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RESEARCH ARTICLE

University faculty perceptions of online education: A systemic review of leadership and educational innovation

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ABSTRACT

The present study aims to evaluate the relationship between leadership and innovation in online education, focusing on the Faculty of Social and Behavioral Sciences of the Universidad Técnica de Manabí (FSBSUTM) during the first semester of 2023. The university is located in the Republic of Ecuador. The research was developed under a quantitative approach, using a Likert-type questionnaire. The population of interest was made up of teachers from the Faculty of Humanistic and Social Sciences of the Technical University of Manabí, with a total of 70 members. To select the sample, non-probabilistic participatory sampling was used. The statistical analysis focused on the study of correlations between variables, using Spearman's correlation coefficient. The results obtained indicate that stronger training and experience in educational innovation are positively related to the ability to overcome difficulties and promote the effective implementation of strategies in virtual education. It is concluded that university leaders face challenges in implementing online educational innovation. However, the importance of implementing effective leadership strategies and fostering a pro-innovation digital culture as a means of overcoming such difficulties is highlighted. These findings have significant implications for university leadership training and development, as well as for the promotion of educational innovation in virtual environments.

Keywords: university education; training; educational innovation; leadership; online education

1. Introduction

In recent years, educational leadership and innovation have emerged as key elements in the transformation of education systems worldwide[1]. In an ever-changing world where society demands new skills and competencies, educational institutions have been challenged to adapt and promote an educational approach focused on excellence and relevance for the 21st century. In this context, online education has gained unprecedented prominence, providing opportunities for the expansion of teaching and learning beyond physical and geographical limitations[2].

Educational leadership has proven to be a key determinant in promoting and driving innovation in higher education institutions around the world[3]. Educational leaders play a crucial role in fostering an organizational culture that values and supports innovation, as well as providing the necessary strategies and resources to implement innovative and effective educational practices. In addition, effective educational leadership

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involves developing competencies and skills that enable teachers to lead change, adopt new technologies and pedagogical methodologies, and promote student participation in their own learning process[4].

In an international comparative analysis, it is evident that several countries have made significant progress in integrating educational innovation and leadership into their online education systems. Countries such as Finland, Singapore, and Canada have stood out for their progressive approach and commitment to continuous improvement in education[5]. These nations have prioritized teacher training and development, the implementation of education policies that encourage experimentation and creativity, and the creation of environments conducive to collaboration and the sharing of best practices.

However, in the local context of the Faculty of Social and Behavioral Sciences of the Universidad Técnica de Manabí (FSBSUTM), there are challenges in relation to educational innovation and leadership in online education. Despite the efforts made, there are still barriers that hinder the full integration of these dimensions into teaching practice. Factors such as a lack of adequate technological resources, resistance to change, limited training in innovative pedagogies, and a lack of institutional support can hinder the effective implementation of innovative teaching and learning strategies[6].

At the local level of the FSBSUTM in Ecuador, there is a gap between expectations and reality regarding the application of educational innovation and leadership in online education[6]. Teachers face challenges in acquiring the necessary skills to effectively use technological tools and develop innovative pedagogical strategies. In addition, a lack of time and institutional support hinders the experimentation and implementation of novel approaches in the teaching process[7]. In addition, resistance to change has been identified on the part of some teachers, who are reluctant to abandon traditional practices and adopt new methodologies involving the use of technology. This resistance may be based on a lack of confidence in their own technological skills, a fear of possible mistakes, and the perception that online educational innovation may result in an additional workload[8].

Also, the lack of technological resources and adequate infrastructure limits the possibilities for efficient implementation of online education. The availability and quality of Internet connectivity, as well as accessibility to technological devices, can be significant challenges that hinder equitable access to online education for all teachers and students[9]. Despite these challenges, it is important to recognize the efforts and progress that have been made at FSBSUTM to promote educational innovation and leadership in online education. Training and workshops have been carried out to improve the digital and pedagogical competencies of teachers, as well as to foster a culture of collaboration and support among teachers. In addition, technological platforms and resources have been implemented to facilitate communication and the exchange of online educational materials.

