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CHAPTER

3

INNOVATIVE STRATEGIES FOR TECHNOLOGY-MEDIATED TEACHING-LEARNING

ESTRATEGIAS INNOVADORAS PARA LA ENSEÑANZA-APRENDIZAJE MEDIADAS POR LAS TECNOLOGÍAS

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CHAPTER 3

INTRODUCTION

The educational models of teaching in Higher Education Institutions (HEIs) are evolving, currently facing very intense debates, which consist of how to make teaching-learning methods innovative, attractive, and of high quality. Another problem is how to adapt them to the changes in 21st century education in accordance with the demands of a changing and productive society (Rajaram, 2021). Some of the most important challenges facing HEIs include developing teachers' skills in content creation, updating teaching-learning methods by incorporating and integrating Digital Technologies (DT) into face-to-face and virtual learning environments, and applying digital tools (Fuentes et al., 2019; Parra-González et al., 2020). However, the diversity of existing methods and resources does not make it easy for teachers to choose those to suit their teaching work demands. In addition, this condition has been favored by the absence of common terminology, the accelerated adoption of technologies and tools in changing contexts, and the lack of integration between methods and tools.

The productive world of the new century demands competencies, capacities, and skills of a higher order that are fundamental for professional activities at the local and global level (Rajaram, 2021; Antonova et al., 2020). This has implied changes in HEIs in the roles of the teacher and student, where the teacher plays the role of a facilitator of learning. The student, on the other hand, is an active subject of learning, responsible for his or her learning (Rajaram, 2021). Likewise, it has been necessary to provide teachers with the relevant competencies and skills needed to incorporate new methodological approaches and technologies that meet the required quality standards (Miranda et al., 2021). In this regard, strategies for the development of digital competencies have been fundamental, allowing teachers to acquire a set of skills, improve collaborative work, and continue learning, in an increasingly effective and autonomous manner (Zhao et al., 2021; Alenezi, 2021).

In relation to the student in HEIs, teaching methodologies have focused on favoring the student's protagonism and participation, giving importance to critical thinking and the development of problem-solving skills, addressing the needs of the changing and productive world, seeking to favor students' leading role and participation, emphasizing critical thinking and problem-solving skills development,

addressing the needs of the changing and productive world. Some of the innovative strategies that have enabled achieving student skills and competencies include Project Based Learning (PBL), Flipped Classroom, Design Thinking, Gamification, and Active Learning, among others.

Particularly, two methods that have acquired a great projection, improving the motivation processes and, above all, the autonomy process are the Flipped Classroom and Gamification (Parra-Gonzalez et al., 2020).

Teaching in HEIs for a modern, changing, and productive society is a complex activity that requires the teacher to identify, select, and apply the best possible combination of strategies to promote meaningful learning. Therefore, the objective of this chapter is to provide a practical and updated synthesis of innovative strategies and technologies to direct and guide the teacher and the HEI, and to make education in HEIs more innovative, attractive, interactive, and effective.

