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Artículos científicos

Hacia un modelo blended learning en una institución de educación superior: un diagnóstico inicial

Towards a Blended Learning Model in a Higher Education Institution: An Initial Diagnostic

Rumo a um modelo de blended learning em uma instituição de ensino superior: um diagnóstico inicial

Perla del Refugio Escamilla Martínez
Universidad Autónoma de Querétaro, México
perla.esmtz@gmail.com
https://orcid.org/0000-0002-2793-8272

Resumen

Este artículo presenta un diagnóstico inicial de las condiciones educativas del Instituto Tecnológico Superior de Rioverde (San Luis Potosí, México) con el objetivo de determinar la pertinencia para la incorporación de una propuesta de *blended learning* en el programa de ingeniería Industrial. Esta investigación recurre al modelo instruccional Praddie, exclusivamente a las etapas de preanálisis y análisis. Se utilizaron técnicas mixtas de investigación para valorar cuestiones relacionadas con los recursos financieros, intereses de los participantes, el plan estratégico de la organización, así como determinar la situación actual del contexto educativo y los niveles de competencia digital tanto de docentes como de alumnos. La población está constituida por profesores, estudiantes y el coordinador de dicho programa educativo. Los resultados muestran una pertinencia adecuada para la implementación de un modelo híbrido de aprendizaje. Si bien se identifican algunas limitaciones de infraestructura tecnológica, hay una buena percepción del contexto educativo por parte de los estudiantes y un nivel medio de la competencia digital de los estudiantes y profesores.

Palabras clave: enseñanza mixta, enseñanza superior, planificación educativa, tecnología de la educación.

Abstract

This article presents an initial diagnosis of the educational conditions of the Instituto Tecnológico Superior de Rioverde (San Luis Potosí, Mexico) with the aim of determining the relevance for the incorporation of a blended learning proposal in the Industrial Engineering program. This research uses the Praddie instructional model, exclusively at the pre-analysis and analysis stages. Mixed research techniques were used to assess issues related to financial resources, the interests of the participants, the strategic plan of the organization, as well as to determine the current situation of the educational context and the levels of digital competence of both teachers and students. The population is made up of teachers, students and the coordinator of said educational program. The results show an adequate relevance for the implementation of a hybrid learning model. Although some limitations of technological infrastructure are identified, there is a good perception of the educational context by students and an average level of digital competence of students and teachers.

Keywords: blended learning, higher education, educational planning, educational technology.

Resumo

Este artigo apresenta um diagnóstico inicial das condições educacionais do Instituto Superior Tecnológico de Rioverde (San Luis Potosí, México) com o objetivo de determinar a relevância para a incorporação de uma proposta de ensino híbrido no programa de Engenharia Industrial. Esta pesquisa utiliza o modelo instrucional de Praddie, exclusivamente nas etapas de pré-análise e análise. Técnicas mistas de pesquisa foram utilizadas para avaliar questões relacionadas a recursos financeiros, os interesses dos participantes, o plano estratégico da organização, bem como determinar a situação atual do contexto educacional e os níveis de competência digital de professores e alunos. A população é composta por professores, alunos e coordenador do referido programa educacional. Os resultados mostram uma relevância adequada para a implementação de um modelo de aprendizagem híbrido. Embora sejam identificadas algumas limitações da infraestrutura tecnológica, há uma boa percepção do

contexto educacional por parte dos alunos e um nível médio de competência digital de alunos e professores.

Palavras-chave: ensino misto, ensino superior, planejamento educacional, tecnologia educacional.

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Introduction

The transition from a face-to-face educational model to a virtual one due to the 2019 coronavirus disease (covid-19) contingency marked the beginning of a new educational paradigm. The incorporation of digital tools for a fully online education represented challenges for educational centers and teachers. Now, after the possibility of a gradual return to the face-to-face classroom, the new challenge is represented by the ambiguity and uncertainty of working under hybrid teaching models. Given this, the opportunities to provide an education of excellence in combined scenarios are determined by the conditions in which the context of each school is found. The implications for this approach have to do with the possibilities of internet access, elements of the context itself, the digital skills of both teachers and students and the needs of each institution for the adaptation of its physical and virtual spaces, among others.

These new models require higher education institutions to be prepared to teach, not only in face-to-face modalities, but also in online and hybrid formats. The use of adaptive and active learning technologies that have an impact on learning, reduce risks and, in addition, serve as a tool for equity and inclusion are the challenges of the way forward. Therefore, education must be rethought under flexible models that provoke new opportunities for the achievement of learning by breaking the rigidity of the paradigms of education (Organization of the United Nations for Education, Science and Culture [Unesco], 2016).

A teaching-learning process in a hybrid modality. Of course, it requires that the conditions of learning that support it be established. The transition will depend on the disposition and preparation that each institution reaches. This innovation, in addition to being a social demand, has now become an educational imperative. According to Educause (2020), the vertiginous increase in the cost of higher education, accompanied by a decrease in public financing, will have economic repercussions on spending decisions and the independence of

the young adult student, which will cause institutions to have to demonstrate its added value and adapt to new social and economic needs through new business and financing models.

Blended learning can be defined as "a combination of resources, means, modalities, techniques, as well as activities which enhance the benefits of each of them in a flexible learning environment" (Escamilla and Muriel, 2021, p. 6) . Undoubtedly, it has great advantages and benefits, such as the reduction of uncertainty regarding innovation and improvement of attitude and attention when implementing them (Martín, Hernández and Sánchez, 2014). Gallou and Abrahams (2018) state that virtuality as a support for face-to-face classes can bring improvements in some types of learning, for example, research-based and multidisciplinary and interdisciplinary, which allow students to develop essential skills. to be an active part in projects. It can even be useful to link researchers and students through multisensory experiences for the acquisition of information in the teaching process, and thus serve as an incubator for connections between different disciplines. In addition to this, Cabero and Román (cited in Nuñez, Monclúz and Ravina, 2019) include the dislocation of knowledge, the autonomy that develops in the student and just-in-time and just-for-me training as advantages of blended learning.

Distance education is mainly characterized by the fact that it is not given at the same time synchronously and in the same space. In accordance with these characteristics, a paradigm shift must be made in the training processes and in the teaching processes in the classroom to take advantage of the advantages of distance education and avoid transferring the same practices of the face-to-face class to a classroom. from distance. In this regard, the Organization for Economic Cooperation and Development [OECD] (September 8, 2020) stated that despite the fact that technological instruments have been incorporated into education, there is uncertainty about the effectiveness of the value proposition of institutions of higher education.