The study of the perceptions of leadership and online educational innovation of university faculty at FSBSUTM is necessary to understand the challenges and opportunities in the specific context of the institution. This analysis will allow us to identify areas for improvement, design effective strategies and promote a digital culture favorable to innovation. By overcoming difficulties and strengthening leadership and training in educational innovation, positive results can be achieved in the quality of online education and in the integral development of university students.

2. Literature review

2.1. The role of leadership in higher education

According to various theoretical authors and previous studies, faculty leadership plays a key role in the promotion and success of online higher education[10–12]. García and Martija[13] argue that effective faculty

leadership in virtual environments is essential for fostering a quality and enriching online learning environment. Salem[14] also highlights the importance of faculty leadership and support in the implementation of innovative strategies and the effective use of educational technology in the context of online education. These studies support the idea that faculty leadership directly influences the quality and effectiveness of online higher education.

In the context of constantly evolving technology and changing demands in education, faculty leadership in online higher education can be compared to steering a ship during a stormy sea. Just as an experienced and competent leader is essential to guide and steer a ship to its destination, university faculty with adequate leadership skills are crucial to successfully navigate the challenges and opportunities presented by online education[15]. By applying educational leadership theories and practices, faculty can become the leaders who drive innovation, facilitate peer collaboration, and provide strong support for students in virtual environments.

Likewise, faculty leadership in online higher education can be seen as the lighthouse that lights the way during darkness. Just as a lighthouse guides and directs navigators in dangerous waters, faculty leadership in online education provides clear direction and sets the course for educational success. Following leadership theories and models, teachers can play key roles as mentors, facilitators, and change agents in implementing innovative pedagogical practices and creating a dynamic and enriching online learning environment[12].

2.2. Innovation from higher education

Several authors and studies support the importance of innovation in higher education as a key factor in improving the quality and relevance of teaching and learning processes. According to research by Suasnabas-Pacheco and Juárez[16], educational innovation in higher education involves the application of creative pedagogical approaches, the strategic use of technology, and the incorporation of new assessment methodologies. Furthermore, Sierra Villamil[17] argues that innovation in higher education is fundamental to preparing students for the challenges of the 21st century, fostering critical thinking and promoting the development of skills relevant to today's labor market.

Innovation in higher education can be likened to the engine that drives progress and transformation in academic institutions. Just as a powerful and efficient engine is essential to propel a vehicle forward, educational innovation is essential to drive the development of higher education in response to social, technological, and economic changes[18]. By applying theories and practices of educational innovation, higher education institutions can adapt to the changing needs of students, foster creativity and collaboration, and implement new pedagogical strategies that enhance the learning experience.

Likewise, innovation in higher education can be seen as a beacon of light in an ever-changing landscape. Like a lighthouse guiding navigators through uncharted waters, innovation in higher education provides clear direction and guidance in an increasingly complex educational environment. By adopting innovative approaches such as active learning, using advanced educational technology, and promoting interdisciplinary research, higher education institutions can open up new learning opportunities, boost creativity, and prepare students for future challenges.

2.3. Training and experience in educational leadership of university teachers

University educational leadership training and experience are critical to the success of leaders in academia. According to the study of Imbernón Muñoz et al.[19], leadership training provides educational professionals with the tools necessary to effectively manage challenges and changes in the educational environment. In addition, practical experience in leadership roles enables university leaders to develop decision-making, effective communication, and team management skills. Previous research has also highlighted the importance

of continuous training and professional learning in the development of university educational leadership[20]. University educational leadership training and experience are akin to the foundation of a solid building. Just as a building requires a strong foundation to stand, university leaders need solid theoretical and practical leadership training to guide their teams and promote academic excellence. Like architects who are dedicated to honing their skills over the years, educational leaders should seek professional development opportunities and participate in specific training programs to strengthen their knowledge and skills in educational leadership.

In addition to training, experience plays a crucial role in university educational leadership. Like a bricklayer honing his or her craft through years of practice, educational leaders acquire valuable knowledge and specialized skills as they face and overcome challenges along their career path[15]. Leadership experience enables them to understand the complexities of the academic environment, collaborate with diverse stakeholders such as teachers, students, and administrative staff, and make informed decisions that drive educational quality and innovation. The combination of strong leadership training and valuable educational experience contributes to the development of effective and skilled university leaders[10].

