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A diagnostic about using educational technology and learning environments in the bachelor's degree program in Computational Sciences at Universidad Autónoma del Estado de Hidalgo

Diagnóstico del uso de tecnología instruccional y ambientes de aprendizaje en la Licenciatura en Ciencias Computacionales de la Universidad Autónoma del Estado de Hidalgo

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Abstract

Instructional Technologies and Educational Environments are tools that together improve academic performance and facilitate student learning, favorably impacting the ability to instruct without the presence of a teacher. However, these potentialities are not always taken advantage of maximum to achieve an effective learning process. In this article, a diagnostic evaluation of a Bachelor's educational program is presented, based on an evaluation instrument that was developed to evaluate the quality of an online educational program. The phenomenological method guided this research because it explored how teachers perceive the educational program in the aspects of instructional technology and learning environments. The purpose is to identify the strengths and weaknesses that the educational program shows because it is a program designed for face-to-face modality. Most of the findings found are weaknesses and it is attributed to the fact that the program was designed for face-to-face modality, which implies that work should be deal with the indicators that have been weak to improve their quality. The use of the results will be of great importance to make decisions and improve the quality of the program to be taught in virtual mode.

Learning environments, Diagnostic evaluation, Instructional technology

Resumen

Las Tecnologías de Instrucción y los Ambientes Educativos son herramientas que en conjunto mejoran el desempeño académico y facilitan el aprendizaje de los estudiantes, impactando favorablemente la capacidad de instruir sin la presencia de un maestro. Sin embargo, estas potencialidades no siempre se aprovechan al máximo para lograr un proceso de aprendizaje eficaz. En este artículo se presenta una evaluación diagnóstica de un programa educativo de Licenciatura, a partir de un instrumento de evaluación que fue desarrollado para evaluar la calidad de un programa educativo en línea. El método fenomenológico guió esta investigación porque exploró cómo los maestros perciben el programa educativo en los aspectos de tecnología instruccional y entornos de aprendizaje. El propósito es identificar las fortalezas y debilidades que muestra el programa educativo por ser un programa diseñado para la modalidad presencial. La mayoría de los hallazgos encontrados son debilidades y se atribuye a que el programa fue diseñado para modalidad presencial, lo que implica que se debe trabajar con los indicadores que han sido débiles para mejorar su calidad. El aprovechamiento de los resultados será de gran importancia para la toma de decisiones y mejorar la calidad del programa que se impartirá en modalidad virtual.

Ambientes de aprendizaje, Evaluación diagnóstica, Tecnología instruccional

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Introduction

The COVID-19 pandemic has had a considerable impact on the work of the human being, in the social, economic, political and academic aspects. In the latter, due to the radical change in the way in which students enrolled in face-to-face programs have had to receive their distance classes in this contingency period, regardless of academic level or school type (public or private). Such a situation, therefore, has forced the use of Information and Communication Technologies (ICT), considering or not, their intention in the instruction, which may result in learning with a lower quality than expected, since it is only to make use of technology, but the instructional design of the course and the skills and competencies that the teacher has in the use of Instructional Technology (IT) and Learning Environments (EA) is also important, to properly impart the teaching and so that students can acquire knowledge according to the learning objectives established in educational programs (COMIE, 2020).

Instructional technology is defined by the Association for Communications and Educational Technology (AECT, for its acronym in English) cited by Camacho and Benitez (2011, p. 5), as “the theory and practice of design, development, use, administration and evaluation of processes and resources for learning” while Camacho and Benitez (2011) define it as the use of appropriate technological resources for instructional purposes to facilitate learning and improve the academic performance of students. The Educational Environments or Learning Environments, Duarte (2003) defines them as the scenario where favorable learning conditions exist and develop. In these scenarios, there are participants such as students and teachers who develop capacities, competencies, skills and values. EA are designed to align the necessary elements and produce the expected results, technology being one of those elements that allow achieving the desired results. Using technology, educational materials can be created, the instructional design of the subject can be developed, an instructional system is created, that is, any product that improves academic performance and facilitates student learning (Groff, 2013).