Other organizations such as the National Association of Universities and Institutions of Higher Education in Mexico [Anuies] (2001), incorporated in this concern and discussion, created through its Directorate of Educational Innovation the Master Plan for open and distance higher education, a document approved in the XXXI Ordinary General Assembly, precisely to start the development of distance learning. This article aims to make an initial diagnosis of the educational context of a higher education institution in order to determine the relevance of a blended learning proposal in the Industrial Engineering educational

program. The research questions that guide this study are: what are the conditions of the educational context of a higher education institution for the implementation of a blended learning model? What is the perception of educational managers for the implementation of a model? blended learning? How do students perceive their own educational context? And what is the level of digital competence of both teachers and students of a higher education institution?

Research that demonstrates the importance of an initial diagnosis for the design of blended learning scenarios affirms that adapting a model of this nature to the conditions of the context to reduce the risks of tradition over totally virtual or totally online classes can contribute to improvement teaching practice, as well as having a greater impact on students (Méndez and Morales, 2021; Morales, Zembrano and Medranda, 2016).

It is necessary to mention that even with this scenario there is a lack of knowledge to identify the conditions prior to the implementation of a hybrid model. Higher education institutions continue to implement new modalities hastily and without a reference for their adaptation. In the case of this research, it is decided to make this initial diagnosis in order to identify the relevance of this model given the characteristics of a higher education institution.

The diagnosis is based on the first two stages proposed in the Praddie instructional model (preanalysis and analysis). It is an investigation that uses a mixed method of investigation using the interview and the survey as data collection techniques. At first, the theoretical foundation is presented. Next, the methodology is detailed: a breakdown of the categories for the qualitative part and an operationalization of variables for the quantitative part. The results show a relevance for the incorporation of the hybrid model, taking into account planning and, in a subsequent design stage, aspects to consider such as technological infrastructure, digital skills of teachers and students, as well as the increase in the perception of students. levels of learning in virtual environments of students. Finally, some considerations and lines of research of interest that arise after this initial diagnosis are discussed.

Theoretical framework

Blended learning is mainly supported by constructivist and cognitive theories. The first, proposed by Vygotsky, posits that knowledge comes from an environment external to the individual, and that this input is interpreted by the learner: in this way, it creates

representations and semiotic constructions. One of the key concepts in this theory is the zone of proximal development, which is defined as “the distance between the level of development determined by independent problem solving and the level of potential development determined by problem solving under the guidance of of an adult or in collaboration with more capable peers” (Vygotsky, 1978, p. 86).

The fundamental principles on which Vygotsky's evolutionary psychology is based is the transition from lower processes to higher functions. For Vygotsky (cited in Daniels, 2012), "the understanding of the social becomes available for individual understanding in communication" (p. 80). Likewise, it explains the way in which social and participatory learning take place under the premise that "human beings make themselves from the outside" (Vygotsky, cited in Daniels, 2012, p. 86), this gives way to a socio-constructivism, where the importance of the individual understood as a social being capable of constructing their meanings from their own experiences.

On the other hand, meaningful learning highlights the importance of the student's prior knowledge to acquire new knowledge. For learning to be meaningful, a favorable attitude and an adequate presentation of the material are required. (Ausubel, Novak y Hanesian, 1983).

To give way to a blended learning model given these approaches, it is necessary to combine elements of two modalities and rescue strategies from each one that favor the effectiveness of the teaching-learning process. The flexibility and fidelity of interaction in a blended modality lies in the allocation of face-to-face time and online or distributed instruction. The decisions of combination of space, time and fidelity are decisive to define dimensions of interaction in a mixed learning environment.

If the advantages of blended learning are taken into account, such as the organization of students' time, flexibility and adaptation, as well as its still perceived disadvantages such as a lack of a clear idea of what this modality implies on the part of teachers and students, and if we add the great weight that is still given to the figure of the teacher as a key actor, for success in this educational modality it is necessary to consider the teacher-student relationship. In this sense, the teacher must be a facilitator of the teaching process, a counselor, a counselor, a designer, an advisor, a researcher, a content facilitator, a technological facilitator, and an organizer/administrator (Gisbert, 2002; Goodyear, Salmon, Spector, Steeples, and Tickner, 2001; Mason, 1991; Salinas, 1998).

In accordance with the above, institutions must modify both the design of the course and the teaching strategies to take advantage of technologies and ensure maximum interaction, as well as the use of electronic resources that allow the development of mechanisms of influence in mediated educational contexts. For technology. In such a way that "the teacher acts as a mediator between the constructive mental activity of the student and the culturally organized collective knowledge" (Roblyer and Ekhaml, 2000, p. 19). By combining components of two modalities, strategies of each one that favor the effectiveness of the teaching-learning process can be rescued. In this sense, Garrison and Vaughan (cited in García, 2018) affirm that it is a transforming modality of higher education based on three main premises: “restructuring of the usual traditional class times; integration of presence times and online learning and redesign of the course to enhance student participation” (p. 15).

The current information society forces us to think and investigate how a learning relationship is carried out, not only articulated by oral and written language, but also by digital image and visual thought (Duarte, 2003). Indeed, the use of computing in learning environments allows carrying out various activities. Finally, Brown (2000) agrees with the benefits provided by the use of the Internet in educational environments, stating that they promote two-way communication.

In short, when introducing a proposal that integrates online and offline, face-to-face and distributed activities, it is a blended learning type, where its effectiveness depends on the previous conditions of the educational center and the characteristics of the actors. education that intervene in the teaching-learning process.

Overall objective

Carry out an initial diagnosis of the conditions of the educational context of a higher education institution to determine the relevance of the implementation of a blended learning model in the Industrial Engineering educational program at the Instituto Tecnológico Superior de Rioverde, San Luis Potosí.

