made up of 12 items, while factor 2 —"Facilitates experiences focused on learning" (FECA)— and factor 3 —"Planning oriented to autonomous learning " (POAA)—were formed with 7 items each. The covariances between the factors ranged from .95 to .98, indicating that they are closely linked to each other.

**Figure 2.** Final solution of the confirmatory factor analysis
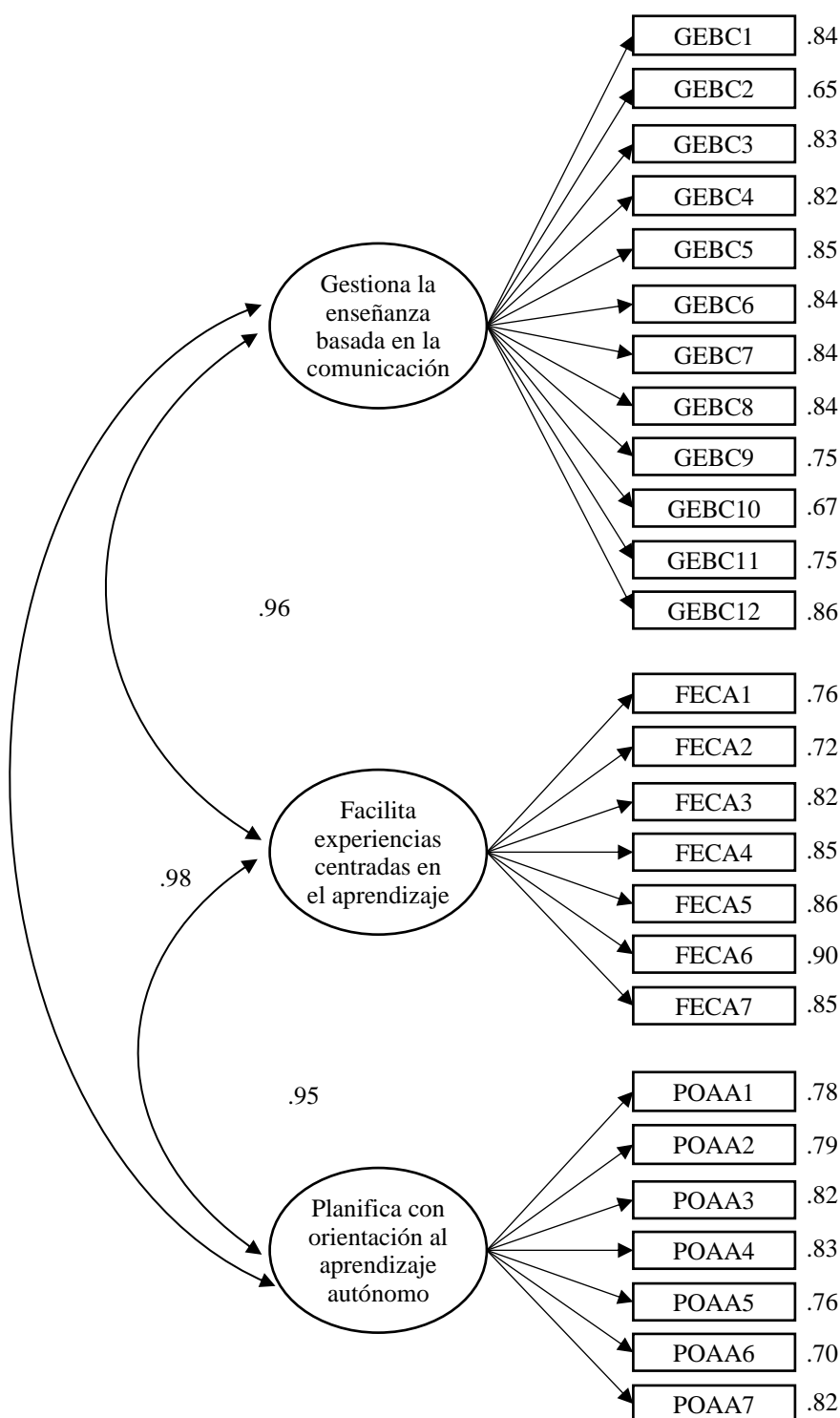


Source: self made

Table 3 shows the reliability properties through McDonald's omega coefficient , where all values are greater than .92, which indicates internal consistency in the participants' responses. In addition, the average explained variance of each factor is presented, the result of the confirmatory factor analysis. Both reliability and validity values are acceptable.