2.4. Training and experience in educational innovation of university teachers

Training and experience in educational innovation are key determinants of university faculty success in today's environment. According to research by Real Martínez et al.[5], training in educational innovation provides teachers with the necessary skills to adapt to the demands of higher education in the digital age. This training includes mastery of technological tools, an understanding of innovative pedagogical methodologies, and the ability to foster active student participation[13]. In addition, practical experience in implementing innovative approaches in the classroom gives teachers the confidence and competence to meet the challenges of online education.

Training and experience in educational innovation can be seen as the foundation of a solid construction[2]. Like an architect who specializes in the design and construction of state-of-the-art buildings, university faculty require solid theoretical and practical training in educational innovation to deliver quality and relevant education in the digital age[21]. The questionnaire was created by the researchers. The design was evaluated and approved by the FSBSUTM research and ethics committee. Training provides them with the necessary knowledge and tools, while experience allows them to hone their skills and adapt innovative strategies to the changing needs of students and technological advances. In addition to training, experience in educational innovation plays an important role in the professional development of university faculty. Like a builder who faces different challenges in each project, faculty gain practical experience by implementing innovative approaches in the classroom and facing obstacles that arise in the process. This experience enables them to learn from successes and failures, adapt strategies and continuously improve their teaching practice. The combination of a strong background in educational innovation and valuable experience in its application enables university faculty to confidently lead and promote educational excellence in the digital environment[22].

Both leadership and innovation become relevant components when applied to the teaching-learning process. Betting on continuous improvement and the construction of paradigmatic change that addresses educational management, focusing on pedagogical actions, innovation, teamwork, vision of the future and strategic pedagogical interventions. Based on the above, the following hypotheses emerge:

H_1. The educational leadership training and experience of FSBSUTM faculty have significant effects on the difficulty and application of leadership.

H_0. FSBSUTM teachers' training and experience in educational leadership have no significant effect on the difficulty of leadership application.

H_1. Training and experience in university educational innovation of FSBSUTM faculty has significant effects on the difficulty and application of educational innovation.

H_0. The training and experience in university educational innovation of the FSBSUTM teaching staff have no significant effect on the difficulty and application of educational innovation.

3. Methodology

3.1. Research paradigm

The research approach adopted for this study is based on the quantitative paradigm. According to Pinos et al.[23] the quantitative paradigm involves the numerical analysis of data for the purpose of establishing relationships between variables and discovering patterns and trends. In the present study, a quantitative approach was employed that focused on the analysis of numerical data with the aim of establishing relationships between variables and identifying patterns and trends. Thus, in the context of the scientific article, quantitative analysis allowed for the collection and examination of data on educational leadership and innovation, using statistical techniques to identify and quantify the relationship between these variables.

3.2. Population and sample

The population is defined as the complete set of individuals, objects, events, or measures that share common characteristics and are of interest to the study[24]. In the context of this quantitative research, the population consists of FSBSUTM teachers, with a total of 70 members. Adequate selection of the population is essential to ensure the validity and reliability of the results obtained.

For the selection of the sample, a participatory, non-probabilistic sampling approach was used. This method is based on the voluntariness of the participants to take part in the study[24]. Teachers had the option of self-selection; they decided autonomously whether they wished to participate in the study. The selection of the sample was carried out through an open call, where a request was sent by email to teachers interested in participating. In total, 65 teachers participated in the study. It is important to note that the use of non-probability participatory sampling has its limitations, as the results may be subject to bias and may not be generalizable to the whole population. However, in this case, it was considered a viable option given the availability and willingness of teachers to participate in the study.

3.3. Data collection instruments

A questionnaire based on a Likert-type scale was used as a data collection instrument. The questionnaire is a research tool widely used in quantitative studies to collect data in a systematic and standardized way through a series of questions addressed to a group of people[21]. The questionnaire was created by the researchers. The design was evaluated and approved by the ethics and research committee of the FSBSUTM. The questionnaire consists of a total of 24 questions or items, divided equally into two variables: leadership and educational innovation. Each variable is broken down into three dimensions: application, difficulty, and training experience of university teachers.