Specific objectives

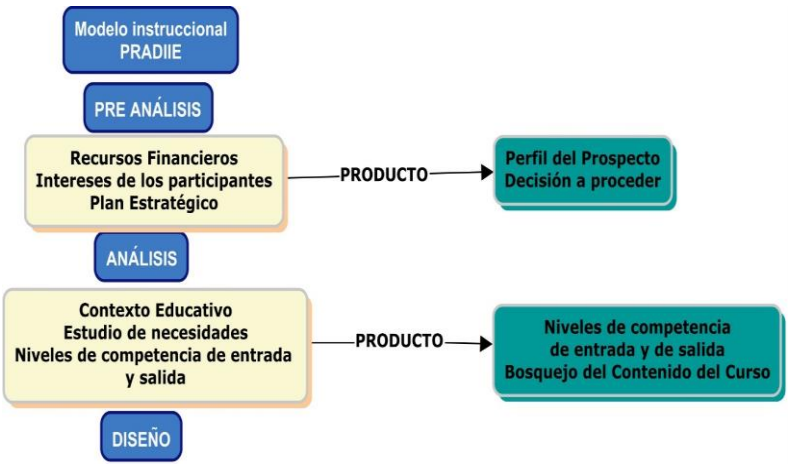
- Determine the profile of the research project prospect and the decision to proceed in accordance with the strategic plan and financial resources of the organization.
- Identify the perception of the educational context of the students.
- Identify students' digital competence.
- Identify the level of knowledge and level of use of technological tools by teachers.

Design

According to the Praddie instructional model, developed by Cookson (2003) to promote online teaching through a six-stage process (pre-analysis, analysis, design, development, implementation and evaluation), for the design of teaching strategies based on the blended learning modality, it is essential to carry out a previous diagnosis, corresponding to the pre-analysis and analysis stages, which can provide elements to determine the relevance of the implementation of a blended learning model in an institution, in this case in the Instituto Tecnológico Superior de Rioverde , and more precisely in the Industrial Engineering educational program. This analysis will serve as input for the next design phase. The objective of this stage is to collect information that is useful for planning and advancing the course.

Figure 1 shows the pre-analysis and analysis stages of the Praddie model, as well as the resulting products of each one.

Figura 1. Etapa de preanálisis y análisis del modelo instruccional Praddie



Fuente: Cookson (2003)

The study is of a mixed methodological nature: it combines methods according to the validity criteria (Reigeluth and Frick, 1999), seeking a complementarity between qualitative and quantitative methodologies.

To determine the pre-analysis, a semi-structured interview was conducted with the career coordinator of the Industrial Engineering educational program, a program in which blended learning strategies will be implemented. Thus, a qualitative technique was chosen, since it allows a greater understanding of people's motives and beliefs (Ugalde Binda and Balbastre-Benavent, 2013). It was developed with the aim of identifying the factors that may influence a poor implementation of a mixed learning methodology.

The dimensions of the interview were worked from what was proposed in a similar study developed by Simón, Benedí, Blanché, Bosch and Torrado (2018), who affirm that these are decisive factors that can affect the implementation of a blended learning model. The idea of carrying out the interview is to determine if the institution is an eligible prospect for the development of blended learning strategies, as well as to have sufficient elements to make the decision to proceed with the project given the current conditions beyond the interference of the researcher. .

Table 1 breaks down the categories and subcategories for this unit of analysis.

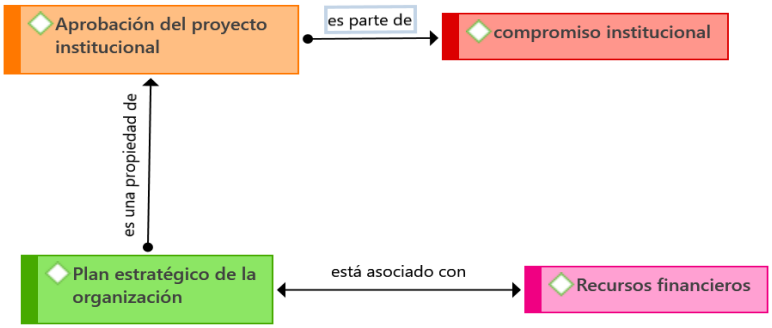
Tabla 1. Categoría Plan Estratégico y Recursos Financieros

Categoría	Definición	Subcategorías	Núm. de preguntas
Plan estratégico y recursos financieros	Cuestiones estratégicas y financieras establecidas dentro de plan de la organización.	*1)* Infraestructura/espacios virtuales y físicos *2)* Competencias digitales docentes/formación del profesorado *3)* Directrices o políticas institucionales *4)* Acceso a recursos tecnológicos *5)* Carga docente *6)* Predisposición del alumno/escasez de recursos del alumno	6

Fuente: Elaboración propia con base en Simón *et al.* (2018)

An analysis of the interview was carried out in the computer program ATLAS.Ti. A transcript of the interview was carried out using a word processor to be analyzed according to the categories that made it up. The codes that guide the interpretation of the discourse come from the questions that guide the evaluation of this stage suggested by Cookson (2003). Figure 2 shows these categories.

Figura 2. Códigos para el análisis del discurso de la entrevista



Fuente: Elaboración propia

On the other hand, the quantitative analysis of the data allows to have a structured approach to study the phenomenon and offers the possibility to investigate in large populations. Thus, statistical generalizations can be reached that provide a vision of social reality, in addition to allowing a counting or computation method to be applied so that a collection of perceived facts can be countable (Bunge, 2000; Ugalde and Balbastre, 2013). . Descriptive statistics provide measures that serve as a reference to identify the state of the variable, they provide us with a photograph of the situation.

In this sense, the survey was used because it allows a more generalized access to the members of a population and it is possible to ask in an indirect way, not very personalized, which provides greater freedom to the people surveyed to answer. It also ensures some objectivity in the data collected. A disadvantage is the complexity, both due to the technical demands of the questions and the difficulties in applying them, since obtaining answers and timely completion is not always successful (Niño, 2007, p. 63).

The first questionnaire was carried out with the objective of determining the current situation of the educational context and the conditions that prevail within the system. Some of the relevant aspects to consider for the implementation of technological resources given the educational context are: access to technology, ease of use, technical support, interactivity, technological needs and requirements of the organization (Bates and Poole, 2003; Escamilla,

1998; Simon et al., 2018). According to this, the questionnaire was developed from three dimensions: access to digital media, quality of educational service and the needs of the institution.

The reliability of the instrument was evaluated through the internal consistency or homogeneity index, a measure that refers to the interrelation that the items have between them (Celina and Campo, 2005), through Cronbach's alpha coefficient (Cronbach, 1951). . The value was determined with the MS Excel program, where data tables can be created. The columns represent the variables and the rows, each of the respondents. The values are those answered by each of the respondents. The result was a Cronbach's alpha of 0.93, since the internal consistency is greater than 0.70, the result is considered acceptable.

