OBSERVATORY
of Educational Innovation
Tecnológico de Monterrey

Tecnológico de Monterrey

EduTrends

MAY 2017

Radar of Educational Innovation 2017

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Introduction

The Radar 2015 led the way to our new edition: the Radar of Educational Innovation 2017, which presents the latest trends in pedagogy and educational technology at Tecnológico de Monterrey at the undergraduate (bachelor) level. The educational innovation map it offers includes the teachers' outlook on the motivations, obstacles, and benefits they find in being at the forefront of the teaching practice.

The objective of the Radar 2017 was to determine the most relevant pedagogic and technological trends from the perspective of innovative teachers at Tecnológico de Monterrey.

An adaptation of the Delphi Method was used to establish the repertoire of trends. In a first phase, two panels of the institution's educational innovation experts mapped and described the most important trends in pedagogy and technology. In the second phase, the list was expanded, discussed, and validated by 145 professors of the Tecnológico who are implementing educational innovation projects financed by the institution (winners of the NOVUS Grant).

In a questionnaire, these professors also assessed the present and future impact of each trend and expressed their opinions on their actual practice in the classroom. The result is a collection of 26 pedagogy trends and 19 educational technology trends.

Among the topics covered in the Radar 2017, we point out the following:

- The 5 most relevant pedagogy and educational technology trends at the Tec de Monterrey and their implementation timeframe.
- The 5 most important trends in the Tec de Monterrey from a discipline perspective, that is, those specifically relevant for the professors' fields of knowledge.
- A glossary that gives a concise explanation of each of the pedagogy and technology trends. It is a practical tool to keep abreast of educational innovations.
- Actual cases in which they were applied. For the trends with the most votes, we present some projects that are underway at the Tecnológico de Monterrey and other universities around the world.
- The main motivations, challenges, and obstacles involved in applying these trends in the teaching practice according to Tecnológico innovative professors.
- A comparison of the evolution of pedagogy trends vs. educational technology trends.
- The evolution of educational innovation at Tecnológico de Monterrey by the comparison of the Radar 2015 results with those of the Radar 2017.
- The methodology employed, which is useful for studies of new trends in educational institutions.

We must look to the future and discover which new teaching and learning ways are gaining ground on the education scene as well as the new technological tools available to us, and do it in a localized manner, within our institutions and classrooms, to avoid depending on educational discourses created in other environments. Finally, we have to do it from the perspective of those who are the pioneers in this exploration: the innovative professors.

The results published in the Radar 2017 may be especially useful for:

- Educational institutions, especially in Latin America, that want to take informed decisions to develop their own agenda on educational innovation.
- Professors who are exploring or about to explore new ways of teaching and need a concrete selection of technologies and pedagogic models to use as inspiration for their own endeavors.
- The educational community of the Tecnológico de Monterrey, in order to know what path educational innovation is taking in the institution.
- Entrepreneurs (educational Youtubers, publishers, school principals, freelancers) in search of emerging market niches in the field of education.
- Researchers interested in directing their scientific work to educational practices in the process of transformation.
- Students interested in finding out about the different learning paths, technologies, and models available to them.
- General public to whom the changes in education are important in order to understand the possibilities of the future and the challenges of the present.

Methodology for the development of the Radar of Educational Innovation 2017

The first Radar of Educational Innovation was published on 2015. That exercise revealed that the trends in pedagogy that back then were considered the most relevant were Flexible Learning, Experiential Learning, Mentoring, Challenge-Based Learning, Hybrid Learning, Gamification, Flipped Learning and Competency-Based Learning. Furthermore, the five emerging trends in educational technology according to the 2015 Radar were Internet of Things, Adaptive Learning, Augmented Reality, Personalized Learning Environments, Ubiquitous Learning, and Virtual and Remote Laboratories.

What has happened since then? Were the 2015 Radar forecasts confirmed? Or has the panorama of the institution's educational innovation changed significantly in just two years? Which are the trends that have presently gained influence? The methodology used to answer these questions was inspired in the Delphi Method, which is normally used in studies about the future, especially in the field of innovation. It consists of a successive chain of expert discussion panels through which an informed agreement is reached regarding what trends are setting the course in this area.

The different stages and procedures of adapting the Delphi Method used to develop the 2017 Radar are described below. In this case, the purpose was not only to define the repertoire of educational trends and predict what their importance will be in the institution in the future but also to get an idea of what the professors who applied these innovative practices in their classrooms thought and felt about them.

Identification of the educational innovation trends

The repertoire of trends in pedagogy and technology that were applied is the result of the triangulation of various sources:

- Radars developed in the Tecnológico de Monterrey since 2012.
- Reports on educational trends, such as New Media Consortium, Gartner, and Educause.
- Interviews with experts of the institution.
- Multiple references found by means of the systematic analysis of the educational trends carried out by the Observatory of Educational Innovation.

Participants

The sample of participants in the Radar of Educational Innovation 2017, both to validate the data gathering instrument and the definitive sample, was made up of professors of the Tecnológico de Monterrey who advance educational innovation projects in the institution and have received the benefit of NOVUS Grants. These grants finance educational innovation proposals in an experimental stage conducted by the professors of the Tecnológico, regardless of the educational level in which the professor teaches or his/her field.

The merit of the selection of the participants was its extension as a total of 145 professors took part. Additionally, the selection had the following characteristics:

- Multi-disciplinary, with professors from different schools and fields.
- Multi-level, with innovative teachers in High School, Undergraduate, and Graduate levels.
- Geographically diverse, with professors from different campuses and regions of Mexico.
- Representative of each of the latest educational innovation trends.

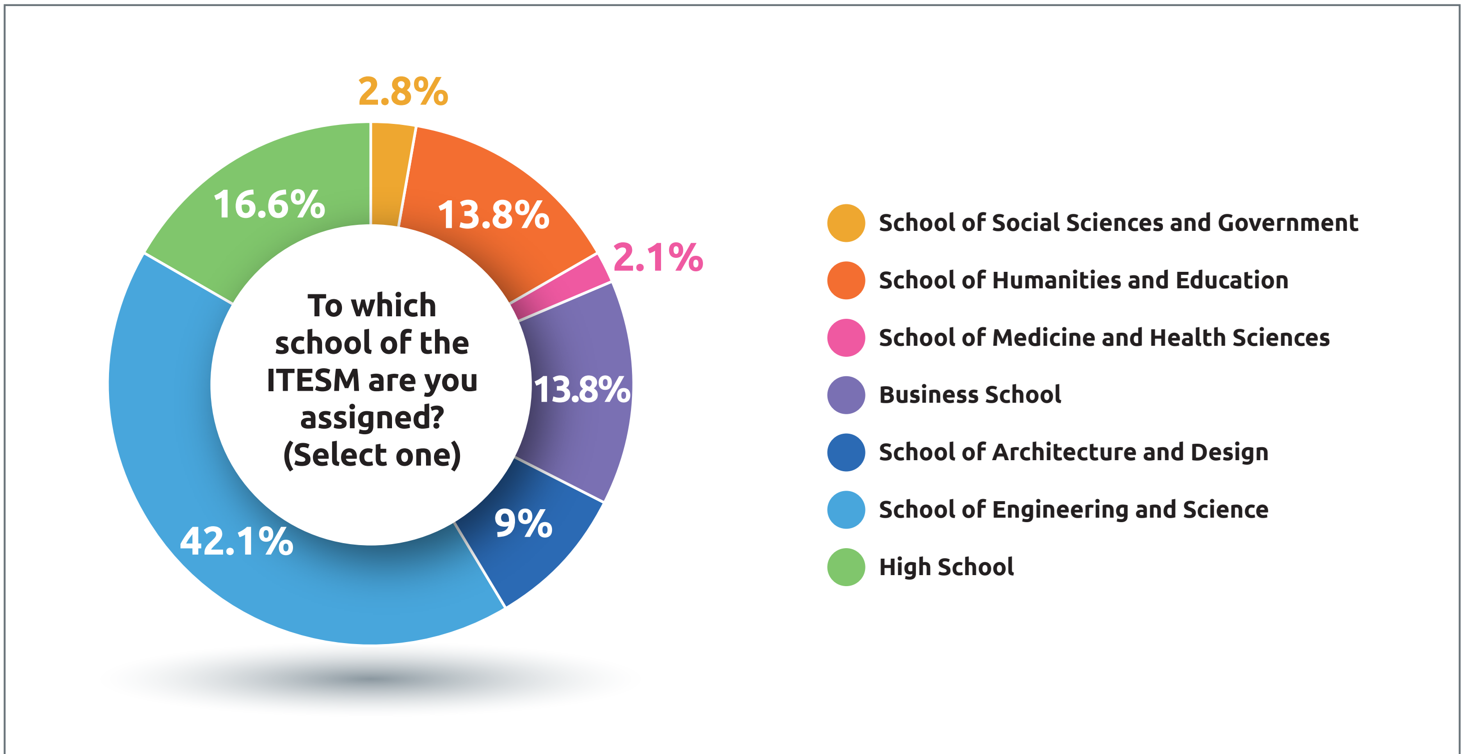

Figure 1. Distribution of professors by school.

