

Technological resources used in the teaching and learning process of agro-industrial engineering subjects at UNAH

Recursos tecnológicos utilizados en el proceso de enseñanza aprendizaje de asignaturas de ingeniería agro-industrial de la UNAH

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ABSTRACT

The aim of this research was to analyze the use of technological resources in the teaching and learning processes of various Agroindustrial Engineering courses at the National Autonomous University of Honduras. The methodology employed a descriptive, cross-sectional study conducted between 2020 and 2022, through the progressive implementation of digital tools such as Microsoft Teams, Zoom, YouTube, Edpuzzle, TikTok, virtual simulators, SPSS, and automated Excel templates, applied to key courses within the program. The results demonstrated an effective educational experience for the academic activities, reflected in high student participation, full access to audiovisual content, and high levels of interaction and feedback. Furthermore, a significant strengthening of cognitive, procedural, and technological competencies was observed, particularly the development of practical skills through virtual simulations, the use of specialized software, and the creation of comprehensive academic projects. Student perception was overwhelmingly positive, valuing the digital tools as innovative, accessible, and facilitators of meaningful learning. The integration of constructivist strategies mediated by ICT constitutes a viable and effective alternative for professional training in Agroindustrial Engineering, especially in virtual or hybrid education contexts.

Keywords: Technological resources, virtual education, digital tools.

RESUMEN

El objetivo de la investigación fue analizar el uso de recursos tecnológicos en los procesos de enseñanza-aprendizaje de diversas asignaturas de Ingeniería Agroindustrial de la Universidad Nacional Autónoma de Honduras. La metodología correspondió a un estudio de enfoque descriptivo y corte transversal, desarrollado entre 2020 y 2022, mediante la implementación progresiva de herramientas digitales como Microsoft Teams, Zoom, YouTube, Edpuzzle, TikTok, simuladores virtuales, SPSS y plantillas automatizadas en Excel, aplicadas en asignaturas clave de la carrera. Los resultados evidenciaron una experiencia educativa efectiva de las actividades académicas, reflejada en una alta participación estudiantil, acceso total a los contenidos audiovisuales y elevados niveles de interacción y retroalimentación. Asimismo, se observó un fortalecimiento significativo de competencias cognitivas, procedimentales y tecnológicas, destacándose el desarrollo de habilidades prácticas mediante simulaciones virtuales, el uso de software especializado y la elaboración de proyectos académicos integrales. La percepción estudiantil fue mayoritariamente positiva, valorando las herramientas digitales como innovadoras, accesibles y facilitadoras del aprendizaje significativo. La integración de estrategias constructivistas mediadas por TIC constituye una alternativa viable y eficaz para la formación profesional en Ingeniería Agroindustrial, especialmente en contextos de educación virtual o híbrida.

Palabras clave: Recursos tecnológicos, educación virtual, herramientas digitales.

1. Introduction

With the World Health Organization (WHO) declaring a global pandemic due to the exponential outbreak of coronavirus COVID-19 in March 2020, all types of activities worldwide came to a halt, urging the population to practice social distancing and confinement. In this context, Information and Communication Technologies (ICTs) became a fundamental means during the pandemic to maintain the operation of activities remotely (Estrada et al., 2022). As a result of the COVID-19 pandemic, the educational system worldwide was affected by the sudden shift from face-to-face classes to online classes (Ramos et al., 2022). The COVID-19 pandemic has generated changes and disruptions in practically all sectors of human activity, serving as a reality check for the educational community, reflecting that there is still progress to be made toward a true digital transformation of education—one that implies a new vision of teaching in a digital world (Sánchez & Esteve, 2023).

In today's digital age, the integration of technological resources into education has significantly modified conventional teaching–learning methods. The use of electronic devices, online platforms, and interactive tools has not only simplified access to information but also enabled the personalization and dynamization of the educational process (Alava & García, 2024). According to Vargas-Zúñiga et al. (2024), technology has revolutionized both teaching and learning. Therefore, the integration of technological tools into the educational process has generated new opportunities and challenges.