Regarding the digital competence of students, authors such as Bates and Poole (2003) agree in suggesting questions to guide this type of analysis: what digital competences or skills are students expected to have before they start the program? For this reason, the application of a questionnaire of 35 questions as statements about digital skills is chosen. The responses are presented using a five-point Likert scale. This instrument is based on the digital skills matrix prepared by the Coordination of Technologies for Education-h@bitat puma (2014). It is organized into seven categories (Avitia and Uriarte, 2017).

In the instructional model proposed by Cookson (2003) for the analysis stage, it is necessary to determine the gap between current skills and expected skills. In accordance with this, the questionnaire applied to teachers aims to identify the level of use and knowledge of technological tools in teaching practice. It is a five-dimensional self-administered questionnaire that follows the digital skills framework of the National Institute of Educational Technologies and Teacher Training [Intef] (2017). It is valued in two dimensions: knowledge and use. He has a Cronbach internal consistency index above 0.8 (Tourón, Martín, Navarro, Pradas and Íñigo, 2018). As a first instance, it collects personal data and then the questions are applied.

The application was carried out through an online procedure using the Google Form tool to a sample of the professors who make up the Economic-Administrative academy of the institution. Regarding the validation of the instrument, which "consists of asking a series of people to demand a judgment towards an object, an instrument, a teaching material, or their opinion regarding a specific aspect" (Cabero and Llorente, 2013, p. 14), what is

proposed by Robles and Rojas (2015) is considered. This process is summarized in Table Two.

Tabla 2. Proceso de validación

Objetivo	Analizar la pertinencia del cuestionario al objeto de estudio y su adecuación al contexto.
Expertos	Dos expertos con trayectoria de cinco a siete años en el campo de la investigación educativa, con grado de doctorado en el área de educación.
Modo de validación	Método individual donde se obtiene la información de cada uno de los expertos.

Fuente: Elaboración propia

The information is obtained through a questionnaire consisting of six questions. The first two regarding the relevance of the items with each category, the following two regarding the formulation of the items, writing and understanding, a question intended for each expert to add or delete categories or items, and a last one to obtain information regarding to scale the questionnaire.

Of each pair of questions, one of them was a four-point Likert scale: 1 = Very low, 2 = Low, 3 = High and 4 = Very high, while the other question was open so that each expert had the opportunity to to express recommendations on each of the aspects. For this case, an adaptation of the original Likert scale from seven to five points was made on the recommendation of the expert peers in the validation process.

The operationalization of the variables for the quantitative part is described in the following table 3.

Tabla 3. Conceptualización y operacionalización de variables

Variable	Definición	Categorías	Ítems	Escala	Indicador/Resultado
Percepción del contexto educativo	La representación social y el significado que el alumno tiene de lo que acontece en su experiencia y realidad escolar (Mateos, 2008).	*Acceso a los Medios digitales*	2	Likert de cinco puntos	1-1.6 Básico 1.6-3.33 Medio 3.33-5 Avanzado
		Calidad en el servicio educativo	6		
Competencia digital del estudiante	Las habilidades y prácticas requeridas para el uso de nueva tecnología de manera significativa y como herramienta de aprendizaje, trabajo y tiempo libre. Comprende el fenómeno esencial de tecnologías digitales tanto en la sociedad como en la propia vida, y la motivación a participar en el mundo digital como actor activo y responsable.	Acceso a la información	8	Likert de cinco puntos	1-1.6 Básico 1.6-3.34 Medio 3.35-5 Avanzado
		Comunicación y Colaboración	8		
		Ambientes virtuales	4		
		Administración de la Información	6		
		Manejo de medios	3		
		Hardware	2		
		Seguridad de la Información	4		
Competencia digital docente	Uso crítico y seguro de las tecnologías de la sociedad de la información para el trabajo, el tiempo libre y la comunicación. Se apoya de las habilidades TIC básicas: uso de ordenadores para recuperar, evaluar, almacenar, producir, presentar e intercambiar información, y	Información	8	Likert de siete puntos	1-2.33 Básico 2.33-4.66. Intermedio 4.66-7 Avanzado
		Comunicación	14		
		Creación de contenidos	6		
		Seguridad	6		

	para comunicar y participar en redes de colaboración a través de Internet.	Resolución de problemas	12		

Fuente: Elaboración propia

Population and sample

For the application of the field study, the students of the Industrial Engineering educational program are taken as the population, since the present proposal will be oriented to attend students of that segment. According to the 2018 Statistical Yearbook of the National Technological Institute of Mexico (Balderas and Sáenz, 2018), 532 students are enrolled in said educational program at the Instituto Tecnológico Superior de Rioverde. The proposal is designed for the subject of Marketing, which is taught in the sixth semester. To identify the teaching digital competence, we worked with the professors of the Economic-Administrative area of the institution.

The first questionnaire was applied with the objective of determining the students' perception regarding the current situation of the educational context and the conditions that prevail within the system. It was applied to two groups of morning shift students enrolled in the subject in the January-June 2021 semester; a total of 77 through non-probabilistic sampling by trial.

The second questionnaire was applied with the objective of identifying the level of digital competence of the students. The sample was selected through a non-probabilistic sampling for convenience to a group of students of the morning shift of the Marketing subject of the semester January-June 2021. In total, 43 students answered the questionnaire.

To identify the level of digital teaching competence, an electronic form was sent to eight teachers who are part of the Economic-Administrative Academy. The selection of the sample was carried out through a non-probabilistic sampling by judgment. In this case, the eligibility criterion was based on the application of the questionnaire to professors with full-time appointments.

Procedure

The questionnaires were applied through the Google Forms tool. It was an online questionnaire whose access link was published on the Classroom platform, where students currently take several of their subjects. Within the form, a legend was included that requested the consent of the students to participate in the study voluntarily and that guaranteed confidentiality, as well as the ethical and academic use of the results obtained. As for teachers, the questionnaire was sent to their email.

Analysis of data

The data was subjected to descriptive statistics to account for the perception of the sample according to the questionnaire. For this analysis, the MS Excel program was used.

Results

Interview

An analysis of the information obtained was carried out. This analysis is adequate given the diagnostic nature of the study, which does not consist in the creation of theory, but in obtaining the necessary input for decision-making regarding the project and the creation of a blended learning course as close to the conditions of the educational context and resources of the institution.

The analysis is presented below, as well as the results of the interview.