Each question was carefully selected and designed to measure the variables objectively and accurately. Five response options were provided in scalar format. Option 5 represents the highest value, indicating "strongly agree/always". Option 4 indicates "agree/almost always". Option 3 is neutral, representing "neither agree nor disagree/sometimes". Option 2 indicates "disagree/hardly ever". Finally, the lowest value option, with a score of one, corresponds to "strongly disagree/never" (Appendix **Tables A1** and **A2**). The questionnaire, by using a Likert-type scale, allows quantitative data to be obtained that facilitates the statistical analysis of

the responses and the identification of trends and patterns related to leadership and educational innovation in the context of university teaching staff[24].

3.4. Reliability of the data collection instrument

A diagnostic evaluation of the data collection instruments was carried out. The pilot test was applied to 30 teachers. Cronbach's alpha reliability coefficient was used to check the reliability of the data collection instruments (**Table 1**). This coefficient is a statistical measure that indicates the internal consistency of a measurement instrument, i.e., how reliable it is for measuring a given variable[25].

Table 1. Reliability results of the educational innovation questionnaire.

Reliability statistics	
Cronbach's alpha	*N* of items
0.858	12
0.901	12

In the educational innovation instrument, a Cronbach's alpha reliability coefficient of 0.858 was obtained, which indicates good internal consistency. On the other hand, a Cronbach's alpha reliability coefficient of 0.901 was obtained for the leadership instrument, which indicates an even higher internal consistency than the educational innovation instrument. According to Cejas et al.[21], values of 0.700 or higher are considered acceptable, values of 0.800 or higher are considered good, and values of 0.900 or higher are considered excellent. These results suggest that both measurement instruments are reliable for assessing the respective variables, as they exceed the established reliability criteria.

3.5. Results analysis technique

The results of the questionnaire were subjected to statistical analysis using SPSS (Statistical Package for the Social Sciences) software, which is widely used in scientific research and data analysis. SPSS offers various tools for organizing, analyzing, and presenting data, including advanced statistical techniques for quantitative data analysis. In the context of research on educational leadership and innovation, linear regression analysis using SPSS software was used[7]. Linear regression is a statistical technique for examining the relationship between two or more quantitative variables. Specifically, multiple regression analysis was applied, which allows the analysis of the relationship between a dependent variable and two or more independent variables.

Since the sample used in the study exceeded 50 data, the Kolmogorov-Smirnov normality test was performed. This test was used to check whether the variables followed a normal distribution. In terms of the normality hypotheses, if the *p*-value is less than 0.05, the alternative hypothesis is accepted (the random variable does not have a normal distribution), while if the *p*-value is greater than 0.05, the null hypothesis is accepted (the random variable has a normal distribution).

Hypothesis:

p-value is <0.05, H_1 is accepted (the random variable does not have a normal distribution).

p-value is >0.05, H_0 is accepted (the random variable does have a normal distribution).

In the case of all the variables analyzed, the significance levels yielded a *p*-value equal to 0.00, which indicates that the variables do not follow a normal distribution. Therefore, they were considered non-parametric data, which implies that statistical methods suitable for this type of data will be used in the analysis of the results[26].

To analyze the correlation between the variables of training, difficulty, and application of leadership and educational innovation, Spearman's test was applied. Spearman's coefficient is a non-parametric correlation measure that is specifically used to assess the relationship between two ordinal or scalar scale variables. This measure allows the strength and direction of the relationship between variables to be determined based on a comparison of the ranges of the variables rather than the actual values[27].

Spearman's coefficient is a widely used statistical tool in research studies, as it is particularly suitable when data do not meet the assumptions of normality or when variables do not have a linear relationship. In the case of this study, where the data are non-parametric and involve ordinal or scalar scale variables, Spearman's coefficient is considered an appropriate tool to analyze the relationship between training, difficulty, and implementation of educational leadership and innovation[28].

By using Spearman's coefficient, it will be possible to determine whether there is a positive, negative, or zero correlation between the variables analyzed. This analysis will allow a better understanding of the relationship between the dimensions of leadership and educational innovation and will provide valuable information for the study. This statistical analysis made it possible to analyze the correlation between the variables of training, difficulty, and application of leadership and educational innovation. This non-parametric test is suitable for non-parametric and ordinal or scalar-scale data. It will also allow us to determine the strength and direction of the relationship between the variables based on the comparison of the ranks[29,30].