The use of ICTs in learning processes has gained importance in higher education due to the methodological changes and challenges these tools bring in facing new forms of communication and access to knowledge in universities (Pineda & Cifuentes, 2020). ICTs have favored teaching and learning processes in university education for both teachers and students, while also maintaining open, continuous, and flexible learning that eliminates time barriers, impacting not only education but also the workplace (Estrada et al., 2022).

Walss Auriolles (2021) suggests ten technological tools that promote formative and shared assessment. These “enable teachers to create activities to establish the learning objective, build and practice content, and demonstrate the application of knowledge in different contexts” (p.133). The author based the selection of these tools on their variety, ease of use for both teachers and students, and accessibility from any electronic device. Some of the tools included in the study were Edpuzzle, Flipgrid, Genially, Mentimeter, among others.

On the other hand, authors such as Infante Moro and Aguaded Gómez (2012) highlight the use of social networks in education, considering them “attractive” for students, as they make it possible to blend formal and informal learning, while also enabling collaboration and free participation among learners.

The teaching–learning process requires that various types of knowledge—cognitive, procedural, and attitudinal—be integrated in an articulated manner within the subjects. According to Paul (2013), the procedural dimension involves doing, manipulating, and producing, which is achieved through in-person attendance in different practical laboratories. When face-to-face attendance is not possible, alternatives such as laboratory simulations using virtual tools are sought, allowing students to carry out the complete simulation. In response to this challenge, educational innovation processes were promoted to strengthen the competencies of Agroindustrial Engineering students, with the purpose of preparing them solidly to face an increasingly competitive labor market.

In this context, the research aims to analyze the use of technological resources in teaching–learning processes of different subjects in the Agroindustrial Engineering program and the perception of undergraduate students, as a real alternative in professional training within Higher Education.

2. Materials and methods

The research was conducted at the National Autonomous University of Honduras with Agroindustrial Engineering students who took the courses in meat processing, agroindustrial processes, food technology, and project formulation and evaluation. The application of technological resources in the teaching–learning processes of these subjects was carried out in three stages (Table 1), which validates a cross-sectional study.



Table 1: Technological resources used in different Agroindustrial Engineering courses.

Year	Courses	Technological resurces employed
2020	Meat processing	Microsoft Teams and Zoom YouTube UNAH Virtual Campus Virtual experiment simulators1 SPSS
2021	Agroindustrial processes Food technology	EdPuzzle TikTok 2021.
2022	Formulation and Assessment of Agroindustrial Projects	Excel YouTube

Source: Own elaboration.

Educational Experience of 2020

The educational experience developed in 2020 was based on the constructivist approach, both theoretically and practically, oriented toward the development of knowledge in the Meat Processing course of the Agroindustrial Engineering program. To strengthen the cognitive component, weekly videoconferences were delivered, recorded, and published on YouTube, with links shared through the UNAH Virtual Campus, facilitating asynchronous access to the content. In addition, the reading and analysis of updated scientific literature was promoted, essential for participation in academic forums, and several topics were complemented with tutorials created on the Zoom platform and likewise disseminated through YouTube. Figure 1 presents the methodological process developed during the educational experience with resources described in Table 1. It begins with the teaching of different types of knowledge, procedures, and the results achieved.

Educational Experience of 2021

The development of the experience consisted of applying the interactive tools Edpuzzle and TikTok in the teaching–learning process during the third unit of the second academic period, with Agroindustrial Engineering students in the courses Food Technology (AG-334) and Agroindustrial Processes (AG-212). For the implementation of Edpuzzle, an induction tutorial video was prepared to guide students on downloading, registering, and using the platform, focusing on the inspection and resolution of the proposed activities. This tool allowed the integration of videos with embedded questions throughout playback, ensuring attention, content analysis, and preventing fast-forwarding of the material.