Approval of the institutional project

The interviewee expresses a favorable opinion regarding the approval of the project by both the authorities and the students. A mixed modality of learning has already been implemented in the Saturday mixed modality Business Management educational program. Regarding the school modality, there seems to be flexibility, especially if the following is taken into consideration: "In theory, if it is implemented in a school student, there would be no major problem on the part of the guidelines, if it were to be implemented by the Management in relation to the director current" (Educational Program Coordinator, 2021).

When asked about the willingness of students to study under this modality, he also showed a positive attitude: "I think they would accept it well where they establish their times and dates" (Coordinador de Programa Educativo, 2021).

Institutional commitment

Regarding institutional commitment, a relationship is found with teacher training in digital skills for teaching when mentioning that teachers are responding positively to these trainings and that the commitment of the institution is given regarding teacher training and flexibility. in some cases in the teaching modalities. The career coordinator mentions an example of a particular case, where students of the school modality had to change to a mixed modality due to teacher needs:

> I can present a good example that is blended with 90% remote, with a remote teacher, prior to this pandemic they already had two semesters working like this, remote, that is, 10% face-to-face and 90% online. Yes, there is that flexibility on the part of Management (Coordinador de Programa Educativo, 2021).

Strategic plan of the institution

It is expressed that there are institutionally flexible policies, in the didactic context, although it is mentioned that a limitation to implement educational innovations in terms of modalities is the number of students per group:

> By regulation, because that is what the guideline indicates, that there should be around 30 to 35 students and well, there in the Technological, mainly in Industrial, sometimes we exceed a bit, because they are the needs to cover to maintain an enrollment (Coordinador de Programa Educativo, 2021).

In this sense, large groups represent a high burden for the teacher who works with virtual environments.

Financial resources

Financial resources are closely related to support for teaching. In the words of the career coordinator: “Because we are a decentralized technology company, we receive support from the federal government, 50%, and another 50% from the state government.” In this

regard, he mentions an example of the relationship between support for teaching and the budget:

> For example, the 28 hours in front of the group and the 12 hours of the load of a full-time teacher, within which a space should be included to develop their work material; Unfortunately right now that is being restricted.

This comment represents the limitations of financial resources that affect support for teaching.

Other aspects that stood out in the interview as points for improvement or to be considered were: the current storage capacity of the Moodle platform, the average capacity of the institutional internet network and limitations that some students may have to connect to online classes only from their smartphones.

Perception of the educational context

Next, the results of the application of the first questionnaire to measure the perception of the educational context are presented. The results are shown in table 4; They are presented by category.

Tabla 4. Acceso a medios digitales

Ítem	Mínimo	Máximo	Media	Resultado
Facilidad de acceso a internet	1	5	3.208	Medio
Facilidad de acceso a una computadora o dispositivo móvil	1	5	3.76	Medio

Fuente: Elaboración Propia

The table above shows the results for the category of access to digital media. The students state that they have medium access to the internet. In both items, the results are above average, which suggests an acceptable availability of both Internet access and a computer or mobile device.

Tabla 5. Calidad en el servicio educativo

Ítem	Mínimo	Máximo	Media	Resultado
Calidad en el servicio educativo	1	5	3.68	Medio
Disponibilidad de los maestros	1	5	3.74	Medio
Uso adecuado de los materiales didácticos para el aprendizaje en línea	2	5	3.64	Medio
Satisfacción con el personal docente	2	5	3.87	Medio
Interacción maestro-alumno en la plataforma	1	5	3.74	Medio
Percepción de aumento en el nivel de aprendizaje	1	5	3.24	Medio

Fuente: Elaboración propia

Table 5 shows that the perception of the students regarding the quality of the educational service is regular. It can be seen that the items "Satisfaction with the teaching staff" (3.87), "Availability of the teachers" (3.74) and "Teacher-student interaction on the platform" (3.74) are the most valued. The result of the rest of the items does not differ much from each other.

Tabla 6. Necesidades de la institución

Ítem	Mínimo	Máximo	Media	Nivel
Espacios adecuados para las clases presenciales y en línea	1	5	3.33	Medio
Recursos y servicios de tecnología de la información ofrecidos por la institución	1	5	3.298	Medio

Fuente: Elaboración propia

Table 6 shows that the students perceive the category of needs of the institution as medium or regular, and give a higher score to “Adequate spaces for face-to-face and online classes”.

Tabla 7. Resultados por dimensión de la competencia digital de los estudiantes

Categoría	Media	Nivel
Acceso a la información	2.72	Medio
Comunicación y colaboración	2.86	Medio
Ambientes virtuales	3.27	Medio
Administración de la información	3.19	Medio
Seguridad de la información	3.37	Alto
Manejo de medios	2.40	Medio
Hardware	2.91	Medio

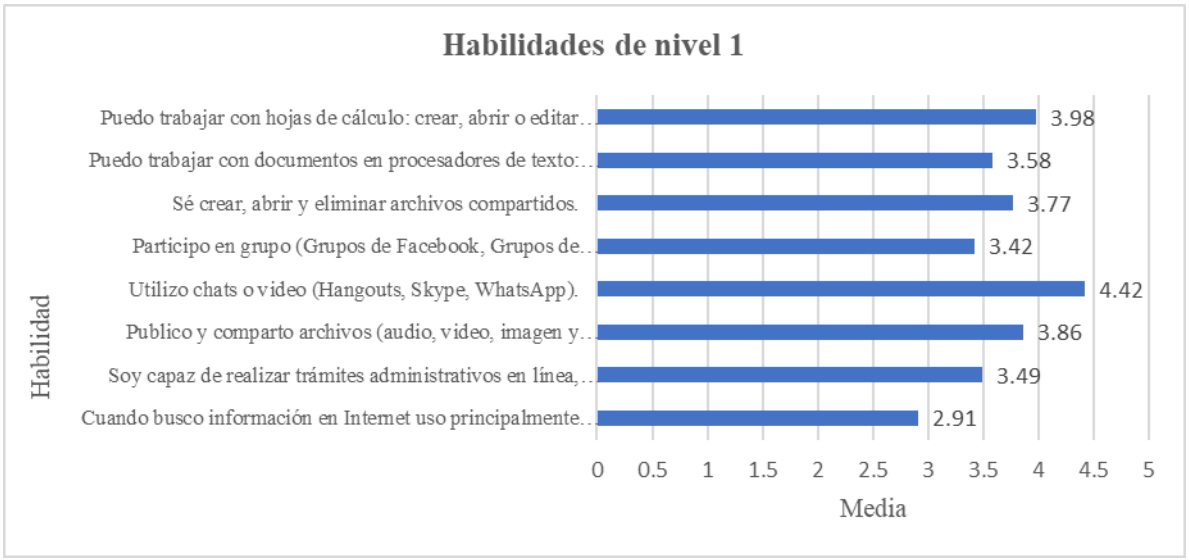
Fuente: Elaboración propia

Table 7 shows the results of the evaluation of the digital competence of the students according to their perception. There it is observed that in all the categories an average score was obtained, except for the category "Information Security", which registers a high level, a score of 3.37, slightly higher than the rest. Even though the rest of the categories have a medium level, the categories that registered the lowest score are “Media management” (2.40) and “Access to information” (2.72).