As all the schools in the institution participated in the 2017 Radar, the result was a contribution by all the areas. The participation per school was as follows: School of Social Sciences and Government, 4; School of Humanities and Education, 20; School of Medicine and Health Sciences, 3; Business School, 20; School of Architecture and Design, 13; School of Engineering and Science, 61; and High School, 24 (Figure 1).

Regarding the academic level in which they teach, the results show that 26 of the professors participating in the radar are from High School, 106 from Undergraduate, and 13 from the Graduate levels (Figure 2).

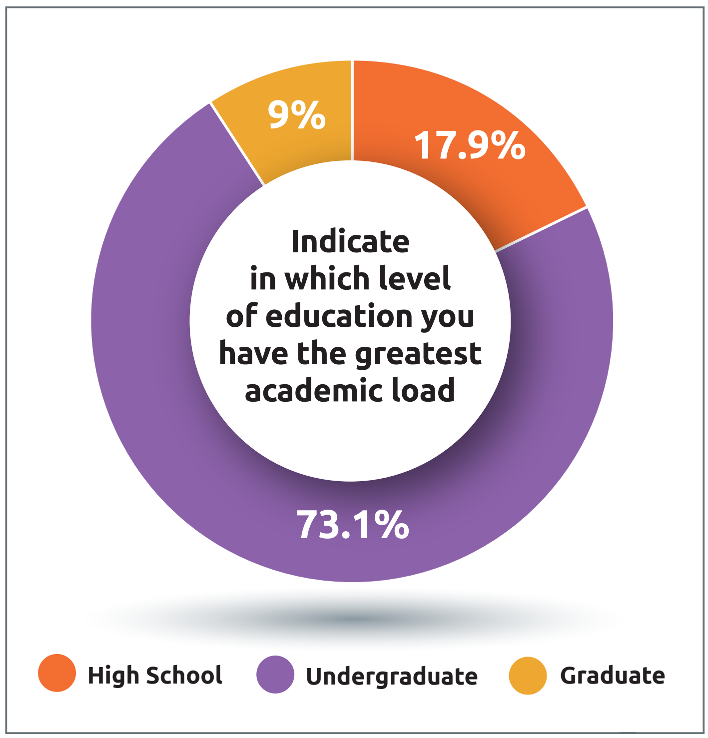

Figure 2. Distribution of professors per academic level and academic load.

The objective of Radar 2017 was to determine the most relevant pedagogic and technological trends from the perspective of innovative teachers of Tecnológico de Monterrey. A 14-item questionnaire was developed to gather information, as well as two cards with 26 pedagogy trends and 19 technology trends (see Glossary).

The Radar of Educational Innovation 2017 was carried out in two phases:

Phase 1: Instrument validation and initial delineation of the trends

The instrument validation was initially obtained by means of the sequenced discussion of two focus groups comprised of different professors on each occasion. The first focus group was held online on November 29, 2016, on the WEBEX platform that enables videoconference sessions. Eight experts in technology and educational innovation whose greatest academic load is at the Undergraduate level of Tecnológico de Monterrey made up this first focus group. The second group was also held via WEBEX on December 2, 2016, and had the participation of five other teachers of similar characteristics.

The criteria they used to assess each item of the questionnaire were:

- How comprehensive were the items in relation to the study variables.
- Clarity, precision, and coherence in the phrasing of the items.
- Relevance of the items to the study variables.

Besides conducting the evaluation, the professors had an open arena to discuss the delimitation and definition of the educational trends and make observations regarding the questionnaire. The necessary corrections were made later based on their suggestions. Finally, the instrument was designed in an online format in Survey Monkey.

Phase 2: Redefinition of the repertoire of trends and assessment of their impact and implementation

The trends established in the two aforementioned panels were polished and delved into an on-site exercise held on December 16, 2016, at the Mexico City Campus. There were 145 innovative professors of the Tecnológico (NOVUS professors) divided into work groups of no more than 10 people. The following are the seven steps of the exercise:

1. Each person was given two cards, one with the pedagogy trends and the other with the technology trends.
2. A moderator explained the instructions for reading the cards, dividing the trends in groups of 6.
3. Six staff members, who acted as assistants to the exercise, supervised and answered questions posed by the attendees.
4. The participants were asked to discuss which trends they considered most relevant.
5. They were also asked to add any trend not previously listed and define it.
6. The suggested trends were added in real time to the online questionnaire format to incorporate them in the vote.
7. The professors voted individually to rank the most relevant trends on their electronic devices: cell phone, tablet or laptop.

Results of the radar of trends in pedagogy at Tecnológico de Monterrey (general prospects)

The following are the results obtained by the radar regarding the general prospects, which are understood here as the set of data that allows us to explore or predict the future of the trends in pedagogy and technology that the professors consider relevant for all the fields of knowledge.

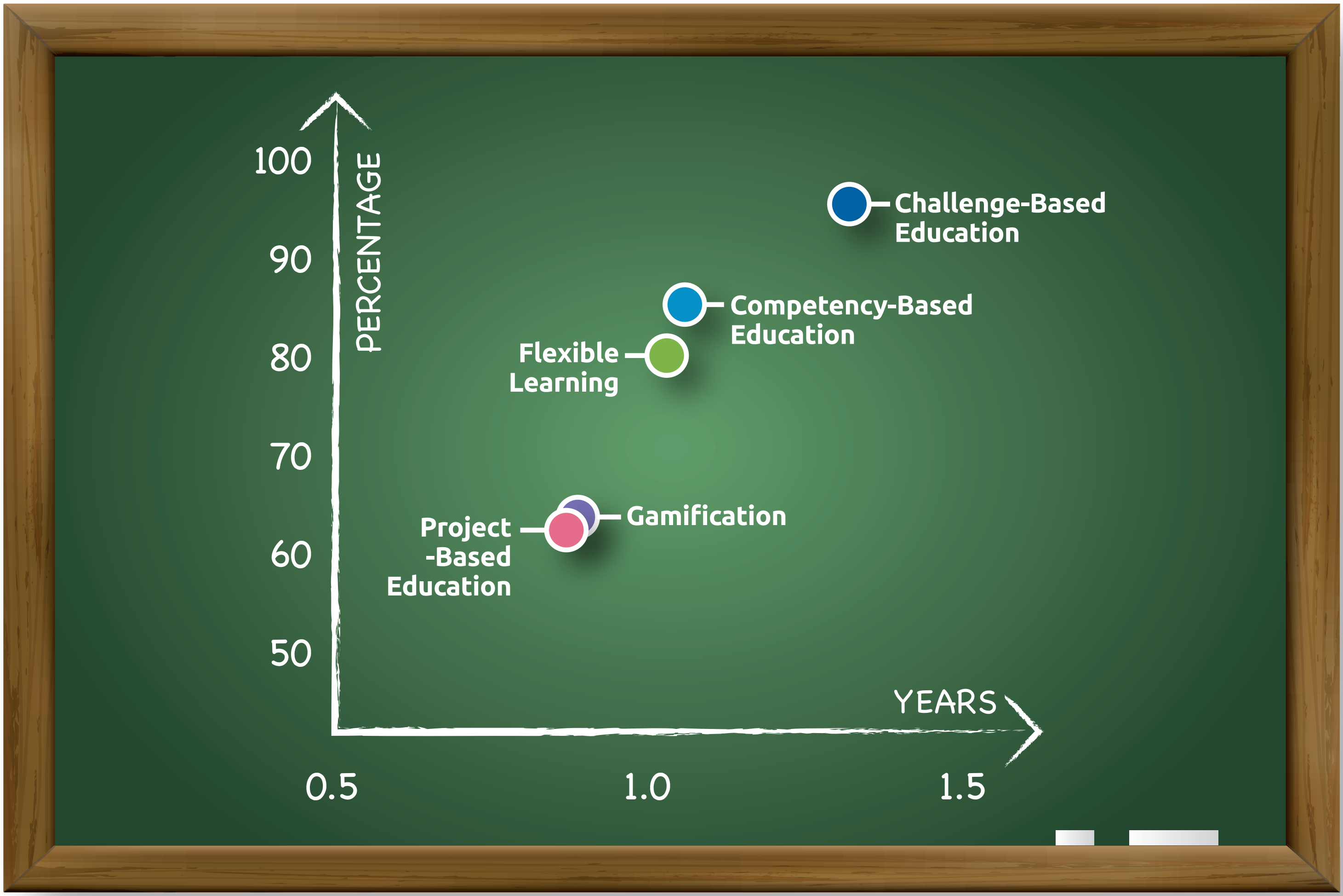

Figure 3. Trends in pedagogy (general prospects).