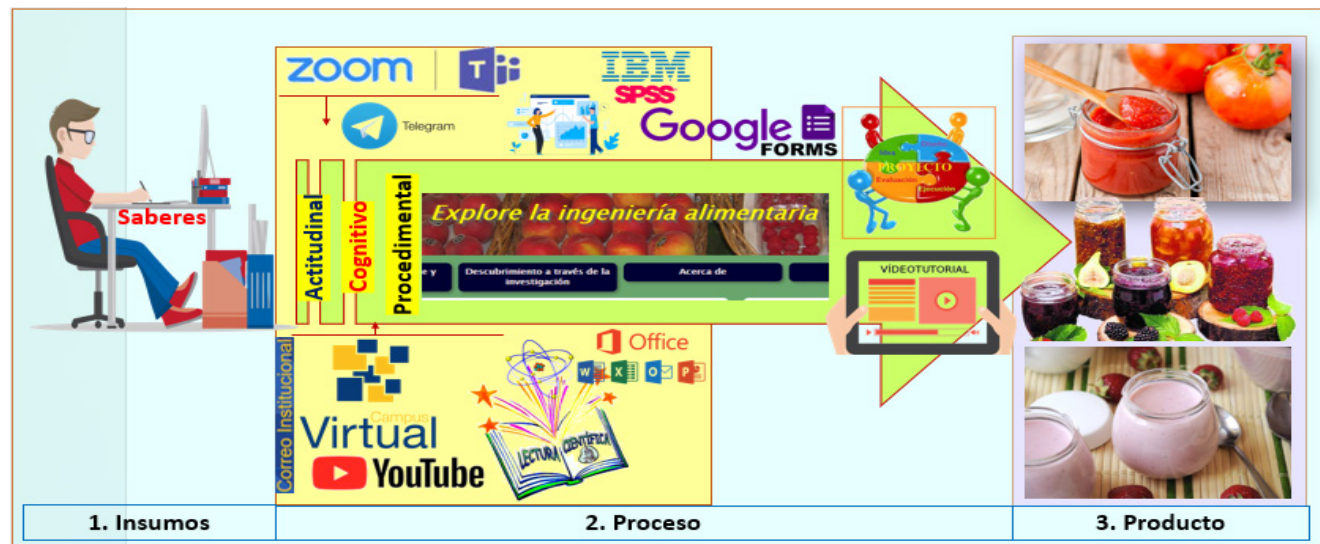


Figure 1: Elements that integrate the teaching–learning process as an educational experience.

1 <http://rpaulsingh.com/learning/virtual/virtual.html>

The videos used in Edpuzzle were created by the instructor through the Zoom platform, later hosted on a YouTube channel and linked to the platform for evaluation, which was carried out based on students' responses and viewing time. Meanwhile, the content generated on TikTok was distributed through WhatsApp groups and the virtual campus, using short videos of up to one minute designed to present the most relevant aspects of each topic in a synthetic way. At the end of each unit, an evaluation instrument was applied to measure students' perception of the use of Edpuzzle and TikTok as methodological tools in the teaching-learning processes.

Educational Experience of 2022

The methodology used was as follows: The study was conducted with students of the Project Formulation and Evaluation course during the period from May 18 to August 19, 2022. Once the course to be worked on was defined, the audiovisual content was created in the following way:

1. Using Zoom as the recording platform and Excel as the tool for explaining and developing the content, each topic requiring a practical explanation in the project formulation class was recorded.
2. Each video created was saved on the computer and later uploaded to the YouTube channel named "ING_EVER REYES."
3. The URL of each video was attached to the respective unit of the class in the UNAH Virtual Campus.
4. Subsequently, access to each video was enabled from the campus as the class content progressed.
5. Students who viewed the videos then commented on their content, with the objective of verifying whether the video was watched completely and responsibly.