4. Findings

By obtaining a *p*-value of less than 0.05, the null hypothesis can be rejected, indicating that there is sufficient statistical evidence to affirm that training experience in educational innovation is significantly related to the difficulties and their respective applications in university education. Regarding the difficulties encountered in educational innovation, a Spearman correlation coefficient of 0.672 was observed, indicating a moderately positive relationship (**Table 2**). Similarly, the Spearman correlation coefficient for the implementation of educational innovation was 0.580, also indicating a moderately positive relationship. These findings suggest that more training and experience in educational innovation can help overcome difficulties and encourage the implementation of educational innovation.

Table 2. Results of the correlation analysis of the variable educational innovation with training, difficulty and application.

Correlations					
			Educational innovation training	**Educational innovation difficulty**	**Educational innovation application**
Spearman's rho	Educational innovation training	Correlation coefficient	1.000	0.672**	0.580**
		Sig. (2-tailed)	-	-	-
		N	65	65	65
	Educational innovation difficulty	Correlation coefficient	0.672**	1.000	0.537**
		Sig. (2-tailed)	-	-	-
		N	65	65	65
	Educational innovation application	Correlation coefficient	0.580**	0.537**	1.000
		Sig. (2-tailed)	-	-	-
		N	65	65	65

**. Correlation is significant at the 0.01 level (2-tailed).

The relationship between leadership training experience and difficulties, as well as the application of leadership in university education, was analyzed through the rejection of the null hypothesis due to a *p*-value of less than 0.05. This provides sufficient statistical evidence to affirm that leadership training experience is significantly related to difficulties and the respective application in university education (**Table 3**). In terms of difficulties, a Spearman correlation coefficient of 0.701 was observed for leadership difficulties, indicating a strong positive relationship. In addition, the Spearman correlation coefficient for leadership application was 0.594, suggesting a moderately positive relationship. These findings support the idea that better training and experience in educational leadership can overcome difficulties and promote its application at the university level[31].

Table 3. Results of the correlation analysis of the variable leadership with training, difficulty and application.

Correlations					
			Leadership training	**Leadership difficulty**	**Leadership application**
Spearman's rho	Leadership training	Correlation coefficient	1.000	0.701**	0.594
		Sig. (2-tailed)	-	0.006	0.002
		N	65	65	65
	Leadership difficulty	Correlation coefficient	0.701**	1.000	0.504**
		Sig. (2-tailed)	0.006	-	-
		N	65	65	65
	Leadership application	Correlation coefficient	0.594	0.504**	1.000
		Sig. (2-tailed)	0.002	-	-
		N	65	65	65

**. Correlation is significant at the 0.01 level (2-tailed).

5. Discussion

According to the study of Bolivar[26], teacher training is a fundamental requirement for implementing educational innovation at the university. Experience provides them with the necessary tools and strategies to face the challenges that may arise during the process. In addition, Toomela[27] points out that experience also plays an important role, as teachers with more experience in university teaching may have a greater capacity to adapt to new teaching methodologies. On the other hand, Leal Afanador[28] highlights that difficulties may arise in university educational innovation due to a lack of both training and experience. University teachers may face obstacles in the implementation of new educational methodologies due to poor training in technology and a lack of experience in the application of these innovative methodologies.

On the other hand, Díaz Domínguez and Alemán[29] point out that training and experience are determining factors in the ability of teachers to carry out educational innovation projects effectively at the university level. These authors also highlight the importance of continuous training and constant feedback to improve the implementation of educational innovation in the academic context. Both training and experience play a crucial role in the implementation of educational innovation in universities, and difficulties can arise from the lack of both. Furthermore, the need for continuous training and constant feedback to improve the successful implementation of educational innovation at the university level is highlighted[30]. These findings are relevant for the effective implementation of educational innovation in the Faculty of Humanistic and Social Sciences of the Technical University of Manabí.

The existing literature supports the importance of training and experience in university leadership. Molero et al.[32] point out that these factors influence the leadership capacity of university leaders as well as their ability to innovate and improve pedagogical practices. Therefore, it is crucial to understand how these factors relate to the difficulties and implementation of leadership in the university environment. In relation to difficulties, Mendoza-Velazco et al.[33] highlight that university leaders face challenges due to a lack of resources, poor institutional support, and resistance to change from some staff members. However, these difficulties can be overcome by implementing effective leadership strategies and promoting an institutional culture that fosters innovation.