Trends in pedagogy	Percentage of total votes	Timeframe (years) for it to become relevant
Challenge-Based Learning	94	1.31
Competency-Based Education	83	1.15
Flexible Learning	80	1.11
Gamification	62	0.86
Project-Based Learning	61	0.85

Table 1. Trends in pedagogy from the general prospects.

Challenge-Based Learning

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In the Applied Electronics course at the Undergraduate level, the students were challenged to design a manufacturing system for LEGO with operational amplifiers (OpAmps). The system input consisted of the sensors needed to carry out each action. For example, one sensor detects that the doll's head is in position and another executes the instruction to paint its face. When both actions are coupled, an actuator is activated which lowers the stamp and paints the doll's face on. The students were free to research and propose sensors and actuators that would work at certain levels of voltage and simulate them in the Multisim software. The students were told that there is no unique solution and that each process may vary considerably from one person to another.

The results exceeded the expectations. The students created complex and functional circuits and thereby developed key competencies such as independent work and problem-solving in the manufacturing field. One of the students recounts their experience: “This practice was complicated because we had been interacting with OpAmps for only a short time. It was a challenge to use them and simulate the process in a factory. But the important part was what we learned, all the research we did and being able to understand how to use all the configurations covered in class to choose the best one depending on its usefulness and functionality.”

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The Mechatronics Lab is part of the classes assigned to work under the scheme of TEC21 Internship for the B.S. in Mechatronics Engineering. Each midterm exam involves challenges focused on understanding the different prototyping tools (e-textiles, processing, and 3D printing) in order to resolve an actual health issue.

The challenges implemented were: a) Develop a wearable to enhance physical strength by means of an accelerometer or a myoelectric sensor; and b) Develop a proposal for a device printed in 3D that can be used as support in a health emergency in a mission to Mars. The design of the latter was based on NASA's “Mars Medical Challenge” contest in which the participants propose CAD models that, when they are printed in space, help maintain the astronauts' health.

The students successfully implemented the new tools and developed novel and functional prototypes. They met 100% of the requirements of each challenge as they could assess their work themselves before the final evaluation, get the professor's feedback and make the necessary adjustments.

Full Sail University
(USA)

The Full Sail University in Florida has been, for decades, forming leaders in the U.S. in the leisure and entertainment industry, such as Gary Rizzo, sound engineer, who won the Oscar, or Sebastian Krys, winner of the Latin Grammys as a record producer. One of its strategic purposes is to stimulate talent in fields in the middle of a cultural and technical revolution such as movies, music, or media-based communication.

They found in Challenge-Based Learning a methodology that allows them to solve problems, develop an experiential learning (Making by Doing) and empower students to come up with their own ideas and learning. As Ann Russell, director of the Cinematographic Production said, “We give students the freedom to explore their creativity. They have an immersive experience that spurs their chance to express themselves.”

Through Challenge-Based Learning, students combine various contents and disciplines, and they do so in collaborative learning environments with “team contracts” that specify each member's function in the pursuit of a common goal. The challenge design should be geared toward generating creative processes and products that are relevant in the labor market and, therefore, should transcend the status of a mere school exercise to earn more credits. The duration is flexible and makes it possible to modulate the learning in brief and intensive cycles of, for instance, one week. Finally, throughout the course, the student can make up a personal portfolio to show the concrete applicability of their talent and capability to add value to the market (Digital Promise, 2016).

Competency-Based Education

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As part of the Master of Administration of Educational Institutions at Tec de Monterrey, in the subjects of Educational Administration and Leadership and Planning of Educational Institutions, two digital mini scenarios were implemented to develop critical thinking and communication competencies. These mini scenarios involve the design of a problematic situation. Students have several alternatives to respond and have to use decision trees to defend the path they chose to follow.

Of the 43 students who worked on the mini scenario of Communication, 42 of them (97.6%) said that the activity helped raised their awareness about the essential elements of the competency, mainly oral expression, content presentation, and focus on the presentation objectives. Moreover, of the 40 students working on the critical thinking mini scenario, 39 (97.5%) reported that the activity helped them distinguish important elements of the competency and understand the different positions of a single theme or problem.

Purdue Polytechnic Institute
(USA)

The Purdue Polytechnic Institute (PPI) is one of the largest technology education centers in the U.S. and ranks first in the number of engineering degrees granted in the country. Their programs in the field of aviation, programming and high-tech engineering are especially renowned.

The PPI bases its curriculum on Competency-Based Education in which the main education achievement is not what the student knows but what he/she can do with that knowledge. To achieve this, it incorporates capabilities from technology, the humanities, and business around eight basic competencies: a) design thinking, b) thought systems, c) effective communication, d) autonomy, e) social interaction, f) ethical reasoning, g) creativity and innovation, and h) applied discipline knowledge.

To define the competencies in an operative manner, the PPI follows the guidelines of the American Council of Regional Accrediting Commissions (C-RAC) and establishes for each competency three levels of mastery assessable by means of an online portfolio. The portfolios' function is twofold: promote the development of competencies and indicate the degree of skill reached by the student in such competencies.

The strategy as a whole allows students to further personalize their learning path in discussions with professors, whose main purpose is to serve as mentors in the learning process. The institution's website summarizes in the following sentence what is the teacher's role in the model: they are "the guide beside the student", not "the sage at the lectern" (Purdue Polytechnic, 2016).

Flexible Learning

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A project was implemented in the subject of Matter and Environment. This project consisted of design, experimentation (pilot phase) and implementation of an interactive holographic device (DMHI) as an educational tool for different subjects in High School. Constructing the device makes the way in which students are evaluated more flexible and allows them to develop their learning in an applied manner instead of the traditional content-based exams.

Although a period of adaptation was necessary for the students to familiarize themselves with this new tool, the results reveal a significant impact on their learning. Over 90% of the interviewees indicated they felt "more motivated" interacting with the DMHI device and qualified the tool as "very relevant" for their various subjects. In fact, the scores of the groups who participated in this experience are higher on average than those of the group that did not take part.

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The evaluation strategies for the Mathematics Modeling Principles course were enhanced with online quizzes generated with Exam View, a program that allows equation editing. The exams were taken on the Blackboard platform. The advantage of these quizzes is that they can be taken as often as the student wants, and the program saves only the highest score attained among all the attempts. Additionally, once they have finished the exam, the students can see which questions they answered incorrectly. This helped them to see their mistakes and learn from them.

In addition to improving their grades, which on average went from 89 in the first midterm to 93 in the second, there was a better learning environment as a result. Also, students were more confident in their own capacity to overcome mathematical challenges and in the fact that if they try harder, they can improve their performance in this field.

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In different subjects associated with programming (Fundamentals of Programming, IT Security, Problem-Solving with Programming) the professor turned over to the student the control of their own learning process. Each student had the chance to show their mastery of the subject content by means of a project they had to create and develop (code, presentation of concepts, project development, video demonstration, among others). However, those students who require a more instructional and linear support receive a series of activities and exams to verify their knowledge and technical skills.

This model is an adaptation of the Joe Bower proposal to abolish the typical grading mechanisms. With this strategy, students tend to feel freer to explore the course material and select their own path to prove their mastery. The true value is a more flexible and personal learning experience, as well as the experience of autonomy obtained by the students. The testimonials of the students who participated in this innovation can be found on the professor's blog.

University of British Columbia
(Canada)

The University of British Columbia (UBC) is one of the 20 best public universities worldwide according to international rankings. They have a population of around 60,000 students from over 140 countries divided between its two campuses, Vancouver and Okanagan. In order to maintain its leadership, the UBC redesigned its curriculum in 2012 and adopted the Flexible Learning educational model.

The UBC's strategic plan consists of providing students different on-campus and online educational possibilities so they can decide what, where, and how to learn. A core strategy is to make a combination of the different modules available to the student to build his/her educational path. They can take the modules online or on-campus and earn credits of the continuing education programs, which students of different ages and profiles, inside and outside the institution, access. The student's experience is also enhanced with programs to study abroad and exchange initiatives among students from different cultures.

As for the professors, the main challenge consists of designing, advising and assessing projects capable of integrating students with different profiles and learning styles. For example, in Dr. Maja Krzic's project, "Virtual Soil Science Learning Resources", students learn about the different types of soil and conservation conditions playing a treasure hunt game in an interactive mobile application. In Dr. Manuel Munro's project, "Open and Interdisciplinary Learning", students and professors collaborate in the production of open-access educational resources related to the contents of their field of interest (University of British Columbia, 2016).

Gamification

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In the Ethics, Governability, and Sustainability course, one of the most common educational techniques used in teaching business leaders - i.e. working with ethical dilemmas in business cases- was gamified. A case simulator was used. It allows the student to see the repercussions of the decisions they make. The student takes part in a fun, active, and competitive learning experience. Students compare their results with those of their classmates or the entire group, or with what would happen in real life if they made a different decision.