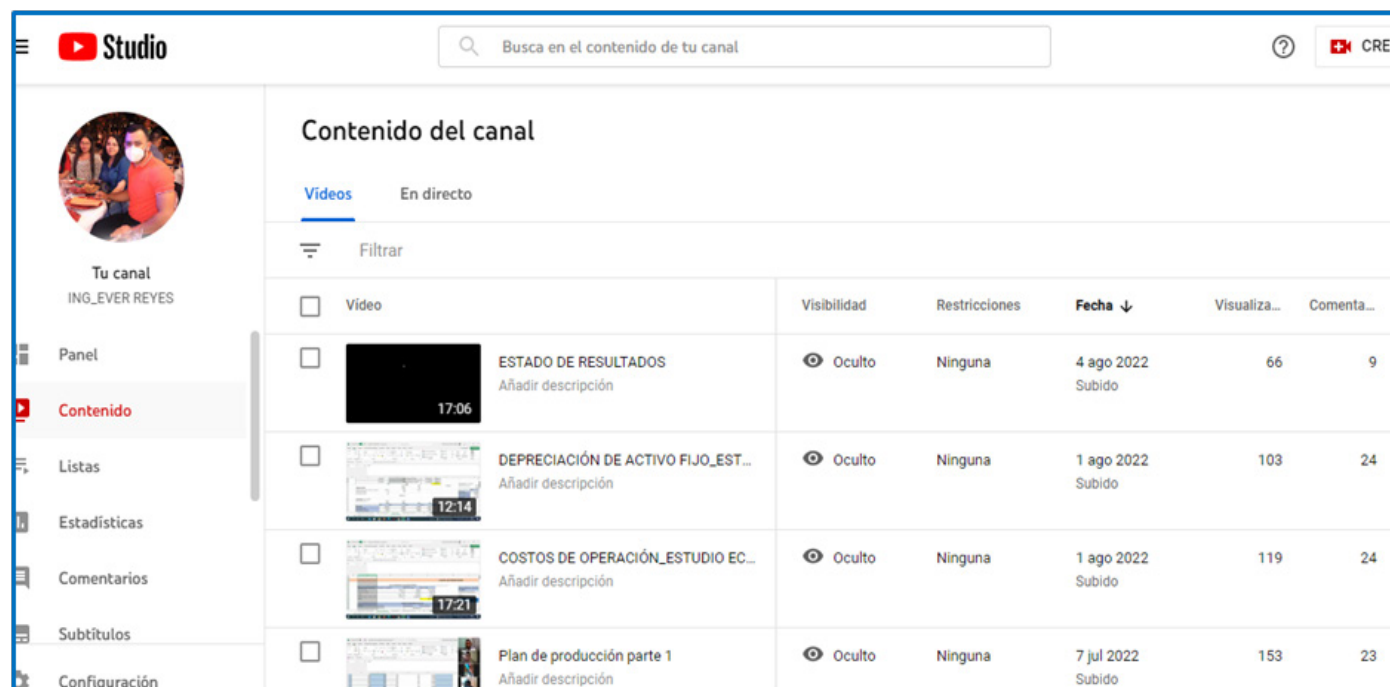


Figure 2: YouTube channel used as a knowledge management tool for the Project Formulation and Evaluation course.

3. Results

Results obtained from the 2020 educational experience:

The complete virtualization of classes was achieved through the implementation of various activities supported by digital resources, technological tools, and synchronous and asynchronous communication media, all oriented toward the construction of meaningful learning and the strengthening of student competencies. Likewise, virtual spaces were

enabled for the development of procedural knowledge, allowing students to carry out simulations typical of the food industry, integrated as part of the virtual laboratories.

As part of the teaching–learning process, 109 videos and tutorials corresponding to the courses taught were recorded and produced, serving as permanent support material for students (Figure 3).

The use of specialized software for quantitative data analysis in the field of agroindustrial engineering was strengthened, specifically through the application of SPSS in the development of academic projects and research activities. Similarly, the preparation of academic reports in the format of scientific articles was promoted, as well as the use of the Microsoft Office suite—particularly Excel—for creating templates, organizing data, and conducting quantitative analysis of projects and activities linked to curricular content development.

The production of documentaries and tutorials created by the students themselves was encouraged, which were shared with their peers, fostering collaborative learning and strengthening communicative and technological skills. Finally, formative feedback was implemented through tutorials as a methodological strategy aligned with competency-based planning, enabling continuous monitoring of learning and the progressive improvement of student performance.