For the interpretation of the results, the matrix of digital skills proposed by the Coordination of Technologies for Education-h@bitat puma (2014) is taken as a basis, which establishes three levels of digital skills, and each of the categories or items contains items representing one of these three levels. The items found in the level one category are those that are considered general knowledge in the use of ICT; level two items represent the knowledge that students acquire and develop in their training journey, and level three items are specialized or technical knowledge related to the use of ICT. This provides a reference to interpret whether students have level one, two or three digital skills, which leads to determining the aspects to prioritize if a digital literacy program is necessary.

Figure 3 shows the skills corresponding to level one. The mean for these skills is 3.67. Among the level one skills that stand out are the use of chats and videos, the ability to work with spreadsheets, as well as publishing and sharing files.

Figura 3. Habilidades de nivel uno



Fuente: Elaboración propia

Figure 4 shows level two skills, which represent the knowledge that students acquire during their training journey. The average of the mean is 2.76. The highest scoring level two skills are knowledge of how to submit assignments and review teacher feedback on the platform and the ability to edit, share and download documents in the cloud.

Figura 4. Habilidades de nivel dos

Fuente: Elaboración propia

Regarding level three skills, those that refer to specialized or technical knowledge, figure 5 shows the results of each of the skills corresponding to this item. The average of the means is 2.54. And the skills that stand out the most from level three are the creation of dynamic tables of contents and indexes and the ability to create and edit macros in a sheet.

Figura 5. Habilidades de nivel tres

Fuente: Elaboración propia

Digital competence of teachers

The questionnaire was answered by eight full-time professors from the Economic-Administrative academy of the institution. One of them was between 20 and 31 years old, four between 31 and 40 years old and three between 41 and 50 years old. The average teaching experience of the participants is four years, with the exception of one, who stated that he had 25 years of teaching experience. For the interpretation of the results of each of the categories related to digital teaching competence, the hierarchy provided by Intef (2017, p. 4) was considered, which establishes the following:

- The basic level: this person has a basic level of competence that can develop their digital competence with some level of support.
- The intermediate level: this person has an intermediate level of competence and through the resolution of simple and defined problems can develop their digital competence.

- The advanced level: this person has the ability to guide others to develop their digital competence in other contexts.

Tabla 8. Resultados por dimensión de la competencia digital de los docentes

Dimensión/Estadísticos descriptivos	Nivel de conocimiento	Nivel de uso	Resultado
Información	3.05	2.73	Medio/Medio
Selección y creación de contenido	2.67	2.37	Medio/Medio
Comunicación	2.63	2.34	Medio/Medio
Seguridad	2.67	2.31	Medio/Bajo
Resolución de problemas	2.99	2.69	Medio/Medio
Media	2.80	2.49	Medio/Medio
Desviación estándar	0.20	0.21	
Varianza	0.03	0.03	

Fuente: Elaboración propia

In table 8 it can be seen that, in most categories, teachers have a level of use and knowledge of technological tools in their practice of medium level. The Security category is the only one with a low level in terms of its use. The mean of the use of the tools, that is, 2.48, is lower than the mean of the level of knowledge, 2.80, which indicates that the teachers have a greater knowledge of the tools than the use they give to them. In general, it is observed that the level of use and knowledge in the five categories is of a medium level, which indicates that through instruction and the resolution of defined problems they have the potential to develop their digital competence.

Discussion

The results obtained indicate an adequate relevance of a hybrid learning model in the institution. In the pre-analysis phase, favorable responses are identified by an educational manager regarding the categories analyzed, mainly in terms of the willingness and flexibility of decision makers, policies and institutional guidelines. On the other hand, the perception of technological infrastructure and financial resources poses certain limitations to Internet

access, as well as adjustments in the teaching load due to financial restrictions. Although it is true that previous attempts at a hybrid modality are mentioned in the interview, these do not seem to have a solid structure or to have been approved under an initial diagnosis. On this particular issue, two aspects that facilitate the implementation of this modality are highlighted: the willingness of teachers to improve their digital skills and the flexibility of institutional policies for its adoption.

Another key component in determining the viability of the proposal is the students' perception of the educational context. In this sense, it is important to point out that the results obtained show a good level of acceptance towards the categories of this construct. It should be noted that the two items with the lowest score turned out to be: Internet access and the perception of increased learning. This is especially relevant given that the questionnaire was applied in a school year where the learning modality was completely online due to the health contingency due to covid-19. Despite not being low scores, they are elements to consider when designing teaching strategies based on a blended learning modality. It is also necessary to make methodological adjustments to move from a virtual modality to a hybrid one that weighs the limitation of Internet access by combining face-to-face classes with distributed resources that resolve the implication of synchronous online classes and at the same time take advantage of the distribution of materials for development. of strategies with a flipped classroom that maximizes the perception of student learning.

The uniformity in the results of the digital competence of the students is remarkable, which may be due to the transition from face-to-face to virtual classes, a circumstance that leads them to improve these skills. Even so, the reinforcement of the skills that have to do with access to information and media management should be considered for the best use of the subjects in a combined modality. Improving these skills also improves the attitude and care for the implementation of innovations, as mentioned by Martín et al. (2014).

Teaching digital competence is a key component for the development of institutional curricular programs. Knowledge of technological tools is inoperative if they are not presented to the same extent in teaching practice. This is consistent with the results, since a higher level of knowledge than use of technological tools has been found in all categories. Likewise, it is noted that the Information dimension, which consists of the location, identification and storage of information for the identification of its use in teaching practice, is the one with the highest score obtained, followed by the Problem Solving dimension.