Incorporating this technological game in the classroom has been a stimulating experience for both students and professors. The preliminary results suggest that gamification enhanced the students' capability to attain a sounder personal, business, and global ethics in contrast to the traditional way to handle ethics cases which the students often perceive as subjective and relative because they are based on values and intangible concepts.

Western Michigan University
(USA)

Western Michigan University (WMU) uses an online simulator to make the university known to future students. Broncoland Tour, starring the mascot Buster Bronco, is a free, downloadable, and interactive video game that allows the user to take a virtual tour of the Campus, request information about courses and workshops, and interact with other candidates to make friends.

The simulator is just one example of how this university is exploring the benefits of gamification in the interaction with its students. Even though gamification does not affect the structure of WMU's educational programs, it does operate as a design principle to create learning activities. In its website, WMU explains how adopting games/video games involves, among other benefits, the positive impact on motivation, immediate feedback, and direct participation of the students in their learning process (Learning by Doing). The ultimate intention is to form dynamic students who are capable of performing successfully in both multimedia digital environments and traditional analog environments (Western Michigan University, 2013).

Project-Based Learning

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In the tourism field of education, the learning process was redesigned to involve the development of tourism projects in the region of Ixtapa, Zihuatanejo, Mexico, where tourism has dropped over the last years in the wake of rising unsafe conditions and crime rates in the region. The class was divided into four teams to compete amongst each other. The project involves a first stage of research to gather information directly from the location. The field work should render innovative and viable action plans to reinvigorate the region's tourism appeal. Finally, the teams are compelled to present propositions before a group of representatives of the private sector, tourism organizations and state authorities of the region.

All the information and results of the activities were presented in the Schoolgy platform. Additionally, various digital applications were used to capture images and sounds and to edit and produce audiovisual messages that are finally posted in a blog designed with the Wix program. Although the results so far have been very positive as learning experiences, there is still a wide margin for improvement of its capacity to impact the target productive sectors.

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The subject Strategic Administration of Projects and Processes requires that the students master the Project Management Institute methodology to develop a project with all its stipulated phases and control requirements. Students should put this methodology into practice in a class project selected by the entire class that benefits the community. In this case, the students had to develop the procedural manual and hold a running race, "+km-hunger", in the community of Tuxtla Gutiérrez, Chiapas, Mexico. To enroll, the participants had to donate one kilogram of non-perishable food and a package of adult diapers, all of which would be donated to a nursing home.

The group was highly motivated throughout the entire execution process. The project was completed by the deadline and had an enrollment of 650 participants, who collectively donated three tons of food and 7,000 adult diapers. The project ended with the actual delivery of all the donated items at the nursing home. It was a deeply moving act that placed the students face to face with their direct beneficiaries.

Ikastola Begoñazpi
(Spain)

The Ikastola Begoñazpi (IB) in Bilbao is one of the emblematic schools of Project-Based Learning (PBL) in Spain. Among its many achievements, it was selected in 2016 to represent Spain in the FLL Global Innovation Award with a project that proposed the recycling of wet wipes.

To develop PBL, the IB used as a basis Harvard University's Teaching for Understanding Framework (TfU) whose core principle is to have the student understand and apply what he/she is studying. The link with Harvard was established when two of its professors participated in Project Zero prompted in Harvard by Howard Gardner (Multiple Intelligences) and David Perkins (Visible Thinking).

The changes affected the curriculum design. Learning contents were extracted from the subjects of the national program, and digital applications intended to develop these competencies were incorporated. Sergio Fernández Sixto, one of the professors, explains: "We use applications for deductive reasoning, critical thinking or decision-making like that of a robot that has to overcome obstacles, the Tangram for geometry or Angry Birds for orientation."

One of the most successful proposals is the "ladder" assessment model. In the first place, the student has a self-assessment rubric so they can understand what they have achieved and what they need to improve. In the second stage, their peers assess their performance. Lastly, the professor comments on the work and assigns the score. The purpose of this strategy is to model the student's capability to learn by themselves and in collaboration with other (Fernández, 2016).

Collaborative Learning
Experiential Learning

The University of Alabama in Huntsville

(USA)

The University of Alabama in Huntsville (UAH) is a public state university known in the U.S. mainly because of its technology and engineering programs, especially in the fields of astrophysics, atmospheric science, and aerospace engineering. It has different research centers, among which the Propulsion Research Centers stands out, in collaboration with NASA.

As part of their quality improvement plan, the UAH created in 2016 the Collaborative Learning Center (CLC) as the core device to disseminate the best collaborative practices and promote environments that are appropriate for collaboration among students, students and professors, and among professors and the institution. The collaborative practices transcend the classroom and are explored in the laboratories and study halls. The activities should be: a) egalitarian, so all the participants contribute significantly; b) conversational, to open communication channels that allow the exchange of ideas; and c) research oriented, by exploring different questions and perspectives to resolve problems.

Among CLC's concrete initiatives is that of hiring professors who develop collaborative educational practices, a scholarship program that trains the beneficiary students to take full advantage of the collaborative focus, and two institutional awards -one for the professors and the other for high-quality collaborative projects.

Experiential Learning

University of Chester

(United Kingdom)

The University of Chester (UCh) is one of the ten universities in the United Kingdom with the best scores due to the quality of their international programs, according to the Student Choice Awards 2017. Among other strategies, the UCh offers its students the chance to accredit a strategic subject in their curriculum with an Experiential Learning project that consists of a five-week stay abroad. This is not an ordinary student exchange program among universities. In this case, the students who request the stay should previously pass a preparation course and get approval for their action plan, which details the experiential learning they wish to attain in relation to a series of topics, such as social justice, sustainable development or business training. From their own personal experience in a foreign environment, the students develop a project with the assistance of their tutor and the academic institution, or the company in which they are accepted.

The UCh is also outstanding because of the high employability rate of their graduates (95.2% with jobs related to their studies or enrollment in higher education), the highest in the northeast of the United Kingdom. Experiential Learning takes a strategic place with a flexible program of professional practices executed in a 5-week experience that allow the students to accredit academic modules and, at the same time, develop their competencies and prior experience in the sectors in which they want to work in the future.

The UCh calls this experiential learning practice Work-Based Learning, emphasizing the practical development of the knowledge acquired in the institution and the exploration of personal sensitivity to resolve problems outside the school. Finally, the intention is to form citizens capable of learning from their own experience in any environment.

Results of the radar of trends in technology at Tecnológico de Monterrey (general prospects)

Table 2 shows the five trends in technology with the highest number of votes in the radar carried out with the professors and the timeframe in which they consider the trends will be relevant:

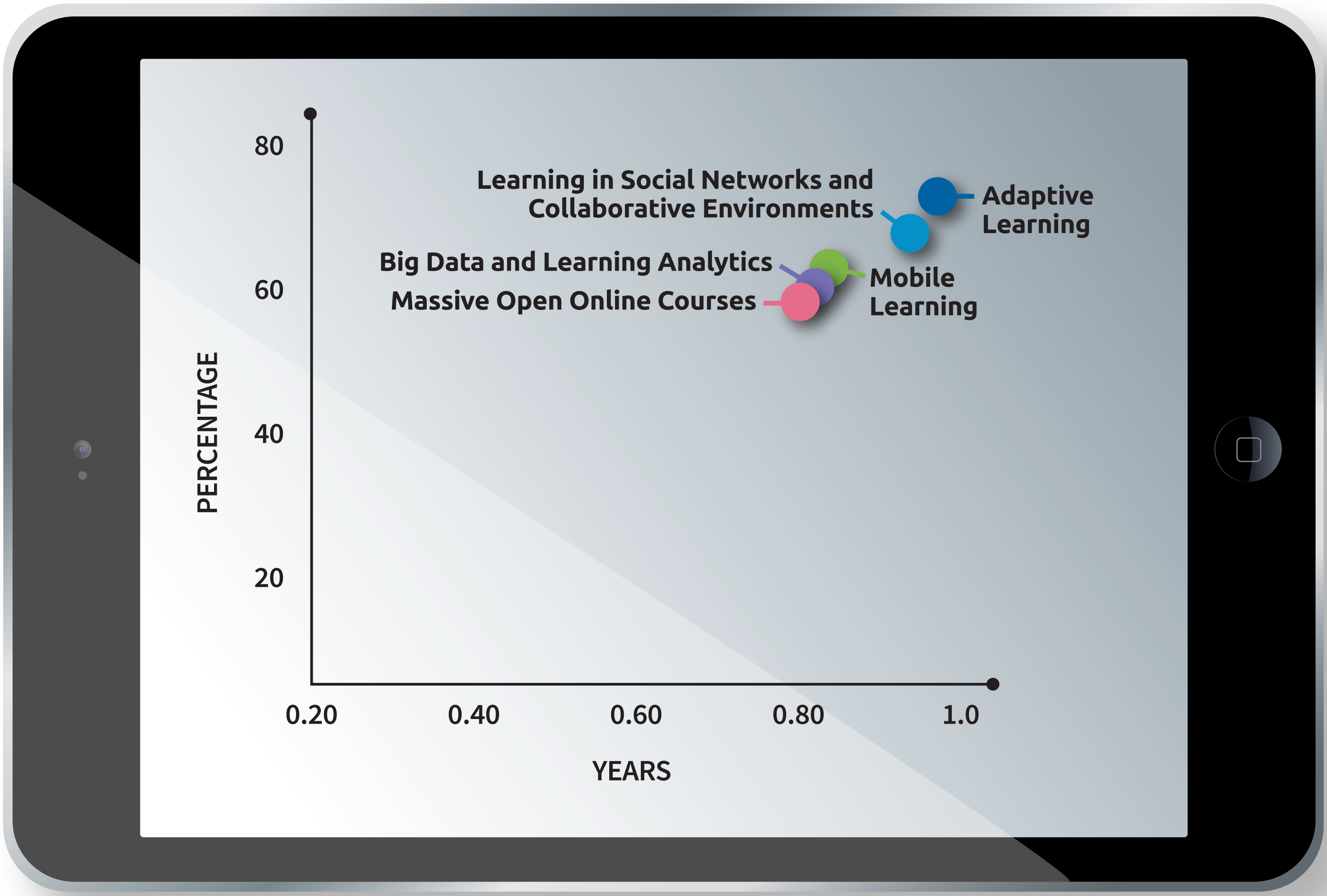

Figure 4. Trends in technology (general prospects).

Trends in technology	Percentage of total votes	Timeframe (years) for it to become relevant
Adaptive Learning	71	0.99
Learning in Social Networks and Collaborative Environments	67	0.93
Mobile Learning	62	0.86
Big Data and Learning Analytics	60	0.83
Massive Open Online Courses	58	0.81

Table 2. Trends in technology from the general prospects.

Adaptive Learning

Arizona State University
(USA)

The Arizona State University (ASU) is the largest public university in the U.S. with a student population of over 70,000. The directors looked for a more efficient way to guide the newly enrolled students in the acquisition of basic knowledge in their college education, especially in the field of mathematics, whose initial courses showed a high rate of failure.

In 2011 the university invested in Knewton, a software that first determines the students' level of knowledge of a concrete content and, depending on the results, it leads them to new tests, contents and educational resources on what they couldn't resolve. After having implemented Knewton in two semesters in the mathematics courses, the student drop-out rate was cut in half and the number of students who completed the course successfully four weeks in advance grew exponentially.

It was the beginning of a growing development of Adaptive Learning in the ASU that was extended to more advanced courses and other fields, and drove the transformation of many classes in laboratories with integrated computers where the professor's main function was to assist and answer the students' questions about the learning paths the platform proposes.

Each student can verify what they know and what they don't about a specific topic, compare their results with those of their peers, access different types of educational exercises to practice their learning (such as diagrams, videos, or exams) or understand the evolution of their knowledge. For the professors, the platform provides valuable data on the students' learning process and allows them to identify, for example, the course contents that are proving more problematic in each stage, the most consulted didactic resources, or the time they dedicated to the students in each exercise (Roscorla, 2014).

Learning in Social Networks and Collaborative Environments

Carnegie Mellon University (CMU)

The Carnegie Mellon University (CMU) is a higher research institution located in Pittsburgh that specializes in computers and robotics. Since 2009, the institutional investment in the development of social networks has been remarkable, with an outstanding presence in Facebook, Twitter, iTunes U, Instagram, and YouTube. The university presents in a single website all its institutional digital networks sorted by schools, institutes and research groups, departments, and programs.

Unlike other universities, CMU does not consider these environments as just a promotional medium for their services and activities but it intends to make them work as educational content generation devices. Its YouTube channel, for instance, offers live broadcasting of interviews with experts, discussion panels or conferences. By means of its iTunes platform, it offers courses in a series of podcasts like the one conducted by the Human-Computer Interaction Institute about the development of applications for iPad.

The use of these social networks is framed in the collaborative learning model that the university uses since 2009 through the Eberly Centre, its educational innovation formation department. On the website, the professors offer information about the technological tools they can use, the pedagogical purposes that can be explored with these tools, and the educational theory frameworks that support this work. Finally, the idea is to create an environment of collaboration where students and professors can resolve learning issues and disseminate knowledge (Carnegie Mellon University, 2015).

Mobile Learning

MoLeNet
(United Kingdom)

The collaboration on a national scale of educational researchers, technologists, and professors from various institutions and education levels (universities, schools, NGOs and professional training centers, among others) made it possible since 2007 to develop MoLeNet, the most extensive and diversified network of mobile learning in the United Kingdom. The macro project, directed mainly to adult training, has so far received more than 20 million dollars in financing and has involved the participation of around 40,000 students and more than 700 professors.

MoLeNet invites any professor or center interested in implementing mobile learning in their training context. It provides technical and pedagogical counseling to develop their initiative, provide a digital educational applications and resources bank, promote communities and collaborative projects among colleagues of different regions, and eventually finances the acquisition of the devices and technological infrastructures. The main requirement is to contribute to knowledge accessibility and to the enhancement of the learning experience regardless of who the user is, its location or economical and social condition.

It is not a government program with pre-set pedagogical directives regarding certain official curricular contents. The project's purpose is to encourage the participants to explore the advantages and challenges of the educational use of mobile devices. To such an end, it is recommended to compile the experiences obtained through the electronic portfolios and observe the development and impact of that educational technology by means of the Research Action model, developed for the long-term improvement of teaching-learning processes (Sheppard, 2010).

Big Data and Learning Analytics

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The professors of the fundamental sciences department used Big-Data, Machine Learning, and Bio-response techniques as part of the "Determination of performance patterns" project for students in the first third of the professional programs. Information from 650 students was gathered combining different variables such as scores, attendance, physical activity, extra-academic activity, bio-response (stress, heart rate, sleep quality, REM states, alpha, beta, gamma, and delta neuron frequencies), and biometric aspects associated with facial geometry. This information was used to create a model to determine the performance pattern of the students in the physics and mathematics courses. Teacher profile aspects were also included.

When the performance indicator algorithm is applied, the prediction correlation varied between 96-98% of matches in the 12 courses that were examined. This seems to be a relevant result to study in detail and thereby expand models under these techniques that promote better processes and teaching methodologies. The objective is to create optimal learning paths for the students and prevention actions and early attention for low-performance students.

Nottingham Trent University
(United Kingdom)

The Nottingham Trent University (NTU) is one of the youngest best-ranked universities in the United Kingdom, with one of the best employability rates – 92.8% of the graduates got a job or higher studies within 6 months of obtaining their degree. It is also the leading university in the student satisfaction index regarding the teaching they received. In 2015, The Guardian described the university as "the most respectful of the environment in the country."

One of the keys of its success is the application and implementation of educational software (NOW is the main one) and data management platforms such as StREAM, an instrument used for student retention. The program interprets the data generated by the interaction of the student in different environments (course platform and digital library, among others) to establish their level of commitment to the educational resources that the university offers, in such a way that both the students and the academic personnel can detect motivation issues and resolve them together in a timely manner.

As Mike Day, the Director of Information Systems of the university, points out, the data analysis should exceed the traditional retrospective focus: "if you're looking in the rearview mirror, you're headed for an accident. We needed a way to look forward and exploit the data for the advantage of our students and that is what StREAM has given us." In fact, the university heads European educational research projects about learning analytics, such as the ABLE Project (Achieving Benefits from Learning Analytics) (ABLE, 2015).

Massive Open Online Courses (MOOC)

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Campus Morelia developed its first MOOC on the Coursera platform under the name Enhancing Writing and Speaking Skills in English. The course consists of four weekly modules and covers from the intermediate to the advanced levels of English language mastery. The MOOC activities are incorporated in the regular assessment of the students, taking the place of the weekly tasks. Each model consists of two projects, one for writing and one for speaking, and contains instructional videos, additional reading passages, review exercises, and quizzes. Students from different groups and levels of English interact and evaluate their peers' activities.

At the end of each implementation, an exit survey is applied. The results are as follows: more that 50% of the participants report having learned from the feedback they received by their peers, and over 60% consider that they contributed to their peers' learning. Over 80% of all the participants indicate that the course enabled them to put their English communication skills into practice and that what they learned in class was relevant and useful, a perception that had been low in prior courses.

The University of Melbourne
(Australia)

According to the Times Higher Education ranking, the University of Melbourne (UM) is considered the best in Australia and ranks 36 worldwide. It was the first Australian university to launch Massive Open Online Courses (MOOCs) through the Coursera platform. In May 2016, there were one million students enrolled in their courses after only three years in the platform.