**Table 3.** Reliability and average variance extracted from the model.

| Factors | Ω | VME |
|---|---|---|
| Communication-based teaching management | .95 | .54 |
| Facilitates experiences focused on learning | .94 | .37 |
| Plan with a focus on autonomous learning | .92 | .43 |

Source: self made

# Discussion

The present study explored the fit of a scale based on a theoretical model, and the results indicated that the three-factor scale was the best fit and represented the measurement of the hybrid model in teaching practice. These three include planning for autonomous learning, managing communication-based instruction, and facilitating learning-centered experiences.

These three latent variables contribute to the classic dimensions that already existed regarding mixed, *b- learning* or hybrid methodologies with generic proposals on teaching practice, such as pedagogical and technical competencies, disciplinary knowledge, technological resources and tutoring (Cabero *et al.,* 2018; Cabero and Barroso, 2016; Marciniak , 2015; Mishra and Koehler, 2006).

Likewise, the results reveal that the adjusted three-factor model better represents the structure of the hybrid model. This finding highlights the importance of managing teaching based on communication, where a reciprocal interaction is established that provides both virtual and in-person support to students. In addition, a variety of indicators stand out, such as establishing interaction and facilitating communication through forums, chats and social networks, promoting collaborative work, providing support and advice, ensuring understanding of the processes addressed, making use of multimedia technology. , use technological tools, provide continuous feedback on tasks and act as a moderator.

Another important factor was facilitating experiences focused on learning. According to Monsalve and Amaya (2014), the management of ICT in the hybrid modality changes the way in which teachers and students interact in the training process, since the former must focus their orientation, activities and evaluation on learning, while the Seconds must develop new, more social and active learning strategies. The indicators that represent this factor include requesting projects and exhibitions collaboratively, facilitating collaborative

technological tools, employing various ways of evaluating learning, using various techniques or strategies, and suggesting other sources of consultation that enrich student learning.

The third factor refers to planning with an orientation toward autonomous learning. For Limay (2018) it is essential that planning is adaptable, contextualized and receptive, taking into account the social and cultural reality of the students. This means fostering meaningful learning based on concrete experiences and promoting comprehensive development and educational success. Therefore, the indicators include showing subject content in an attractive way linking with the interests and motivations of the students, considering their doubts to make changes or adjustments for the following sessions, carrying out activities such as case studies and problem solving, allowing course sequences allow access to the content autonomously, include a virtual communication space for the exchange of opinions, navigate the platform without support from the teacher and that the interactions on the platform are clear, coherent and precise to facilitate the realization of tasks or activities.

In conclusion, the scale presented statistical results that corroborate the validity of the instrument, since acceptable values were achieved in the goodness of fit indices, as well as the reliability of the data used in the analysis, so it can be stated that it is a useful instrument to evaluate teaching practice in the hybrid modality.

## Conclusions

The evaluation of teaching practice, especially in the context of the hybrid modality, represents an extremely relevant challenge, which encompasses not only the conception of the construct and its diversity, but also its characteristics, structure and, as has been established in this study , its measurement and the derivation of instruments around it.

Based on the established objective, it was possible to corroborate the validity and reliability of the data of the proposed scale to evaluate teaching practice in hybrid modality in higher level settings in the Mexican context. In this sense, the findings of this study reveal a model of three factors to be considered in teaching practices in hybrid environments: management of teaching based on communication, facilitation of experiences focused on learning and planning oriented towards autonomous learning.

In summary, this research addresses an existing gap in studies on hybrid models, since it provides a theoretical and empirical reference to guide teaching practices in flexible learning environments. Therefore, it is recommended to use the instrument as a technique to

evaluate teaching performance in the mixed modality, *blended . learning* or hybrid, since the questionnaire allows us to identify, from the students' perspective, the three main variables in pedagogical mediation, merging virtual and face-to-face environments.