This suggests a high adaptation to the needs of the student body to provide information that helps to understand the topics that are addressed in the subjects. On the other hand, it is essential to help improve the digital skills of teachers regarding security and communication: the first essential to create safe online work environments and the second to promote collaborative, research-based and multidisciplinary learning (Gallou and Abrahms, 2018), which favors the creation of learning communities in accordance with a socio-constructivist approach to learning (Vygotsky, 1978).

Conclusions

The situation of uncertainty that all educational levels in Mexico are going through demands the understanding of a new educational dynamic. The safe return to classes depends on the conditions provided by each educational center to ensure such safety, without losing sight of the fulfillment of its main objective: educational excellence, as established by the General Law of Higher Education in Mexico. Thus, identifying the elements that intervene in a hybrid learning proposal given the health contingency that the world is going through is crucial for its effective implementation.

The diagnosis made allowed to fulfill the general objective of identifying the relevance of a hybrid learning model in the Industrial Engineering educational program at the Instituto Tecnológico Superior de Rioverde, San Luis Potosí. The results suggest a relevance to start the design of strategies for this modality, however, it is necessary to take actions such as the search for alternatives of free and functional access platforms to support the contents, the support to teachers for the preparation of contents in online, introductory digital literacy courses for both teachers and students that allow them to solve some aspects of information and communication technologies (ICT) for the use of a hybrid environment. In general, both the perception of students and educational managers about the context is good, which fosters favorable environments for the appropriation of a mixed modality.

The digital skills that most predominate in students are level one skills. Likewise, the skills that dominate the most in these categories are the management of chats and spreadsheets. This finding is important to define the content of a course that can enable students in digital skills at higher levels.

Regarding the results of digital teaching competence, a medium level is found in all categories, which means that they may be able to develop their digital teaching competence

through a training program that allows them not only to raise their level in these skills, but also help others achieve it.

From the technological point of view, the implementation of a proposal for a hybrid modality is pertinent and capable of sustaining a constructivist approach to learning, but it must be implemented in harmony with a pedagogical approach in accordance with the requirements of this modality. This is consistent with the results of Méndez and Morales (2020), who conclude that this relevance will only be effective when treated as an approach that equally requires the appropriation of educational managers. The hybrid modality cannot only be seen as a transitory educational trend, it must be understood as the new prevailing educational modality of higher education.

Future lines of research

This diagnosis was made with the aim of determining the relevance of a blended learning model for a higher education institution. The study variables were mainly related to the perception of educational managers and the digital skills of those involved in the teaching-learning process. Inquiring about aspects such as the motivation and perception of the student to join a hybrid model are complementary lines of research to the present, which help to specify blended learning teaching strategies specific to the needs of these educational actors. Another relevant line of research is about learning methodologies corresponding to blended education. In this sense, it is about seeing this methodology also from a pedagogical approach that supports it but with more practical overtones. Although this initial diagnosis is the turning point to proceed with the decision and prepare those involved in the teaching-learning process in terms of ICT tools, these considerations must be complemented with the learning needs of the subjects to whom the proposal is addressed.

References

Asociación Nacional de Universidades e Instituciones de Educación Superior en México [Anuies]. (2001). *Plan maestro de educación superior abierta y a distancia. Líneas estratégicas para su desarrollo*. Ciudad de México, México: Asociación Nacional de Universidades e Instituciones de Educación Superior en México.

Ausubel, D., Novak, J. y Hanesian, H. (1983). *Psicología educativa*. *Un punto de vista cognoscitivo*. México: Trillas.

Avitia, P. y Uriarte, I. (2017). Evaluación de la habilidad digital de los estudiantes universitarios: estado de ingreso y potencial educativo. *Edutec. Revista Electrónica de Tecnología Educativa*, (61). Recuperado de http://dx.doi.org/10.21556/edutec.2018.61.

Balderas, I. y Sáenz, N. (coords.) (2018). *Anuario Estadístico 2018*. México: Tecnológico Nacional de México. Recuperado de https://www.tecnm.mx/pdf/ANUARIO_ESTADISTICO_2018.pdf.

Bates, A. and Poole, G. (2003). *Effective Teaching with Technology in Higher Education*. San Francisco, United States: Jossey-Bass/John Wiley and Son.

Brown, J. S. (2000). Growing Up: Digital: How the Web Changes Work, Education, and the Ways People Learn. *Change: The Magazine of Higher Learning*, *32*(2), 10-20. Retrieved from https://www.tandfonline.com/doi/abs/10.1080/00091380009601719.

Bunge, M. (2000). *La investigación científica*. México: Siglo XXI Editores.

Cabero, J. y Barroso, J. (2015). La educación a distancia: cada vez menos a distancia. En Rodríguez, M. y Cabero, J. (coords.), *Mitos, prejuicios y realidad de la educación a distancia*. Caracas, Venezuela: Universidad Metropolitana. Recuperado de https://www.researchgate.net/publication/286928688_La_educacion_a_distancia_cada_vez_menos_a_distancia.

Cabero, J. y Llorente, M. C. (2013). La aplicación del juicio de experto como técnica de evaluación de las tecnologías de la información (TIC). *Eduweb. Revista de Tecnología de Información y Comunicación en Educación*, 7(2), 11-22. Recuperado de http://tecnologiaedu.us.es/tecnoedu/images/stories/jca107.pdf.

Celina, H. y Campo, A. (2005). Aproximación al uso del coeficiente alfa de Cronbach. *Revista Colombiana de Psiquiatría*, *34*(4), 572-580. Recuperado de https://www.redalyc.org/articulo.oa?id=80634409.

Cookson, P. (2003). Elementos de diseño instruccional para aprendizaje significativo en la educación a distancia. Taller presentado en la IV Reunión Nacional de Educación Superior, Abierta y a Distancia. Sonora.

Cronbach, L. J. (1951). Coefficient Alpha and the Internal Structure of Test. *Psychometrika*, *16*(3), 297-334. Retrieved from https://www.researchgate.net/publication/225269894_Coefficient_Alpha_and_Internal_Structure_of_Tests.

Coordinación de Tecnologías para la Educación-h@bitat puma. (2014). Matriz de habilidades digitales. Ciudad de México, México: Dirección General de Cómputo y de Tecnologías de Información y Comunicación de la UNAM. Recuperado de https://educatic.unam.mx/publicaciones/matriz-habilidades-digitales-2014.pdf.

Daniels, H. (2012). *Vygotsky y la pedagogía*. Barcelona, España: Paidós.