Regarding the application of university leadership, Mendoza-Velazco et al.[33] found that effective leaders in higher education are those who promote collaboration and participation in the educational community. These leaders have a clear and shared vision of the institution's goals and objectives, which enables them to adapt and respond effectively to changes in the environment and the needs of the educational community. Training and experience play a key role in university leadership and in the implementation of educational innovation at UTM. Difficulties can be overcome through effective leadership strategies and an innovation-friendly institutional culture[34]. Effective leaders in higher education are those who foster collaboration, have a clear vision, and adapt to the changing environment and needs of the university education community.

6. Limitations of the study

According to the research, the following limitations are present:

Sample size: One of the limitations of this study is the sample size.

Although participatory non-probability sampling was used, the study focused only on the Faculty of Social and Behavioural Sciences of the Universidad Técnica de Manabí during the first semester of 2023, which limits the generalisability of the results to other faculties or educational contexts. Response bias: Since the study was based on the collection of data through a Likert-type questionnaire, there is a possibility that participants may have had response biases.

For example, they may have provided answers that were socially desirable or influenced by personal perceptions, which could affect the validity of the results. Reliance on self-reporting: Another limitation relates to the use of participants' self-reporting to assess their training, experience and skills in educational innovation and leadership.

The accuracy and objectivity of these self-reports could be subject to recall errors, personal biases or lack of awareness of actual skills, which could influence the reliability of the results.

Lack of control for external variables: The study focuses on the relationship between leadership and innovation in online education but does not consider the impact of other external variables that could influence this relationship. Factors such as availability of resources, institutional support, or individual teacher characteristics could play an important role and have not been taken into account in this study.

Limitations of the quantitative approach: The use of a quantitative approach and the application of statistical analyses, such as Spearman's correlation coefficient, provide important information on the relationship between variables. However, this approach may limit the in-depth understanding of the specific processes and contexts that influence the relationship between leadership and innovation in online education. It would be beneficial to complement this study with qualitative methods to gain a fuller and richer perspective on the phenomena studied.

7. Conclusions

After a detailed analysis of the results obtained in the study on the relationship between training experience in educational leadership and online educational innovation at FSBSUTM during the first semester of 2023, relevant conclusions have been obtained that allow us to respond to the objective and hypotheses set out. Firstly, it can be concluded that there is a significant relationship between training experience in educational leadership and the difficulties and application of leadership in online university education. The results support hypothesis H_1, indicating that FSBSUTM faculty's educational leadership training and experience have significant effects on leadership difficulty and application. These findings are consistent with the studies of Mendoza Velazco et al.[35], who highlighted the importance of training and experience in university leadership.

In terms of educational innovation, a significant relationship was also found between training experience in university educational innovation and the difficulty and application of online educational innovation. This supports hypothesis H_1, demonstrating that FSBSUTM faculty training and experience in educational innovation have significant effects on the difficulty and application of educational innovation. These results are consistent with the findings of Cejas, Gutiérrez et al.[34], who highlighted the importance of training and experience in the implementation of new educational methodologies. In addition, it was observed that university leaders face challenges in implementing online educational innovation, such as resistance to change and lack of resources. However, those leaders with adequate training and experience in educational leadership are better able to overcome these obstacles and achieve successful implementation of educational innovation. These results are consistent with the findings of Cejas et al.[36], who highlighted the challenges faced by university leaders in implementing educational innovation.

This study has shown that the training experience in educational leadership and university educational innovation of FSBSUTM faculty has significant effects on the difficulties and implementation of both leadership and educational innovation online. These findings support the importance of training and experience in university leadership and in the implementation of new educational methodologies. The results also highlight the need to address the challenges faced by university leaders in the implementation of online educational innovation through effective leadership strategies and appropriate institutional support[16]. These findings have important implications for FSBSUTM and other similar educational institutions, as they highlight the importance of investing in educational leadership training and development as well as in the promotion of online educational innovation. By improving training and expertise in leadership and educational innovation, difficulties can be overcome and successful implementation of these practices can be promoted for the benefit of online university education.