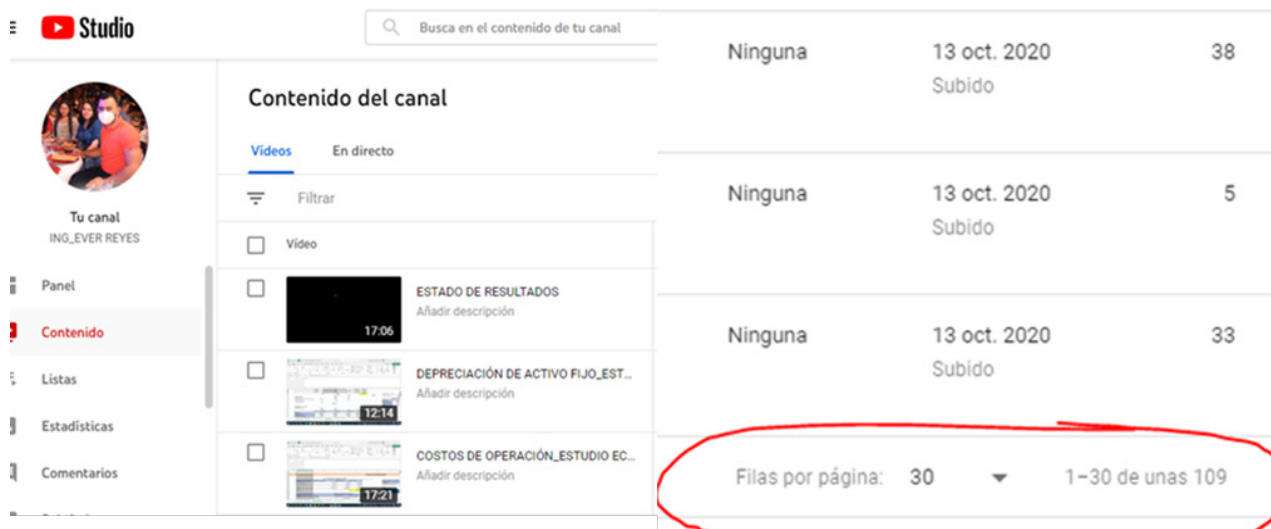


Figure 3: Recording of videos and tutorials uploaded to the YouTube channel.

Educational Experience of 2021

The results obtained correspond to the analysis of the impact of applying Edpuzzle and TikTok in the teaching of various contents, based on students' perception and their level of involvement in the teaching–learning process. The study included 40 students from the Agroindustrial Engineering program, of whom 77.5% were female and 22.5% male.

The Edpuzzle and TikTok platforms were applied in the training process and used by 100% of the participating students, ensuring full coverage of the pedagogical intervention.

Various educational videos were designed and produced, hosted on the instructor's YouTube channel, and later linked to Edpuzzle. Through this platform, students viewed the content and responded interactively to the questions posed during each video (Figure 4).

Each of the activities developed in Edpuzzle was evaluated, complemented by the submission of short videos created in TikTok, which were later analyzed and discussed in class, fostering critical reflection on the topics addressed.

A data collection instrument was applied to measure students' perception of the use of Edpuzzle and TikTok as interactive tools in teaching–learning processes. This instrument was distributed via Google Forms, WhatsApp, and the institutional virtual campus to facilitate access to the link.

The data obtained were analyzed using descriptive statistics with SPSS software, based on the ratings assigned to each of the instrument's questions, yielding the following results: Regarding Edpuzzle, 77.5% of students agreed or strongly

agreed that this tool is fundamental for achieving meaningful learning (Table 2). Likewise, the same percentage considered that its use contributes to making the course development more innovative. Furthermore, 72.5% indicated that they enjoyed using Edpuzzle, highlighting its ease of use, the interactive nature of learning, and the innovative presentation of content. The use of Edpuzzle allows the course development to be more innovative for the improvement of learning.

Table 2: Evaluation of Edpuzzle and TikTok in the teaching–learning process of Agroindustrial Engineering students.

Evaluation	Questions valued by students*			
	Q1	Q2	Q3	Q4
	%	%	%	%
Strongly disagree	5.00	5.00	15.00	12.50
Disagree	5.00	10.00	10.00	10.00
Neither agree nor disagree	12.50	7.50	17.50	22.50
Agree	37.50	40.00	37.50	40.00
Strongly agree	40.00	37.50	20.50	15.00
Total	100.00	100.00	100.00	100.00

Source: Own elaboration.