One of its contributions to the evolution of the MOOCs has been to offer, in an alliance with BNY Mellon which is one of the most prestigious global investment companies, a package of a series of courses in the finance field that allow obtaining an accreditation of higher education as a specialist in "Basic Aspects in Corporate Finances." Enrollment is not free but the cost of the online course is significantly lower than that of a specialization in that field in a university in an on-campus format.

Since 2013, when it started its courses in Coursera, the UM has diversified its catalog of courses on Gerontology, Epigenetics, Adolescent Health, Animal Behavior or Citizen Journalism. During this time, the university has generated over two million evaluations and over ten million videoconference visits. An interesting piece of information is that one of every three students enrolled come from emerging countries, which gives an idea of the MOOCs' global character and their potential as a device for equal access to specialized education (The University of Melbourne, 2016).

Personalized Learning Environments

The Open University
(United Kingdom)

The Personalized Learning Environments (PLE) are a set of tools, sources, activities, and networks that the student can use to build their own learning experience. The challenge is not only in multiplying the stimuli and accesses to knowledge but also in developing a critical perspective of the information on the internet along with the capability to learn how to learn in the cloud.

The Open University (OU) is a leader in the exploration of the benefits the PLEs can contribute to the learning process. It is the university with the largest enrollment in the entire United Kingdome with close to 200,000 students, and it develops programs mainly online. The university develops ROLE (Responsive Open Learning Environments), a European research project to develop theoretical orientation and technological tools that help the student build learning communities on the internet.

The university also offers courses and workshops for the formation of this learning in the cloud. The Self-Regulated Learning course, available on iBook, is interactive and consists of building a Personalized Learning Environment by means of a widget. Other workshops handle the use of digital portfolios (Drive, for example) or the participation in the blogosphere (Mikroyannidis y Connolly, 2016).

Aprendizaje Ubicuo

Centro Universitario Internacional de Barcelona (UNIBA)
(Spain)

The International University Center of Barcelona (UNIBA) is an institution affiliated to the Universitat de Barcelona that offers online academic programs. Its educational model is based on the principle of Ubiquitous Learning, learning at anytime and anywhere, migrating to where the student is immersed most of the time, the internet, by means of Wi-Fi or Bluetooth.

The student accesses courses on the Virtual Campus of the UNIBA through the Blackboard platform. Each course lasts between four and five weeks. It consists of a set of magisterial classes issued on video, online chats with guests that share their experiences about actual cases, virtual classes in which the professor interacts with the students or promotes online networking among them, and the access to a series of resources and educational contents related to the subject matter. The student will submit at the end of the course a series of weekly practices, based on their participation and progress of such activities online, and a final project in which they should accredit the competencies they developed.

In this learning process, the UNIBA makes available to the student a program general manager, a coordinator whose function is to answer questions regarding the management of the platform or the administrative processes, and a professor to tutor their learning issues with the subject contents (UNIBA, 2017).

Results of the radar of trends in pedagogy at Tecnológico de Monterrey (discipline prospects)

The following are the results obtained by the radar regarding the discipline prospects, which are understood here as the set of data that allows us to explore or predict the future of the trends in pedagogy and in technology that the professors consider relevant for all the fields of knowledge.

Trends in pedagogy	Percentage of total votes	Timeframe (years) for it to become relevant
Challenge-Based Learning	69	0.96
Competency-Based Education	51	0.71
Project-Based Learning	50	0.69
Collaborative Learning	45	0.63
Experiential Learning	37	0.51

Table 3. Trends in pedagogy from the discipline prospects.

The distribution of the knowledge fields was made taking into consideration the classification established by the National Board of Science and Technology (CONACYT):

1. **Physics, Mathematics, and Earth Sciences**
2. **Biology and Chemistry**
3. **Medicine and Health**
4. **Humanities and Behavior**
5. **Social and Economics**
6. **Biotechnology and Agriculture**
7. **Engineering and Industry**

As shown in the results of this study (Table 3), the general prospects and the discipline prospects reflect some similarities and differences. Challenge-Based Learning, Competency-Based Education and Project-Based Learning were selected for both areas. However, as seen before, the general prospects include Flexible Learning and Gamification while the discipline prospects contemplate Collaborative Learning and Experiential Learning.

For the professors in the Physics, Mathematics and Earth Sciences fields, the Competency-Based Education is the most relevant pedagogic trend. To those working the field of Biology and Chemistry, Collaborative Learning is the most significant. Those working in the field of Medicine and Health lean simultaneously toward Challenge-Based Learning and Experiential Learning. For the professors in the fields of Humanities and Behavior, Social Sciences and Economics, Biotechnology and Agriculture and Engineering and Industry, the most useful trend for their educational practice is Challenge-Based Learning (Table 4).

	Trends in pedagogy				
Disciplines	Challenge-Based Learning	Competency-Based Education	Project-Based Learning	Collaborative Learning	Experiential Learning
Physics, Mathematics, and Earth Sciences	27.6%	41.4%	13.8%	37.9%	20.7%
Biology and Chemistry	40.0%	0.0%	40.0%	60.0%	20.0%
Medicine and Health	100.0%	0.0%	0.0%	0.0%	100.0%
Humanities and Behavior	37.8%	35.1%	21.6%	29.7%	18.9%
Social Sciences and Economics	71.4%	47.6%	42.9%	33.3%	42.9%
Biotechnology and Agriculture	66.7%	33.3%	33.3%	0.0%	33.3%
Engineering and Industry	55.1%	30.6%	53.1%	26.5%	24.5%

Table 4. Distribution of the pedagogical trends in the disciplines.

Distribution of the pedagogical trends in the disciplines

Results of the radar of trends in technology at Tecnológico de Monterrey (discipline prospects)

Trends in technology	Percentage of total votes	Timeframe (years) for it to become relevant
Adaptive Learning	56	0.78
Learning in Social Networks and Collaborative Environments	45	0.63
Mobile Learning	43	0.60
Personalized Learning Environments	36	0.50
Ubiquitous Learning	35	0.49

Table 5. Trends in technology from the discipline prospects.

As Table 5 shows, Adaptive Learning is the technology trend preferred by the professors from the discipline prospects, followed by Learning in Social Networks and Collaborative Environments, Mobile Learning, Personalized Learning Environments, and, lastly, Ubiquitous Learning.

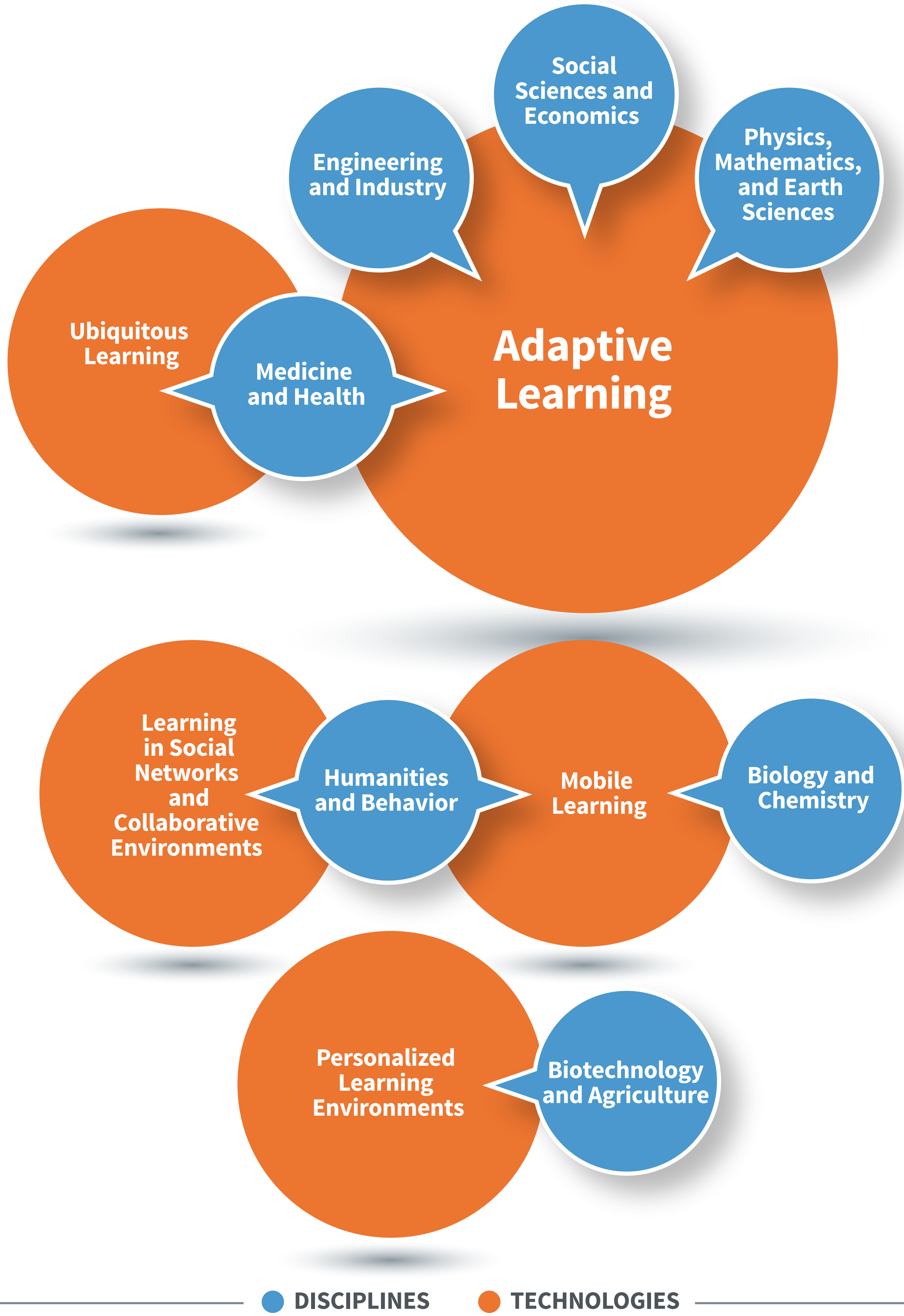
The two trends that establish the difference with respect to the general prospect are Big Data and Learning Analytics and Massive Open Online Courses.