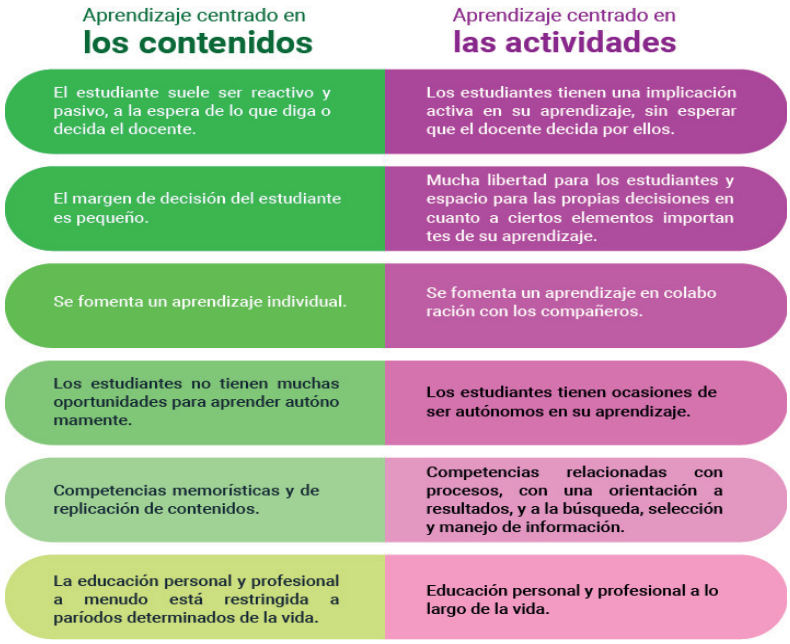
ACTIVE METHODOLOGIES

By active methodologies, we mean methods, techniques, and strategies used by the teacher to turn the teaching process into activities that encourage active student participation and lead to learning. They are methodologies that focus on activities rather than content, which implies profound changes in the actions of teachers and students, along with changes in the planning of subjects, classes, and evaluation. An Active Methodology is an interactive process based on teacher-student, student-student, student-teaching material, and student-medium communication, which enhances the responsible involvement of the latter and leads to the satisfaction and enrichment of teachers and students (López, 2005).

Activity-centered learning is a higher level of student engagement and work, favoring autonomous learning and generating competencies for learning to learn in collaboration with peers (Gros, 2011).

Figure 1

Content-based learning vs. activity-centered learning (Gros, 2011, p. 39)



Activity-centered learning places the student at the center of the learning process, gives him or her a leading role, and favors collaborative and autonomous learning. In addition, it allows students to develop higher order skills[1] demanded by the knowledge society and useful not only for academic but also for professional life.

To design an educational process focused on activity over content, a wide variety of active methodologies has been designed and implemented to promote the construction of learning and meaning, based on an active role of the students and in collaboration with them.

Below, we present a set of active methodologies, some of which have a long history in teaching, and others that have emerged because of advances in education and digital technologies.

Case studies

The case study is a methodology characterized by being a detailed analysis of a situation, real or created, but feasible to address in teaching, which recreates the conditions of the working environment of the future professional.

[1] Analysis, synthesis, conceptualization. Information management, critical thinking, research, metacognition.

Case studies can be presented in written, audiovisual, or non-participant observation forms. In its implementation, students are required to analyze the case using principles, concepts and theories reviewed in the course. The teacher should pose questions that help the analysis. Finally, students prepare a strengths, weaknesses, opportunities, and threats (SWOT) analysis of the case studied. In this methodology, the evaluation should consider the progress the students have made and the conditions under which it has been carried out. The final product is relevant, together with the process through which students manage to reach that product, which makes it necessary to think of evaluation in an integrated manner in the teaching-learning process (Labrador & Andrew, 2008).

Problem-Based Learning (PBL)

Problem-based learning is a methodology that assumes problems as a starting point for the acquisition and integration of learning. It confronts students with problematic situations associated with their profession, mobilizing a set of resources, and learning to solve them from this point (Díaz Barriga, 2005). Students are required to reflect on the problem, discuss, and propose hypotheses to solve them, considering their previous learning on the subject, exploring possible strategies to face the problem with the support of relevant information, and finally verifying the hypothesis through the background information gathered and the basis of their answers. It responds to "an inductive approach in which students learn the content while trying to solve a real-life problem" (Atienza, 2008). The evaluation in this methodology should be a process where the use of information, integration of the theoretical aspects of the course, and the transfer of what has been learned to new problems are valued.

Design Thinking

Design Thinking is a methodological approach focused on creative and cooperative problem solving through the establishment of needs, design, and iteration of the solution. This methodology seeks to develop critical and logical thinking in students, openness to new ideas and proposals, creative thinking, and another set of metacognitive competencies (Latorre-Cosculluela et al., 2020). Students also develop self-learning skills, improvement in teamwork competencies, such as assertive expression of opinions, empathy, and knowledge sharing. According to Jiménez and Castillo (2018), this methodology encourages students not only to do things differently but to do things in a better way, it also fosters autonomous learning based on imagination, integrative thinking, optimism, experimentation, and group collaboration. Design Thinking is carried out through a series of stages which are problem planning, definition, design, prototyping, and evaluation. These

activities allow the student to formulate assertive answers and solutions to an identified problem.

Service Learning (SL)

Service Learning (SL) is a methodology that integrates learning based on experience and service that contributes to provide real solutions to community problems (Martinez, et al., 2013), generating a space for training in values for students (Jouannet et al., 2013). In this way, "developing a service action transforms and gives meaning to learning and, on the other hand, developing active and meaningful learning improves the action of solidarity" (Puig et al., 2011). To implement this methodology, learning activities that position reflection as an articulating axis of the learning process need to be designed. Before, during, and after the process, students should be allowed to understand all the aspects involved in their intervention in a given community, while at the same time favoring the re-signification of the intervention developed. The methodology encourages students to relate the course content to the service experience, ask questions, propose theories and action plans, and express their ideas (Jouannet et al., 2013).