Distance education supposes a transformation and innovation of the methodological strategies to teach classes (Verdezoto Rodríguez & Chávez Vaca, 2018) and leads to significant changes in the work of both the teacher and the student, seeking from the latter a greater participation in the educational process with the purpose of obtaining a meaningful and collaborative learning (Rojo Domínguez & Arregui Mena, 2017). However, not all teachers are prepared for such renewal and, consequently, these purposes are often not achieved.

This virtual modality has been on the rise in educational institutions. However, the quality assessment instruments for this modality type focused on the course design and not on the actions of the teacher who taught the course. However, both the course design and the skills and competencies of the teacher to handle technology as a tool to transmit knowledge are important, since a committed teacher can be successful in teaching a course despite poor instructional design and vice versa, a failure may occur in the course, despite a good instructional design, which means that the quality of the teacher is decisive for the quality of the course (Piña & Bohn, 2014).

The definition of quality in education is ambiguous and inconsistent for some authors, given that education is intangible, Bates (2015) cited by Lenert and Janes (2017) defines quality as: "... teaching methods that successfully help learners develop the knowledge and skills they will require in a digital age" (p. 2). Rubrics and various quality instruments have been used for years as quality measures of the educational program, the online course, the teacher's work, and the student's learning, among other aspects. The authors Newhouse, Buckley, Grant, and Idzik (2013); Parscal and Riemer (2010); Piña and Bohn (2014), and Roehrs, Wang and Kendrick (2013) cited by Lenert and Janes (2017) used the Quality Matters rubric which was designed between 2006 and 2007 to measure quality in the design of online courses, A few years later Shelton (2010) with the support of the Online Learning Consortium built an instrument for higher-level educational institutions to measure the quality of their online programs.

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In this context, there is a need to measure the quality of an educational program of any level, which is why evaluation or self-evaluation is used to diagnose the state in which it is. In this evaluation, different indicators are integrated that impact in some way on the use of IT and LE, such as infrastructure, instructional design and support of different kinds. As a result of the diagnosis, the strengths and weaknesses of the program will be detected, the latter aspects being the ones that must be addressed to improve the quality of the program. For these, strategies must be established, as well as planning and executing the corresponding actions to guarantee the continuous improvement necessary in the educational program.

The diagnostic evaluation of an educational program must be carried out by choosing an appropriate instrument, that is, one that has been designed with the objective of measuring aspects related to the combined use of IT and LE, in order that the results are adequate and according to the objective, and in the case of online or distance courses, the evaluation instrument must establish and implement more rigorous metrics to measure their quality (Wendler, et al., 2012).

In this article, a diagnostic evaluation of a higher-level educational program designed for face-to-face modality is carried out, which due to the COVID-19 contingency has had to change to virtual or online modality and it is required to know if the program meets the necessary elements in terms of instructional technology and educational environments to be taught in this last modality, for this reason a diagnostic evaluation instrument has been chosen for a higher-level educational program in virtual or online modality, whose indicators are related to IT and LE, and which is also a scorecard with very rigorous metrics to measure the quality of online courses in higher education, called "Quality scorecard for the administration of online education programs: a Delphi study" (Shelton, 2010).

The objective of this study is to identify the strengths and weaknesses in instructional technology and learning environments in the Bachelor´s degree program in Computational Sciences at Universidad Autónoma del Estado de Hidalgo (UAEH) through a diagnostic evaluation instrument in IT and LE. The problem detected is that it is unknown whether the BSC has elements at a satisfactory level in IT and LE aspects to be taught in virtual or remote mode, preserving or without impairing its quality.

Material and methods

The research design is cross-sectional, that is, a non-experimental method to collect and analyze data at a given time or period. The foregoing, due to the fact that a single application will be made to a teaching group and several variables will be investigated, being oriented to the design and implementation of an instrument to assess its results (Hernández, Fernández, & Baptista, 2014).

Studies with this type of design offer more descriptive results than experimental ones, which is ultimately what is sought since their objective is aimed at identifying the strengths and weaknesses of the use of instructional technology and learning environments in the educational program in particular.

On the other hand, it has a quantitative approach because the results are obtained from a diagnostic evaluation. As mentioned above, the evaluation instrument used was based on the work "Quality scorecard for the administration of online education programs: a Delphi study" (Shelton, 2010), because it is an instrument that was developed to evaluate the quality of an online or distance educational program, whose indicators are related to instructional technology and learning environments. Table 1 shows the 50 selected indicators, the indicator number, description and category to which it belongs are observed, according to the author's instrument.