However, for future studies it is suggested to investigate other factors that could be incorporated into the model, such as the variables associated with teaching performance in the hybrid modality and students' autonomous learning. Likewise, and since it is assumed that the use of ICT facilitates the development of cognitive skills through interaction in virtual environments, work could be done on creating a more complete explanation model around said construct. Furthermore, it is invited to expand the scope of the study to other universities in different countries that implement this type of modality with the aim of achieving greater generalization of the findings. These suggestions would contribute to a better understanding and approach to the phenomenon.

Finally, it is crucial to highlight that decision-makers in higher education institutions must reconsider the strategies and instruments used in teaching to improve the quality of teaching-learning processes and, consequently, influence the student training. In this way you can contribute to achieving the objectives set to respond to the demands of the society to which they are due.

**Gratitude**

## References

Area, M. (2017). La metamorfosis digital del material didáctico tras el paréntesis Gutenberg. *Revista Latinoamericana de Tecnología Educativa, 16*(2). https://relatec.unex.es/article/view/3083/2113

Arias, O., E., Brechner, M., Pérez, A., M. y Vásquez, M. (2020). *Hablemos de política educativa en América Latina y el Caribe. De la educación a distancia a la híbrida: 4 elementos clave para hacerla realidad*. https://publications.iadb.org/es/hablemos-de-politica-educativa-en-america-latina-y-el-caribe-2-de-la-educacion-distancia-la-hibrida

Avello, R. y Duart, J. (2016). Nuevas tendencias de aprendizaje colaborativo en e-learning: Claves para su implementación efectiva. *Estudios Pedagógicos, 42(1),* 271-282. https://dx.doi.org/10.4067/S0718-07052016000100017

Banco Interamericano de Desarrollo (BID) (2021). *Hacia una educación 4.0. 10 módulos para la implementación de modelos híbridos.* https://publications.iadb.org/es/hacia-una-educacion-40-10-modulos-para-la-implementacion-de-modelos-hibridos

Cabero, J. y Barroso, J. (2016). Formación del profesorado en TIC: una visión del modelo TPACK. *Cultura y Educación*, *28*(3), 633-663. 10.1080/11356405.2016.1203526

Cabero, J., Llorente, M. y Morales, J. (2018). Evaluación del desempeño docente en la formación virtual: ideas para la configuración de un modelo. *RIED. Revista Iberoamericana de Educación a Distancia, 21*(1). 261-279 https://revistas.uned.es/index.php/ried/article/view/17206/16912

De Vincenzi, A. (2020). Del aula presencial al aula virtual universitaria en contexto de pandemia de COVID-19. *Debate Universitario, Vol. 8*(16). https://dialnet.unirioja.es/servlet/articulo?codigo=9057954

Didriksson, A. (2019). La construcción de una agenda de transformación para la universidad en América Latina y el Caribe. Balance y perspectivas de la CRES-2018. *Perfiles Educativos, 41*(163), 203-218 https://www.scielo.org.mx/pdf/peredu/v41n163/0185-2698-peredu-41-163-203.pdf

Engel, A. y Coll, C. (2022). Entornos híbridos de enseñanza y aprendizaje para promover la personalización del aprendizaje. *RIED. Revista Iberoamericana de Educación a Distancia, 25*(1), 225-242. https://doi.org/10.5944/ried.25.1.31489

Fullan, M. (2020). *Education Reimagined; The Future of Learning. A collaborative position paper between New Pedagogies for Deep Learning and Microsoft Education*. http://aka.ms/HybridLearningPaper

García, R., Manig, A., Mortis, S. y Del Hierro, E. (2015). La modalidad mixta: un estudio sobre los significados de los estudiantes universitarios. *Innovación Educativa, 15*(68), 73-97. https://www.redalyc.org/articulo.oa?id=179442126006

Limay, D. (2018). *Gestión curricular en el uso de la estrategia mi pueblo, mi escuela para mejorar la conciencia ambiental de la Institución Educativa Pública N° 1840* (trabajo de grado). Universidad San Ignacio de Loyola. http://repositorio.usil.edu.pe/bitstream/USIL/5369/3/2018_LIMAY_LOPEZ_DARLING.pdf