Flipped Classroom

The Flipped Classroom or inverted classroom is a methodology that considers performing simple learning activities outside the classroom, such as observing or memorizing. More complex activities, such as reasoning, take place in the classroom. This method has stood out for its practical and dynamic components (Parra-González et al., 2020; Hew & Lo, 2018). It is a methodology that reverses the order of a traditional class, presenting the content before the face-to-face class by means of short videos, audios, or readings (among other inputs) that students review in the autonomous work prior to the class. The face-to-face class is focused on activities, where the content previously addressed by the students is used. Acknowledging the importance of content mastery, expanded understanding is achieved through teacher mediation in solving the task. (Schneider et al., 2013).

Gamification

Gamification is a methodology that combines the mechanics of games with the educational environment, allowing to improve the results and predispositions of students to learn (Parra-González et al., 2020).

It is also increasingly frequent for assessments to use innovative strategies, replacing traditional assessments, for example, assessment combined with

Gamification, such as interactive quizzes or Trivia game-like contests (Sera & Wheeler, 2017; Fotaris et al., 2016).

DIGITAL TECHNOLOGIES FOR TEACHING

There are a multitude of digital technologies and tools that can be used in the teaching and learning process at different levels, from elementary education (Pierce & Cleary, 2016) to higher education (Castañeda & Selwyn, 2018). Some of these tools have a general purpose (e.g., Padlet fosters discussion on a certain topic by organizing the contributions of each student in notes that are presented on a board and ordered according to their relevance) (Beltrán-Martin, 2019). Other tools have a more specific purpose (e.g., Photomath allows solving mathematical equations by taking a photograph of the equation, providing a step-by-step explanation of the process of solving the equation) (Igcasama et al., 2020). In any case, the use of digital technologies and tools for teaching has accelerated strongly in recent years, mainly due to the digital transformation of educational institutions (Delgado Kloos et al., 2021) and the availability of multiple devices in the classroom that allow the use of technologies and tools, including teachers' and students' own devices (Parsons & Adhikar, 2016). It is also important to note that many technologies and tools, particularly many of those offered through the cloud, are licensed for educational use, which allows their free or low-cost use by teachers and students.

This acceleration in the adoption of technologies and tools, along with their changing nature and the multiple purposes for which they can be used complicate the definition of a single classification for such technologies and tools. In this regard, there have been several attempts to classify technologies and tools that can be used for teaching (Goodwin & Highfield, 2012; Cherner et al., 2014; Stevenson & Hedberg 2017). For example, de la Serna-Tuya et al., (2020) propose a classification of technologies and tools aligned with the levels of Bloom's revised taxonomy (remember, understand, apply, analyze, evaluate, and create). An interesting classification, which is dynamically revised as new tools appear, is proposed by Andrea Oviedo through a representation of teaching technologies and tools as a periodic table (Oviedo, 2020). In this classification, eight categories are established for technologies and tools: 1) content creation; 2) communication and community; 3) content creation; 4) content creation; and 5) content creation; 2) communication and community; 3) assessment and gamification; 4) programming; 5) organization of ideas and blackboards; 6) educational content; 7) content management; and 8) tools and resources. However, it is important to note that not all categories are independent and that the same tool can have different uses depending on the purpose established by the teacher. For example, Google Suite (now Google Workspace) tools such as Forms, Docs, Sheets, and Slides can be used by teachers

and students for content creation, but they can also be used to foster collaborative work and organize ideas by editing documents synchronously or asynchronously (Tan & Kim, 2011). Another example of technology that can be classified into several categories is H5P, which is a framework to create and organize HTML5 content and can also be used to assess students (Reyna et al., 2020).

Regarding the creation of educational content, we can use technologies and tools that make it easier for teachers to create rich texts, infographics, slides, or videos, among others. For example, three major software vendors provide tools for content creation in the cloud: Google (Workspace), Microsoft (Office 365) and Apple (iWork). Other tools that allow, for example, the creation of interactive presentations or infographics include Prezi, Canva, Genially, or Nearpod. It is also important to highlight some tools that can be used to produce educational videos such as PowToon, Kaltura, Camtasia, Screencast-O-Matic, or Panopto, among others (Laaser & Toloza, 2017).