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Indicator No.	Description	Category
10	Faculty, staff, and students are supported in the development and use of new technologies and skills.	Technological support
11	The minimum standards guidelines are used for course development, design, and delivery of online instruction.	Course development and instructional design
12	Technology is used as a tool to achieve learning outcomes in the delivery of course content.	Course development and instructional design
13	Instructional materials, course syllabus, and learning outcomes are periodically reviewed to ensure they meet program standards.	Course development and instructional design
14	The courses are designed for students to develop the knowledge and skills necessary to meet the learning objectives at the course and program level. These can include participation through analysis, synthesis and evaluation.	Course development and instructional design
15	Learning objectives describe outcomes that are measurable	Course development and instructional design
16	Selected assessments measure the learning objectives of the course and are appropriate for an online learning environment.	Course development and instructional design
17	Student-centered instruction is considered during the course development process.	Course development and instructional design
18	There is consistency in the development of the course for retention and quality of the student.	Course development and instructional design
19	The design of the course encourages the participation of teachers and students.	Course development and instructional design
20	Current and emerging technologies are evaluated and recommended for online teaching and learning.	Course development and instructional design
21	An instructional design is provided for creating an effective pedagogy for synchronous and asynchronous class sessions.	Course development and instructional design
23	The online course site includes a schedule that describes course objectives, learning outcomes, assessment methods, textbook information, and other related course information, making the course requirements transparent to the user. time of registration.	Course structure
24	The institution ensures that all distance education students, regardless of where they are located, have access to appropriate library / learning resources to support the courses they are taking (SACS statement).	Course structure
25	Expectations for student assignment completion, grading policy, and faculty response are clearly provided in the course syllabus.	Course structure
26	Links or explanations of technical support are available in the course.	Course structure
27	The instructional materials are easily accessible and usable for the student.	Course structure
28	The course adequately addresses the special needs of students with disabilities through alternative instructional strategies and / or referrals to special institutional resources.	Course structure
29	They provide opportunities / tools to encourage student-student collaboration (i.e. web conferencing, instant messaging, etc.).	Course structure
30	The documents attached to the modules are in a format that can be easily accessed with multiple operating systems and productivity software (PDF, for example).	Course structure
31	Student-to-student interaction and teacher-to-student interaction are essential features and are facilitated in a number of ways.	Teaching and learning
32	Feedback on student assignments and questions is constructive and provided in a timely manner.	Teaching and learning
33	Students learn appropriate methods for effective investigation, including assessment of the validity of resources and the ability to master resources in an online environment.	Teaching and learning
34	Students have access to library professionals and resources to help them cope with the overwhelming amount of resources online.	Teaching and learning
35	Instructors use specific strategies to create a presence in the course.	Teaching and learning
36	Students must be provided a way to interact with other students in an online community.	Social and student commitment
37	Technical assistance is provided in course development and assistance with the transition to online teaching [for faculty].	Teacher support