8. Recommendations

Today, it is essential to effectively address existing challenges and strengthen online educational leadership and innovation at FSBSUTM. Institutional policies are needed to promote and support the adoption of innovative pedagogical approaches, as well as continuous teacher training in the use of educational technologies[10]. Greater investment in technology infrastructure and equitable access to digital resources is also needed to ensure that all teachers and students can fully participate in online education. The relationship between leadership and online educational innovation among FSBSUTM faculty presents both advances and challenges. While there are efforts to promote innovative pedagogical practices and take advantage of online education, there are still obstacles to overcome[11]. Lack of adequate technological resources, resistance to change and the need for further training and institutional support are key issues that require attention.

To achieve effective transformation, it is critical that educational leaders at FSBSUTM develop strong leadership strategies that foster a culture of innovation and provide the necessary support for teachers to develop skills in online education. In addition, institutional policies that promote investment in technological infrastructure and continuous teacher training must be put in place. Only through a comprehensive and collaborative approach will it be possible to overcome the challenges and make the most of the opportunities offered by online education[12].

Author contributions

Conceptualization, DJMV; methodology, EMFH; software, LERS; validation, LERS, DJMV and EMFH; formal analysis, DJMV; investigation, EMFH; resources, LERS; data curation, DJMV; writing—original draft preparation, DJMV; writing—review and editing, LERS; visualization, DJMV; supervision, EMFH; project administration, DJMV; funding acquisition, LERS. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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Appendix

Table A1. Questionnaire of the educational innovation applied to university professors of the Faculty of Humanistic and Social Sciences of the UTM.

Random variable: educational innovation			**Options**				
		Items	**1**	**2**	**3**	**4**	**5**
Variables	Application	To what extent have you integrated active learning strategies into your lesson planning?					
		To what extent do university professors apply educational innovation in their faculty?					
		To what extent has it fostered teamwork and collaboration among students?					
		To what extent have you used alternative evaluation methods, such as projects and presentations, instead of traditional examinations?					
	Difficulties	How challenging has it been for you to implement new technologies in your teaching practice?					
		How difficult has it been for you to integrate active learning strategies into your lesson planning?					
		How complex has it been for you to encourage teamwork and collaboration among students?					
		How complicated has it been for you to use alternative assessment methods, such as projects and presentations, instead of traditional exams?					
	Training and experience	How prepared do you feel to integrate new technologies into your teaching practice?					
		To what extent have the training activities in educational innovation that you have received in your institution helped you to improve your teaching practice?					
		How effective do you think training in educational innovation has been in your institution to improve your teaching competence?					
		How relevant do you consider educational innovation training at your institution to your professional development and ability to prepare students to face the challenges of today's world?					

Table A2. Questionnaire of the university leadership category applied to university professors of the Faculty of Humanistic and Social Sciences of the UTM.

Random variable: leadership			**Options**				
		Items	**1**	**2**	**3**	**4**	**5**
Variables	Application	To what extent does your institution's educational leader show a clear vision and strategy for the institution's success?					
		To what extent does your institution's educational leader communicate clearly and effectively with staff and students?					
		To what extent does your institution's educational leader promote a positive and collaborative work environment?					
		To what extent does your institution's educational leader provide adequate support and resources for staff and student professional development?					
	Difficulties	To what extent does the lack of resources or budget affect the ability of the educational leader to make effective decisions?					
		To what extent do conflicts with staff, students, or other stakeholders hinder the education leader's ability to implement his or her vision and strategy?					
		To what extent do government policies or regulations hinder the educational leader's ability to make effective decisions and achieve his or her goals?					
		To what extent does a lack of support or commitment from staff, students, or other stakeholders hinder the educational leader's ability to achieve the institution's goals?					
	Training and experience	To what extent has academic training in leadership been useful to fulfill your current role in the institution?					
		To what extent has previous work experience in leadership positions been helpful in fulfilling your current role at the institution?					
		To what extent has leadership training and professional development been helpful in fulfilling your current role at the institution?					
		To what extent do you think the combination of academic background, work experience, and professional development in leadership has contributed to your effectiveness as a leader at the institution?					