Communication among teacher and students or among students themselves and the creation of communities within a subject or course is typically supported by tools that allow synchronous or asynchronous communication. In this regard, videoconferencing tools can be used for synchronous communication such as Zoom, Google Meet, Blackboard Collaborate, or MicrosoG Teams (Lenkaitis, 2020). Alternatively, discussion forums of institutional platforms, known as LMS (Learning Management Systems) such as Moodle, Canvas, or Open edX (Tirado et al., 2015), can be used, as well as other popular general-purpose tools for asynchronous communication such as WhatsApp, Telegram, Discord, or Slack (Menzies & Zarb, 2020).

Assessment is a very relevant aspect that can be gamified thanks to tools that allow implementing interactive quizzes with point systems, medals, and rankings. Many tools of this type have emerged in recent years and are successfully used for both formative and summative assessment (Göksün & Gürsoy, 2019) and include Kahoot!, Wooclap, Quizziziz, Quizlet, Socrative, or Mentimeter, among others (Vallely & Gibson, 2018).

All these tools require students to use a mobile device to be able to answer the questions, although there are other tools intended for elementary education that do not impose this requirement. These tools work with codes that students must show the teacher, who reads with their mobile device, as is the case of Plickers (Wood et al., 2017). Finally, it is worth noting the case of tools that allow to integrate assessment with educational content in a simple way, as is the case of the creation of videos with integrated assessment questions thanks to tools such as Edpuzzle (Mischel, 2019).

Another interesting category that is becoming increasingly relevant is the one

that refers to teaching and learning programming, generally in non-university educational contexts or non-engineering-focused university education. In this sense, a first approach to programming can be carried out with block-based languages, such as Scratch, Blockly, or Snap! (Ortiz-Colon & Romo, 2016; Ball et al., 2019). Alternatively, there are other tools that allow mobile application development also by connecting blocks and that allow students to easily introduce them to the world of programming, as is the case of MIT App Inventor (Wolber et al., 2015).

Numerous tools support students in idea organization and knowledge construction such as, for example, shared whiteboards, such as Google Jamboard, MicrosoG Whiteboard, Padlet, Miro, Sketchboard, Stormboard, Whiteboard Fox, Limnu, and OpenBoard, among many others (Pardo-Cueva et al., 2020; Alanya-Beltrán et al., 2021). There are also tools to specifically create concept maps such as Mindmeister or Coggle (Debbag et al., 2021). Finally, other tools can be used to organize the tasks to be performed, such as Trello (Kalizhanova et al., 2018).

In relation to educational content, there are many sources available to teachers and students, for general purposes (e.g., presentations on Slideshare, videos on YouTube, academic articles on Google Scholar) and specific purpose (e.g., content for STEM learning on Khan Academy, content for language learning on Duolingo, MOOCs - Massive Open Online Courses - on edX or Coursera, etc.) (Thompson, 2011; Huynh et al., 2016). For educational content management and organization, LMS such as Moodle, Canvas, Blackboard, Google Classroom, or Open edX are usually used, although there are other lighter technologies and platforms to organize content, such as Wordpress or Google Sites, and even Symbaloo or Edmodo, more oriented to pre-university education, among others (Holland & Muilenburg, 2011). Finally, it is important to consider the extensive number additional tools and resources, some of which are browser extensions, such as image banks and other open-license educational resources (e.g., Pixabay for images and OpenCourseWare for all types of content).

ACTIVE METHODOLOGIES AND DIGITAL TECHNOLOGIES DIGITAL

Active methodologies innovate in the teaching-learning processes, for which digital technologies are a great ally. They are successfully inserted in education when they accompany processes of methodological changes that promote the active participation of students. During the first years of DT use, projects focused on technical innovation to create technology-based learning environments; now the focus is the student and the methodology (Salinas, 2004). DTs are conceived as

tools to support and improve how to provide students with educational assistance and to promote their autonomous and self-regulated learning capabilities (Coll et al., 2006).

In the current university context, teachers face the challenge of changing their role from teacher-centered teaching to a student-centered learning process. This implies for Amador et al. (2017) developing competencies to guide, advise, and create spaces and opportunities for students to develop professional competencies, being immersed in a process of reflection and analysis of their own teaching practices. The keys to the university of the 21st century are new DTs, interdisciplinarity and innovation. Teachers become mediators, articulators of learning environments and facilitators of autonomous learning of students, thus they are required to adequately manage pedagogical and technological content (Gros, 2011).