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38	Instructors are prepared to deliver distance education courses and the institution ensures that faculty receive training, assistance, and support at all times during course development and delivery.	Teacher support
39	Teachers receive training and materials related to fair use, plagiarism, and other relevant legal and ethical concepts.	Teacher support
40	Teachers receive ongoing professional development related to online teaching and learning.	Teacher support
41	Clear standards are set for teacher engagement and expectations around online teaching.	Teacher support
42	Workshops are held for teachers to inform them about emerging technologies and the selection and use of these tools.	Teacher support
43	Before starting an online program, students are counseled on the program to determine whether they possess self-motivation and a commitment to distance learning.	Student support
44	Before starting an online program, students are advised on the program to determine if they have access to the minimum technology required by the course design.	Student support
45	Students receive (or have access to) program information, including admission requirements, tuition and fees, books and supplies, technical and supervisory requirements, and student support services prior to admission and course registration.	Student support
46	Students have access to the training and information they will need to secure the required materials through electronic databases, interlibrary loans, government archives, new services, and other sources.	Student support
47	Throughout the duration of the course / program, students have access to appropriate technical assistance and technical support personnel.	Student support
48	Student support staff is available to address student questions, problems, bug reports, and complaints.	Student support
49	Students have access to effective academic, personal, and career counseling.	Student support
50	Minimum technology standards are established and made available to students.	Student support
51	Student support services are provided outside of the classroom, such as academic advising, financial assistance, peer support, etc.	Student support
53	Students receive relevant information: ISBN numbers, providers, etc. and modes of delivery for all the required; Instructional materials: digital format, electronic packages, print format, etc. to ensure easy access.	Student support
54	The program demonstrates a student-centered approach rather than trying to tailor the distance education student service to the student services on campus.	Student support
56	Students are instructed in appropriate ways to communicate with faculty and students.	Student support
57	The institution provides guidance to both students and faculty in the use of all forms of technologies used for the delivery of the course.	Student support
58	Tutoring is available as a learning resource.	Student support
59	Students are instructed on the appropriate ways to get help from the program.	Student support
62	The expected learning outcomes at the course and syllabus level are regularly reviewed to ensure clarity, usefulness, and appropriateness.	Evaluation and assessment
64	The retention of courses and programs is evaluated. The results of the course assessments are used as part of the teacher / instructor performance assessments.	Evaluation and assessment
67	Course evaluations are examined in relation to teacher performance evaluations.	Evaluation and assessment

Table 1 Indicators for the diagnostic evaluation of the bachelor's degree program in Computational Sciences
Source: (Shelton, 2010)

Then, having defined the indicators to be evaluated, a questionnaire was used as a means to carry out the diagnostic evaluation, which is the most used instrument to collect the data.

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This questionnaire consisted of a set of 50 questions related to eight categories, distributed as follows: 1 indicator from the Technological Support category, 11 indicators from the Course Development and instructional design category, 8 indicators from the Course structure category, 5 indicators from the Teaching and learning category, 1 indicator from the Social and student commitment category, 6 indicators from the Teacher support category, 15 indicators from the Student support category, and 3 indicators from the Evaluation and assessment category .

The questions are closed and contain categories or response options that have been previously delimited, for which the Likert-type scale was used, with four response options, which are: Fully compliant, Moderate use, Insufficiently observed and Not observed. Each indicator is worth up to three points, with the following values:

- Not observed. It refers to the fact that no presence of the indicator to be evaluated is observed, so its score is 0 points.

- Insufficiently observed. It refers to the fact that a slight existence of the indicator has been found, however, it needs to improve in this area, so its score is 1 point.

- Moderate use. It corresponds to the fact that a moderate use of the quality indicator has been found, however, some improvement is needed in this area, so its score is 2 points.

- Fully compliant. It refers to the fact that the quality standard is being fully implemented and does not require improvement in this area, so its score is 3 points.

This way of working the questions has the purpose of facilitating the coding of the results and, consequently, their analysis.

Once the means to obtain the information of interest has been defined, the population to be studied is defined and the results are to be generalized over. The population, that is, the number of teachers who teach at the BSC is 90, however, due to the COVID-19 contingency, 36 teachers were contacted through email and / or cell phone number, to whom it was the invitation to answer the questionnaire. Therefore, the size of the universe of 36 teachers was considered, the margin of error was estimated at 10% and the confidence level was 90%, with these data the size of the sample that is calculated is 24 teachers, the calculation is obtained through the use of online sample calculators (Asesoría Económica & Marketing, 2009; netquest, 2020). The instrument was applied to 36 teachers, and 25 answered, which represents 69.4%.

Finally, making a summary of the steps of the methodological design, the following phases were carried out:

- Selection of indicators in Instructional Technology and Learning Environments of the diagnostic evaluation instrument (Shelton, 2010).

- Creation of the evaluation instrument in Google Forms (Google, 2020).

- Organization of results.

- Analysis and discussion of results.

Evaluation application results

Once the diagnostic evaluation instrument was applied to the teachers of the BSC educational program, the results that are presented below were grouped by category in order to promote a discussion of the aspects that could be improved to achieve an educational quality in the remote mode. The data of each category were managed by graphs of two types:

- Categories with a single indicator: Percentage of the teachers number in each of the possible answers (level of development of the category).