**Q1: The use of Edpuzzle is very important for achieving meaningful learning.*

Q2: The use of Edpuzzle allows the course development to be more innovative for the improvement of learning.

Q3: The use of TikTok is very important for achieving meaningful learning.

Q4: The use of TikTok allows the course development to be more innovative for the improvement of learning.

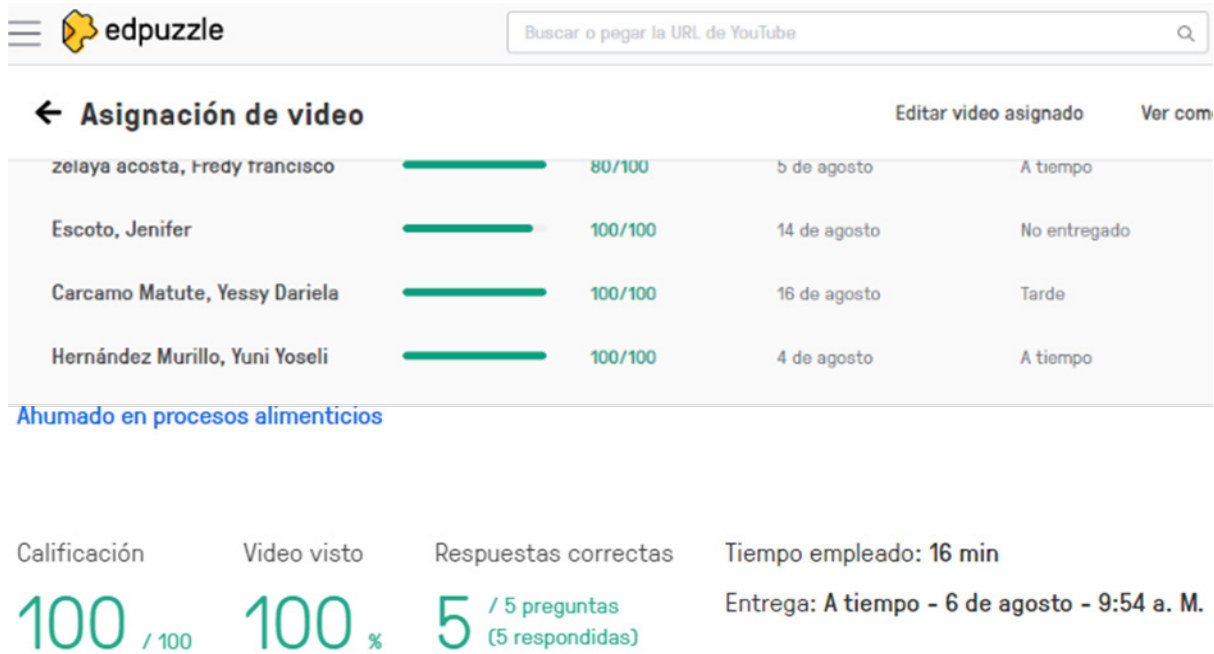


Figure 4: Edpuzzle technological resource in the teaching–learning process of the Food Technology course in Agroindustrial Engineering.

Overall, at least 80% of students expressed satisfaction with the use of Edpuzzle and TikTok as interactive tools, as evidenced in the qualitative comments collected. Among the most representative opinions regarding Edpuzzle was: “*I liked it because it asks questions while explaining the topic, and this way we gain more knowledge of the objectives of the topic explained; moreover, if we cannot be present in class, we have the facility to access it at any time.*” Regarding

TikTok, students noted that *“it allows us to view the content in a short time and explains the topics with clear and precise examples.”*

With respect to TikTok, 57.5% of students indicated that this tool is very important for achieving meaningful learning (Table 2), while 43% expressed that they found it appealing due to its ease of use, brevity of content, interactive learning, and innovative way of presenting topics.

Educational Experience of 2022

The main results obtained from the implementation of the project were as follows: The students developed skills to apply practical analyses in project formulation and evaluation, achieving a better understanding of the different stages of the process. Asynchronous access to content fostered a high learning rate and strengthened competencies in structuring projects at the profile, prefeasibility, and feasibility levels, supported by the use of automated templates that facilitated the organization and presentation of information. As part of the training process, teams created automated templates in Microsoft Excel that integrated the main components of project analysis, and 12 tutorial videos with practical content were produced, culminating in the presentation of four complete projects.