Marciniak, R. (2016). *Autoevaluación de programas de educación universitaria virtual* (tesis doctoral). Universidad de Barcelona. https://www.educacion.gob.es/teseo/imprimirFicheroTesis.do?idFichero=v66vhfKNT4c%3D

Medina, P. y Deroncele, A. (2019). La evaluación formativa desde el rol del docente reflexivo. *Maestro y Sociedad, 16*(3), 597-610. https://maestroysociedad.uo.edu.cu/index.php/MyS/article/view/4979

Meydanlioglu, A. and Arikan, F. (2014). Effect of Hybrid Learning in Higher Education. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering, 8*(5). doi.org/10.5281/zenodo.1092346

Mishra, P. and Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record, 108*(6), 1017-1054. http://dx.doi.org/10.1111/j.1467-9620.2006.00684.x

Monsalve, J. C. y Amaya, D. M. (2014). Implementación de ambientes de aprendizaje b-learning: retos para docentes y estudiantes. *Revista Colombiana de Ciencias Sociales, 5*(2), 408-417. https://revistas.ucatolicaluisamigo.edu.co/index.php/RCCS/article/view/1256/1286

Organización de las Naciones Unidas (ONU) (2015). *ONU llama a superar brechas en el uso de las TIC*. https://www.un.org/development/desa/es/news/administration/wsis10.html#:~:text=El%20Secretario%20General%20de%20la,econ%C3%B3mica%20inimaginables%20hace%20apenas%20una

Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura (Unesco) (2023). Repensar la educación híbrida después de la pandemia. https://unesdoc.unesco.org/ark:/48223/pf0000385359/PDF/385359spa.pdf.multi

Ortiz-López, A., Olmos-Migueláñez, S. y Sánchez-Prieto, J., C. (2021). Calidad en e-Learning: identificación de sus dimensiones, propuesta y validación de un modelo para su evaluación en educación superior. *Revista Iberoamericana de Educación a Distancia*, (24), 225-244. https://doi.org/10.5944/ried.24.2.29073

Ramírez, C., J. y Ramírez, C., M. (2019). Cuando hablamos de gestión educativa, ¿de qué hablamos? *Educa, Revista Universitaria, 126*. https://educa.upnvirtual.edu.mx/index.php/hecho-en-casa/8-hecho-en-casa/370-cuando-hablamos-de-gestion-educativa-de-que-hablamos

Real, C. (2019). Materiales didácticos digitales: un recurso innovador en la docencia del siglo XXI. 3C TIC. *Cuadernos de Desarrollo Aplicados a las TIC, 8*(2), 12-27. http://dx.doi.org/10.17993/3ctic.2019.82.12-27

Romero, R., D., Quiñonez, A., M., A. y Del Castillo, B., A., G. (2021). Intervención didáctica para el aprendizaje de números complejos en modalidad virtual. *Sahuarus. Revista Electrónica de Matemáticas, 5*(1). https://doi.org/10.36788/sah.v5i1.111

Secretaría de Educación Pública, SEP (2021). *Principales cifras del sistema educativo nacional 2020-2021*. Dirección General de Planeación, Programación y Estadística Educativa. http://www.planeacion.sep.gob.mx/Doc/estadistica_e_indicadores/principales_cifras/principales_cifras_2020_2021_bolsillo.pdf

Smidt, L., M., A. y Velázquez, F., M., E. (2021). Implementación y evaluación del enfoque b-learning en el laboratorio de transferencia de calor en Ingeniería Química. *InterCambios*. *Dilemas y Transiciones de la Educación Superior, 8*(2), 26-40. https://doi.org/10.29156/inter.8.2.4

UN (2020). Policy Brief: The World of Work and COVID-19 (June, 2020). United Nations. https://cutt.ly/6fpDKHF

Valdés, A., García, F., Torres, G., Urías, M. y Grijalva, C. (2019). *Medición en investigación educativa con apoyo del SPSS y el AMOS*. Conacyt.

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