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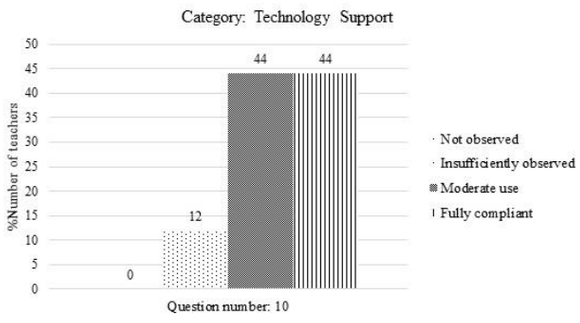
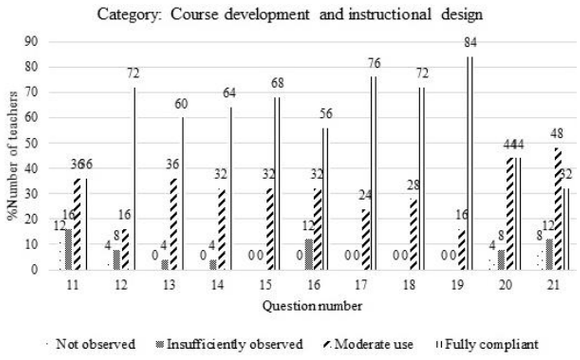
- Categories with more than one indicator: Percentage of the teachers number by the indicator number evaluated in that category, each line indicates one of the possible responses (level of development of the category).

The results obtained in the diagnostic evaluation by categories of the Shelton instrument (2010) are presented below. Graphic 1 shows the percentage of the number of teachers who evaluated the only indicator of the Technological Support category; In Graphic 2, the results obtained in 11 indicators of the category Course development and instructional design can be observed (questions from number 11 to 21).

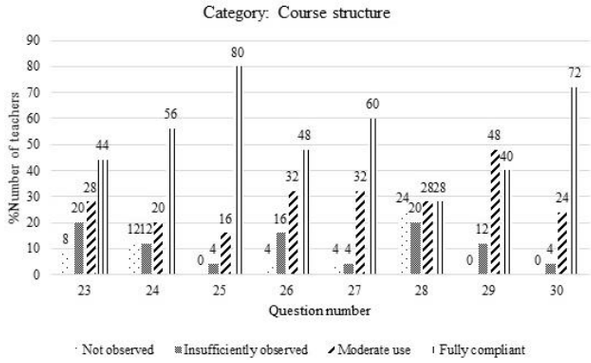
In Graphic 3, we can see the results obtained in the eight indicators of the course structure category (questions 23 to 30); Graphic 4 shows the results of five indicators in the Teaching and learning category (questions 31 to 35); As well as in Graphic 5, the results obtained in the indicator corresponding to the category Social and student commitment are shown (question 36).



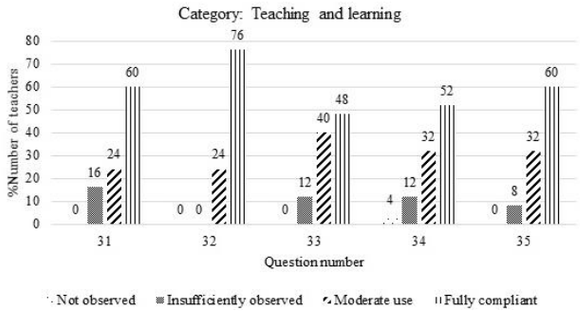
Graphic 1 Results obtained in the Technological Support category



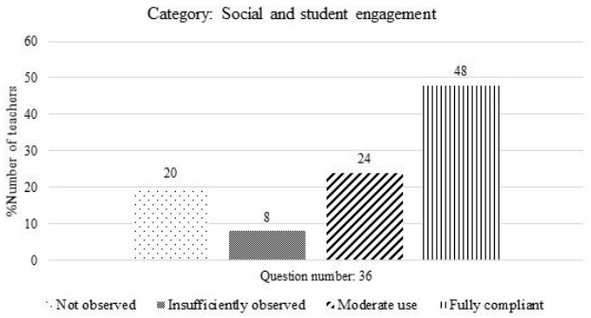
Graphic 2 Results obtained in the category of Course development and instructional design