	Trends in technology				
Disciplines	Adaptive Learning	Learning in Social Networks and Collaborative Environments	Mobile Learning	Personalized Learning Environments	Ubiquitous Learning
Physics, Mathematics, and Earth Sciences	62.1%	37.9%	31.0%	31.0%	37.9%
Biology and Chemistry	40.0%	0.0%	80.0%	20.0%	60.0%
Medicine and Health	100.0%	0.0%	0.0%	0.0%	100.0%
Humanities and Behavior	21.6%	32.4%	32.4%	18.9%	10.8%
Social Sciences and Economics	61.9%	28.6%	28.6%	42.9%	23.8%
Biotechnology and Agriculture	28.6%	33.3%	33.3%	66.7%	0.0%
Engineering and Industry	38.6%	22.4%	22.4%	16.3%	22.4%

Table 6. Distribution of the technology trends in the disciplines.

Table 6 shows that Adaptive Learning is the trend preferred by those in the fields of Physics, Mathematics and Earth Sciences; Medicine and Health; Social Sciences and Economics, and Engineering and Industry. The professors who work in the field of Biology and Chemistry consider Mobile Learning the most relevant for their discipline. Those in Humanities and Behavior selected simultaneously Learning in Social Networks and Collaborative Environments and Mobile Learning, and those involved in the field of Biotechnology and Agriculture preferred the Personalized Learning Environments.

Distribution of the technology trends in the disciplines



Comparison of the results of the 2015 and 2017 editions of the Radar of Educational Innovation

Trends in pedagogy				Trends in technology			
2017		2015		2017		2015	
Trends in pedagogy – Radar of Educational Innovation 2017	Timeframe (years) for it to become relevant	Trends in pedagogy – Radar of Educational Innovation 2015	Timeframe (years) for it to become relevant	Trends in technology – Radar of Educational Innovation 2017	Timeframe (years) for it to become relevant	Trends in technology – Radar of Educational Innovation 2015	Timeframe (years) for it to become relevant
Challenge-Based Learning	1.3	Flexible Learning	2.3	Adaptive Learning	0.9	Adaptive Learning	1.8
Competency-Based Education	1.1	Challenge-Based Learning	1.2	Learning in Social Networks and Collaborative Environments	0.9	Personalized Learning Environments	1.6
Flexible Learning	1.1	Flipped Learning	0.8	Mobile Learning	0.8	Ubiquitous Learning	1.5
Gamification	0.8	Experiential Learning	1.7	Big Data and Learning Analytics	0.8	Internet of Things	2.4
Project-Based Learning	0.8	Hybrid Learning	1.0	Massive Open Online Courses	0.8	Remote and Virtual Laboratories	0.8
		Competency-Based Education	0.7			Augmented Reality	1.7
		Mentoring	1.3				
		Gamification	0.9				

Table 7. Comparison of the results of the 2015 and 2017 editions of the radar.

The comparison of the pedagogy and technology trends (Table 7) of the 2015 Radar and the 2017 Radar reveal a highly dynamic evolution of the educational innovation at Tecnológico de Monterrey. On the one hand, most of the trends perceived as relevant in 2015 continue to be relevant two years later. However, the position these trends have in the preferences of the surveyed professors is highly variable.

Another significant piece of information is the different behavior of the pedagogy and technology trends. Among the pedagogy trends, two of the three most valued trends in the 2015 Radar, i.e. Flexible Learning (first place) and Challenge-Based Learning (second) remained among the three top ranking trends in the 2017 Radar (Flexible Learning takes the third place while Challenge-Based Learning takes first). By contrast, the variability shown in the technology trends is significantly greater. Although Adaptive Learning is still in the first place after two years, the rest of the trends selected in the 2015 Radar were not among the top selections in the 2017 Radar.

For instance, the Massive Open Online Courses (MOOC) or the Big Data and Learning Analytics two years ago were not among the top in the discussion about the most relevant technology trends in the upcoming panorama of educational innovation.

The above seems to validate, on the one hand, the predictive capability of the methodology used in the Observatory of Educational Innovation to detect the emerging innovative trends within the institution.
On the other hand, it shows that the field of educational technology is subject to a very fast transformation in comparison with the greater stability of the pedagogic models.

The timeframe in which the professors calculate the highest relevance of both trends is not, however, as reliable. For instance, in the 2015 Radar Gamification was predicted to be an even more relevant trend in a term close to one year (0.9 of a year). Two years later, its estimation of greater relevance in the 2017 Radar was set for a similar term (0.8 of a year).

Main reasons why teachers of Tecnológico de Monterrey implement educational innovation in their teaching practice

The map of the educational innovation trends that are taking off in the institution would not be complete without the perception of those who create and implement such innovative practices: the professors. They were offered three proposals: the motivations that drive them to innovate their teaching practice, the benefits they obtain, and the obstacles they face in the implementation.

In the case of the motivation, as shown in Table 8, the two main reasons the professors indicated were, first, the importance innovation has for them (70.4% of the responses), followed very closely by the need to change their way of teaching (67.3%). Personal satisfaction came in third.

Therefore, the professors who were consulted had an intrinsic motivation when it came to innovating in their classes, derived from their own needs and dreams, that is, they came from "the inside out." On the contrary, they gave less value to external motivations such as the usefulness for their research agenda, directives from their superiors, or the students' interest.