Active methodologies are enhanced by the possibilities offered by DTs, such as search and access to information, interaction and collaboration, virtual platforms, general and specific digital resources, and tools to generate mental and conceptual maps, among others. This allows for innovation in teaching, incorporating active methodologies and favoring collaborative and autonomous student work. There is a set of active methodologies such as the flipped classroom and gamification that arise under the protection of digital technologies. Without DTs it is impossible to implement them. There is a series of techniques that facilitate the implementation of active methodologies using ICT (Salinas et al., 2008).

Introducing digital technologies in teaching is a process that must be approached carefully. First, the desired learning outcomes must be selected. Second, there is the methodology, in this case the active methodology to be used. Third, the digital technology that is most relevant for the implementation of the learning activity must be sought. The following table shows for different active methodologies, activities, or techniques that can be employed and the digital technologies that could be used

Table 1

Active Methodologies and Digital Technology Use

Active Methodologies	Activities and Techniques	Digital Technologies
Gamification	Points Levels Classes Challenges Badges Prizes	Elever Preguntados Cerebriti Kahoot Brainscape Educaplay Quizlet
Cooperative Learning	Screencast Forum Blogs Wikis	Google Drive Blogger Slideshare
Project-based Learning	Blog creation Product elaboration Research projects Community projects	Zoom Google Drive YouTube Prezi Slideshare
Flipped Classroom	Reading Guides Slide presentation Pre-recorded Videoconferences Online libraries Screencast Infography	Prezi YouTube Moodle Google Académico Kahoot Pinterest

Table 1 (Continued)

Active Methodologies	Activities and Techniques	Digital Technologies
Design Thinking	Forums	Canva
	Concept maps	Power Point
	Infography	Drive
	Interviews	Moodle
	Cause/effect diagrams	Telegram O WhatsApp
	Moodboard	Pinterest
	Brain- storming	
	Sketching	
	SWOT or PESTEL	
	Canva Matrix	

Source: Buenaño-Barreno *et al*. (2021)

Digital technologies contribute to the acquisition of skills in information search and management, communication, collaboration and creation of digital resources, and their well-planned use could have positive effects on the teaching and learning process. From this perspective it is important to identify types of digital technologies that can be used within the different strategies and learning activities that promote active methodologies. It is the teacher who, based on a methodology, decides the role to be played by the DTs. This involves diagnosing teaching situations, deciding the DT to be used, designing, implementing, and evaluating the experience (Prendes et al., 2018).

CONCLUSIONS

Teaching in higher education requires changes to respond to the current needs demanded by the knowledge society. There is a profile of students entering higher education with a high degree of digital technology management, which they use for social and leisure aspects rather than to support their learning processes (Sánchez-Caballé et al., 2020).). On the other hand, the demands of the labor market demands and job dynamization require competencies associated with teamwork, collaboration, problem solving, and commitment to society.

In this scenario, active methodologies are called to show a path of innovation, an opportunity to align university teaching to the demands of new students and the labor

field. Designing teaching from the use of active methodologies incorporating DT, is a strategy that enhances student learning, brings them closer to the technological world that they experience outside the classroom, and allows teachers to renew their teaching. Therefore, it is advisable to use the mixture: active methodologies and digital technologies, in different contexts and educational levels.

Active learning methodologies present important challenges to teachers because their success is the correct design of activities framed in a pedagogical plan, which are especially suited to the needs of students and involving the use of digital technologies. It is essential for teachers to constantly research DTs that can be applied in developing activities based on active student learning (Reyes-Maldonado & Chaparro-García, 2013).

Training is required for teachers in active methodologies and in teachers' digital competence understood as the skills, attitudes and knowledge required to promote true learning in a DT-enriched context. A digitally competent teacher must be able to use technology to enhance and transform classroom practices and to enrich his or her own professional development and identity (Fraser et al., 2013). In this sense, the DigCompEdu framework (Redecker & Punie, 2017) is widely used to diagnose and train in Digital Teaching Competence in Higher Education (Cabero et al., 2021). These trainings should be carried out using active methodologies and inserting DT as a support resource, they should model how to implement teaching under this approach. They can be practiced in face-to-face modality, online courses, MOOC, or other instances. The MOOC "INNOVAT" developed under the InnovaT project "Innovative Teaching Across Continents - Universities From Europe, Chile and Peru on an Expedition," is an example of how to approach through a MOOC the teacher training in active methodologies and DT, in order to innovate in university teaching (Silva et al., 2020).

It is desirable to collect and make visible good practices that act as models for other teachers.

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