Graphic 3 Results obtained in the Course structure category

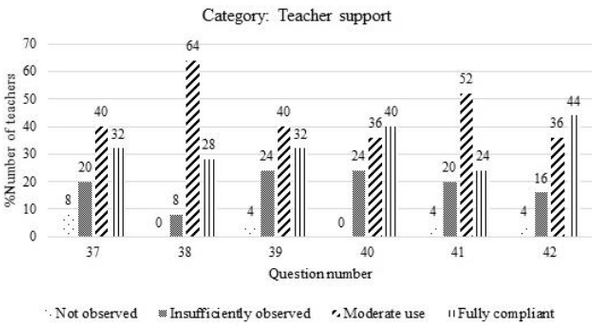


Graphic 4 Results obtained in the Teaching and learning category

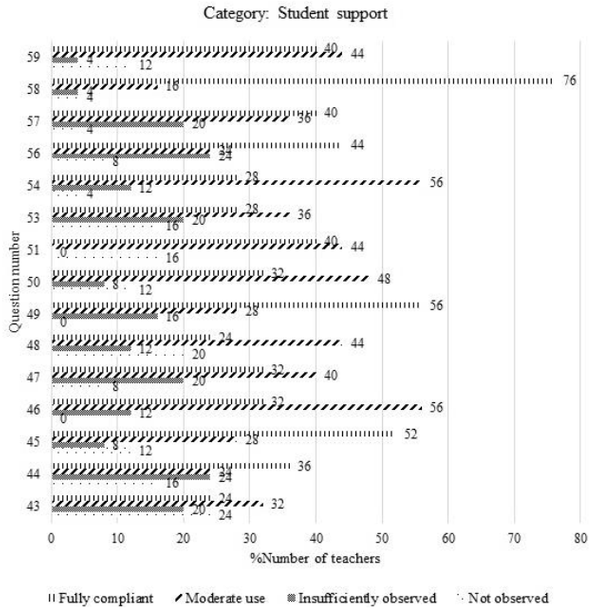


Graphic 5 Results obtained in the category of Social and student commitment

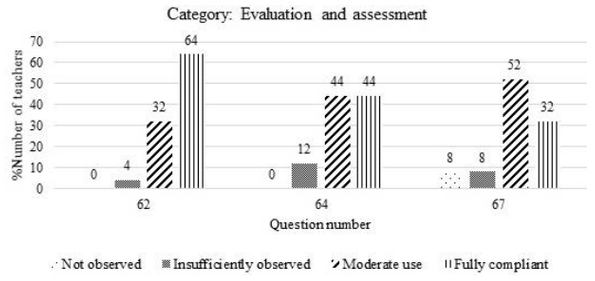
In Graphic 6, the results obtained in the six indicators of the Teacher support category are presented (questions 37 to 42); In Graphic 7, the results obtained in 15 indicators of the Student support category can be observed (questions from 43 to 51, questions 53 and 54, and questions from 56 to 59), and finally, in Graphic 8, the results obtained in the three indicators of the Evaluation and assessment category (questions 62, 64 and 67) are shown.



Graphic 6 Results obtained in the Teacher support category



Graphic 7 Results obtained in the Student support category



Graphic 8 Results obtained in the Evaluation and assessment category

Discussion and analysis of results

For the analysis of the results, it has been considered that an indicator is a weakness if any of the options Insufficiently observed and Not observed has been selected by any of the respondents, therefore, it is evaluated as a strength if none of these options has been selected.

Under this criterion, the results have identified some strengths in two categories, being the same: Course development and instructional design (indicators 15, 17, 18 and 19), and the Teaching and learning indicator (indicator 32), in the rest of the categories weaknesses were identified. Each specific category is discussed below.

The categories of Technological support, and Social and student commitment have a single indicator, in which it is shown that teachers are dissatisfied with these services, having evaluated them with 12% and 28%, in the options of Insufficiently observed and Not observed respectively (See Graphic 1 and Graphic 5). From what can be seen that faculty, staff and students do not receive sufficient support in the development and use of new technologies and skills.