Duarte, J. (2003). Ambientes de aprendizaje: una aproximación conceptual. *Estudios Pedagógicos*, (29), 97-113. Recuperado de https://www.redalyc.org/articulo.oa?id=173514130007.

Educause. (2020). *2020 Educause Horizon Report*. *Teaching and Learning Edition.* Louisville, United States: Educause. Retrieved from https://library.educause.edu/resources/2020/3/2020-educause-horizon-report-teaching-and-learning-edition.

Escamilla, J. (1998). *Selección y uso de la tecnología educativa*. Ciudad de México: Trillas.

Escamilla, P. y Muriel, V. (2021). Acercamiento a la discusión académica sobre blended learning. *Revista Tecnológica-Educativa Docentes 2.0, 12*(1), 130-142. Recuperado de doi.org/10.37843/rted.v1i1.263.

Gallou, E. and Abrahams, P. (2018). Creating space for active learning. (Opportunities from) using technology in research-based education. In Tong, V., Standen, A. and Sotiriou, M. (eds.), *Shaping Higher Education with Students: Ways to Connect Research and Teaching* (pp. 165-175). London, England: UCL Press. Retrieved from www.jstor.org/stable/j.ctt21c4tcm.27.

García, L. (2018). Blended learning y la convergencia entre la educación presencial y a distancia. *RIED. Revista Iberoamericana de Educación a Distancia*, *21*(1), 9-22. Recuperado de http://revistas.uned.es/index.php/ried/article/view/19683.

Gisbert, M. (2002): El nuevo rol del profesor en entornos tecnológicos. *Acción Pedagógica*, *11*(1), 48-59.

Goodyear, P., Salmon, G., Spector, J. M., Steeples, C. and Tickner, S. (2001). Competences for online teaching: A special report. *Educational Technology Research and Development*, *49*, 65-72. Retrieved from https://link.springer.com/article/10.1007/BF02504508.

Instituto Nacional de Tecnologías Educativas y de Formación de Profesorado [Intef]. (2013). *Marco común de competencia digital docente*. España: Ministerio de Educación, Cultura y Deporte. Recuperado de https://aprende.intef.es/sites/default/files/2018-05/2017_1020_Marco-Com%C3%BAn-de-Competencia-Digital-Docente.pdf.

Martín, A., Hernández, M. y Sánchez, M. (2014). Fases y clasificación de adoptantes de *blended learning* en contextos universitarios. Aplicación del análisis CHAID. *Revista Española de Pedagogía*, *72*(259), 457-476. Recuperado de www.jstor.org/stable/24726632.

Mason, R. (1991). Moderating educational computer conference. *Deosnews, 1*(19).

Mateos, T. (2008). La percepción del contexto escolar. Una imagen construida a partir de las experiencias de los alumnos. *Cuestiones Pedagógicas*, *19*, 285-300. Recuperado de http://hdl.handle.net/11441/14069.

Méndez, F. y Morales, M. C. (2020). Diseño de un ambiente de aprendizaje blended learning como propuesta de innovación educativa en la Universidad de la Sierra Juárez. *RIDE Revista Iberoamericana para la Investigación y el Desarrollo Educativo, 11*(21). Recuperado de https://doi.org/10.23913/ride.v11i21.731.

Morales, J. C., Zembrano, M. J. y Medranda, M. M. (2016). Diagnóstico de la metodología blended learning: Caso Universidad Técnica de Manabí, periodo 2015. *Journal of Library and Information Sciences*, *4*(2). Recuperado de https://doi.org/10.15640/jlis.v4n2a1.

Niño, V. M. (2011). *Metodología de la investigación*. Bogotá, Colombia: Ediciones de la U.

Nuñez, E., Monclúz, I. M. y Ravina, R. (2019). El impacto de la utilización de la modalidad B-Learning en la educación superior. *Alteridad. Revista de Educación*, *14*(1), 26-39. Recuperado de https://dx.doi.org/10.17163/alt.v14n1.2019.02.

Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura [Unesco]. (2016). *Educación 2030: Declaración de Incheon y Marco de Acción para la*

realización del Objetivo de Desarrollo Sostenible 4. Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura. Recuperado de https://unesdoc.unesco.org/ark:/48223/pf0000245656_spa.

Organización para la Cooperación y el Desarrollo Económicos [OCDE]. (8 de septiembre de 2020). La educación es clave para construir una sociedad más resiliente, dice la OCDE. Recuperado de https://www.oecd.org/centrodemexico/medios/panoramadelaeducacion2020.htm.

Reigeluth, C. y Frick, T. (1999). Formative Research: A Methodology for Creating and Improving Design Theories. In Reigeluth, C. (ed.). *Instructional Design theories and Models. A New Paradigm of Instructional Theory* (vol. II) (pp. 633-652). Mahwah, United States: Lawrence Erlbaum.

Robles, P. y Rojas, M. D. C. (2015). La validación por juicio de expertos: dos investigaciones cualitativas en lingüística aplicada. *Revista Nebrija de Lingüística Aplicada a la Enseñanza de las Lenguas, 18*. Recuperado de https://www.nebrija.com/revista-linguistica/files/articulosPDF/articulo_55002aca89c37.pdf.

Roblyer, M. D. and Ekhalm, L. (2000). How Interactive Are YOUR Distance Courses? A Rubric for Assessing Interaction in Distance Learning. Retrieved from https://www.merlot.org/merlot/viewMaterial.htm?id=87631.

Salinas, J. (1998). El rol del profesorado universitario ante los cambios de la era digital. *Agenda Académica, 5*(1), 143-158

Simon, J., Benedí, C., Blanché, C., Bosch, M. y Torrado, M. (2018). Análisis cuantitativo y cualitativo de la semipresencialidad del sistema universitario de Cataluña. *RIED. Revista Iberoamericana de Educación a Distancia*, *21*(1), 113-133. Recuperado de https://doi.org/10.5944/ried.21.1.18773.

Tourón, J., Martín, D., Navarro, E., Pradas, S. e Íñigo, V. (2018). Validación de constructo de un instrumento para medir la competencia digital docente de los profesores (CDD). *Revista Española de Pedagogía*, (269), 25-54.

Ugalde, N. y Balbastre, F. (2013). Investigación cuantitativa e investigación cualitativa: buscando las ventajas de las diferentes metodologías de investigación. *Revista de Ciencias Económicas*, 31(2), 179-187. Recuperado de https://revistas.ucr.ac.cr/index.php/economicas/article/view/12730.

Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes.* Cambridge, United States: Harvard University Press.