The participation of the 31 students was significant, with 100% video viewing and more than 50% interaction through comments, demonstrating a high level of commitment to the academic material. 94.1% of students successfully created their own Excel templates and presented them before an evaluation panel. Student perception of the methodology was highly positive, highlighting the usefulness of the templates and videos for project development, as well as the value of audiovisual content as an effective strategy to strengthen learning, rated mostly between excellent and very good.

4. Discussion

The emergence of the pandemic in 2020 abruptly transformed the global educational system, generating a significant impact on teaching–learning processes. In this context, maintaining student engagement required the implementation of new teaching methodologies supported by technological resources and the use of synchronous and asynchronous virtual spaces. This process represented an adaptation challenge both for faculty, who had to transition from face-to-face teaching to virtual environments demanding pedagogical innovation, and for students, who had to adjust to new forms of learning that sought to simulate, as much as possible, the experience of in-person lectures. According to Rodríguez-Garcés et al. (2025), non-presential education, fully supported by

digital systems, provided flexibility and ubiquity to teaching processes while granting autonomy to students, creating spaces for synchronous or asynchronous interaction, particularly among peers.

Similarly, Parada and Rodríguez (2021) and Umaña-Mata (2020) argue that this type of education also implied a rupture with the traditional role and functions of teachers, which challenged classical teaching–learning models. Digital competencies in the use of educational technologies, the management of adapted curricular designs, and the transformation of the teacher’s role into that of a facilitator of learning became increasingly relevant. In this new context, students assumed greater responsibility for their own learning process in autonomous spaces without traditional supervision, which generated particular tension and uncertainty in evaluation.

For teachers, the change to these new ICT-mediated teaching methodologies represents a challenge of updating and innovating. According to Valverde and Cifuentes (2022), the university of the 21st century demands a pedagogy that places students at the center of the teaching–learning process, with teachers acting as facilitators of dialogue, guides of learning, and mediators in the construction and reconstruction of knowledge.

Barreto Zúñiga et al. (2023) conducted research on *“Edpuzzle as a Tool to Manage Meaningful Learning at the University of Guayaquil”*, concluding that content managed through Edpuzzle fosters meaningful learning by leveraging audiovisual material available online, which stimulates students’ interest in learning. Likewise, the findings of the present study confirm that the use of Edpuzzle constitutes an effective didactic strategy to strengthen meaningful learning and promote educational innovation in virtual teaching contexts, aligning with pedagogical approaches that encourage interaction, autonomy, and student engagement in their own learning process.

The findings also confirm that TikTok can contribute to meaningful learning when used in a planned and contextualized manner, enhancing pedagogical innovation and student engagement, especially in virtual or hybrid education contexts. Lecona et al. (2025), in their study *“The Use of TikTok as an Effective Learning Tool in Upper Secondary Education”*, reported positive results, highlighting its impact on motivation (70% positive responses) and knowledge retention (75%).

5. Conclusions

The adoption of innovative pedagogical strategies based on a constructivist approach and supported by digital resources proved to be an effective response to the

educational challenges of the 21st century, especially in crisis contexts such as the COVID-19 pandemic. The combination of synchronous and asynchronous methodologies, the use of specialized software, experimental simulators, competency-based assessment, and the active production of content by students ensured the transfer of scientific and technical knowledge, strengthened cognitive, procedural, and attitudinal skills, and promoted meaningful learning centered on autonomy, student protagonism, and integral development.

The integration of digital tools such as Edpuzzle, TikTok, Excel templates, and videos hosted on YouTube demonstrated a positive impact on the teaching-learning process, particularly in highly complex courses such as Project Formulation and Evaluation. Flexible access to content, immediate feedback, and the possibility of reinforcing topics through clear and contextualized audiovisual resources fostered active participation and student engagement, consolidating more autonomous, meaningful, and effective learning, while expanding the possibilities of applying these innovative strategies in other educational settings.

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