In the category of Course development and instructional design, there are seven of the 11 indicators with at least one dissatisfied teacher (See Graphic 2), which implies that in this category, the BSC educational program does not comply with aspects such as: minimum standards for course development, design and delivery of online instruction, use of technology to achieve learning outcomes, periodic review of instructional materials, and having an instructional design for synchronous and asynchronous classroom sessions, in other aspects. It should be mentioned that instructional design is a very important part in the integration of technologies in the teaching-learning process (Moranchel Pocaterra, Morales Franco, & Quiñónez Salcido, 2017), since it is where knowledge is planned and organized, didactic materials, activities, evaluations and the sequence of contents, among other educational resources, all this favors meaningful learning of students (Molina & Molina, 2002; Zapata, 2013), so it is important to establish actions and follow up to improve the aspects of this category in the program.

In the Course structure category, the eight indicators (from 23 to 30) are considered weaknesses, since at least one teacher has evaluated them as Insufficiently observed, and in five of the eight indicators (23, 24, 26, 27 and 28), in addition, they evaluated it in the category of Not observed (See Graphic 3).

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This situation reveals that the educational program lacks most of the indications included in this category, which are: the information that must be included on the course website, such as the program that describes the objectives, learning outcomes, evaluation methods and bibliography, among others; that the institution guarantee access to library/learning resources for distance education students; that technical support links or explanations are available in the course; that instructional materials are accessible and usable for the student; in other aspects.

In the Teaching and learning and Evaluation and assessment categories, although most of their indicators were evaluated as Insufficiently observed, they only have one indicator evaluated as Not observed (See Graphic 4 and Graphic 8).

From the evaluation in the Teaching and learning category, it can be seen that some of the teachers consider that there is little interaction from student to student and from teacher to student; they also point out that students learn little about appropriate methods for effective research, including evaluating the validity of resources and the ability to master resources in an online environment; similarly, some teachers state that they lack specific strategies to make students perceive their presence in the course. Finally, at least one teacher believes that students do not have access to library professionals and resources to help them cope with the overwhelming amount of online resources.

Regarding the category of Evaluation and assessment, it can be observed that some teachers consider that the learning results expected at the course and program level are not regularly reviewed to guarantee clarity, usefulness and appropriateness; nor are the results of the evaluations carried out on the course used as part of the teacher's performance evaluations; and, at least one teacher believes that course evaluations are not tested in relation to teacher performance evaluations.

In the Teacher support category, although all the indicators were evaluated as Insufficiently observed, in four of these, at least one teacher also evaluated it as Not observed (See Graphic 6).

This finding allows us to perceive that teachers feel dissatisfied in aspects such as technical assistance in the development of the course and support in the transition from online teaching, in training and materials related to plagiarism and other legal and ethical concepts, as well as, in training on the selection and use of emerging technologies, among others.

In the Student support category, 12 of the 15 indicators were evaluated as Not observed, so this category is one of the greatest weaknesses that the program has, since teachers consider that it lacks the services that it should include (See Graphic 7), which are: before starting an online program, students are advised about the program to determine if they have self-motivation and a commitment to distance learning; students are advised on the program to determine if they have access to the minimum technology required by the course design; student support staff is available to answer questions, problems, bug reports and complaints from students; student support services are provided outside of the classroom, such as academic counseling and financial assistance; students receive relevant information such as ISBN numbers, providers, among others; students receive instructional materials in digital format, electronic packages, and print formats, among others, to ensure easy access; students are instructed in appropriate ways to communicate with faculty and students; and tutoring is available as a learning resource; in other aspects.

Conclusions

The results achieved in this study have made it possible to punctually identify the aspects that must be addressed in the educational program to provide quality training in the virtual modality. It is noteworthy that some of the categories such as institutional support, teacher support and student support are currently being worked on by the university management, in response to the situations presented during the COVID-19 contingency, where all the educational programs of the institution abruptly went from face-to-face to virtual mode. For the remaining categories, an improvement plan has been developed where specific strategies have been defined in order to work on the identified weaknesses.

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Two extremely important aspects stand out in this study that favorably affected the scope of the research objective, the first, referring to the instrument selected as the basis, which has been improved over the years by its authors in order to deeply examine the aspects that affect the quality of an educational program in terms of instructional technology and learning environments. As a second aspect, but of equal relevance, the objective participation of teachers that allowed us to have an X-ray of the current state of the program.

The work carried out represents one more effort, of all those who have been endeavouring to enrich the distance modality, especially in raising awareness of all its actors so that they can contribute individually and collectively to evolve towards a quality virtual educational process.

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