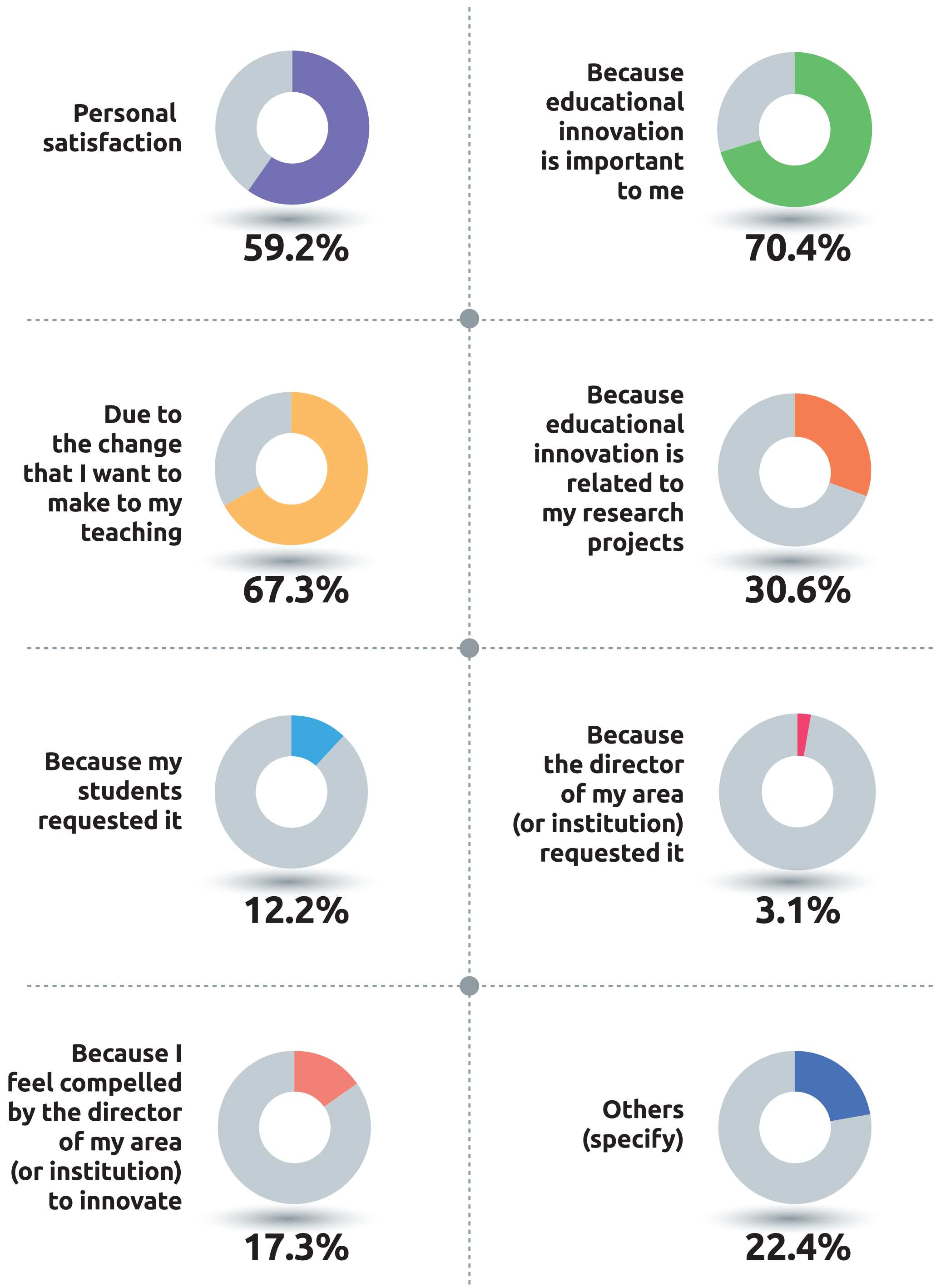


Table 8. Reasons that support the use of educational innovation at Tecnológico de Monterrey.

Perceived benefits of implementing trends in pedagogy and/or technology

Regarding the specific benefits obtained by implementing pedagogy/technology trends, the ones with the most votes are the positive impact on the students' motivation (80,6%) and the improvement of the students' performance (73.5%). Although the significant improvement of their own teaching practice was highly valued (62.2%), the results indicate that the benefits that stand out focus on the learning rather than on teaching enhancement. It is the change in students' attitude and performance what they valued the most.

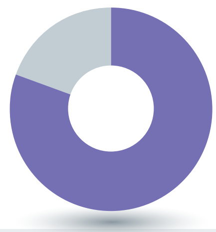
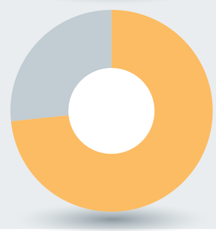
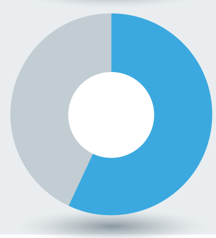
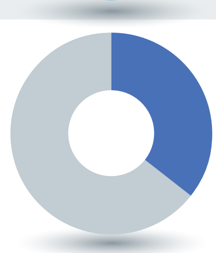
Benefits	Percentage of responses	
Motivate my students **to learn**		80.6%
Better academic performance of the students		73.5%
Significant **improvement** in my **teaching practice**		62.2%
It keeps me up-to-date in teaching the discipline		57.1%
It contributes to my **professional projection** inside and out of Tecnológico de Monterrey		35.7%

Table 9. Benefits perceived by the professors regarding the implementation and use of trends in pedagogy and technology.

Obstacles to Implementing Trends in Pedagogy and/or Technology

Obstacle	Percentage of responses	Obstacle	Percentage of responses
Lack of time	56.1%	Lack of budget	26.5%
Resistance to change	48.0%	Incompatibility with the curricular structure/rules and accreditations	21.4%
Complexity and/or slow institutional processes to make purchases	36.7%	Lack of physical spaces (classrooms, labs, libraries)	19.4%
Lack of training and/or updating of related topics	27.6%	Complexity and/or slow institutional processes to hire support personnel	18.4%

Table 10. Obstacles perceived by the professors regarding the implementation and use of trends in pedagogy and technology.

Implementing new models and educational resources is a complex change fraught with satisfactions but also obstacles. The surveyed professors indicated the lack of time as the main challenge to resolve in the institution (56.1% of the responses). The other two significant obstacles would be resistance to change in general (48%), and the complexity and/or slow institutional processes for making purchases.

This ranking of the responses makes us think about the diverse nature of the factors that hinder the success of educational innovation. Some of them, such as resistance to change, is covered widely in literature in the discussion of the specialists. Therefore, the lack of time and the obstacles in the acquisition of material resources help us to pay attention to the pragmatic operative dimension of the implementation process in the institutions. Developing educational innovation involves certain investment costs on multiple levels (in tangible assets, like hardware and software acquisition) as in intangibles (the time that is required).

Conclusion

The 2017 Radar of Educational Innovation makes available to any person or organization interested in education an exploratory methodology to recognize the emerging trends in educational trends within an institutional context. At Tecnológico de Monterrey we have carried out this exercise at the undergraduate level on a biannual basis. The 2015 Radar identified some trends in pedagogy and technology which essentially have been confirmed as relevant in the present, according to the data obtained in the 2017 Radar.

The comparison between both radars corroborated the predictive capability of the methodology that was used, at least within our institutional environment. Furthermore, both radars distinguish emerging trends in the pedagogic models and in educational technologies. When contrasting the evolution of both dimensions of the educational innovation, the pace of transformation is faster in educational technologies vs. the relatively more stable change of the pedagogic models.

Although the changes in the trends mapped in the 2015 Radar and the 2017 Radar are remarkable, certain patterns remain constant. To summarize, other possibilities include:

- The relevance of the educational models and technologies focused on the user's learning and experience.
- The evolution from the teaching of discipline contents to a more integral focus directed to the development of transversal and multidisciplinary competencies.
- The paradoxical relevance of the increasingly personalized learning processes and at the same time the increasingly social learning processes (based on interaction).
- The transformation of the learning process in an experiential, motivated and challenge-oriented experience.
- The greater freedom of those who learn to decide when, where and how they want to learn, provided they have access to digital technology and know how to use it.

The 2017 Radar combines the map of the educational innovation territory with the perspective of those passing through such territory – the innovative professors of the institution. Their assessment of the process of implementing such changes provides us with, among other lessons, the intrinsic motivation felt by the teachers, the positive impact observed in their students' learning, and the considerable investment of time required to carry out the innovative practices.

The 2017 Radar offers at the same time a look back, a mirror and a compass of the evolution of the educational innovation within the Tecnológico de Monterrey. The comparison of its results with those of the 2015 Radar helps us to understand the evolution from past to present. The data of the most relevant trends in pedagogy and technology creates an awareness of the present scenario. Additionally, its predictive assessments about the behavior of these trends in the upcoming years can serve as a reference point into the horizon for those who wish to invest time and resources in transforming their educational practices.

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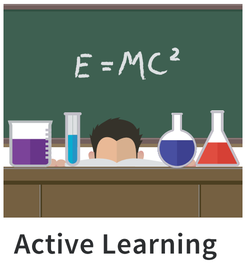
APPENDICES

Glossary of trends in pedagogy



Active Learning

A student-focused teaching-learning strategy that promotes continuous participation and reflection by means of activities that are typically motivating and challenging, seeking to deepen knowledge, develop data search, analysis, and synthesis skills, and promote an active adaptation to problem-solving.

Authentic Learning

Type of learning, based on constructivist psychology, in which a student relates new information with information they already possess, readjusting and rebuilding both pieces of information in this process. The structure of the prior knowledge conditions new knowledge and experiences, and they, in turn, modify and restructure the former.

Research-Based Learning

Consists of the application of teaching-learning strategies that seek to connect research with teaching, which allows for the partial or total inclusion of the student in an investigation based on the scientific method, under the supervision of the teacher.

Problem-Based Learning

A didactic approach in which a small group of students meets with a tutor to analyze and propose a solution to a real or potentially real problem related to their physical and social environment. The objective does not focus on solving the issue but rather on using it as a trigger so that the students cover the learning objectives, and develop personal and social competencies.

Project-Based learning

Didactic technique focused on the collaborative efforts of a group of students to design and develop a project as a way to achieve the learning objectives of one or more disciplines and to develop competencies related to the management of actual projects.

Challenge-Based Learning

A strategy that provides students with a general context where they, in a collaborative manner, must determine the challenge to resolve. Students work with their teachers and experts to solve this challenge in communities around the world and develop a deeper knowledge of the subjects they are studying.

Collaborative Learning

The didactic use of small groups where the students work together to obtain the best learning outcomes in themselves and in others. It promotes the development of skills, attitudes, and values in students.

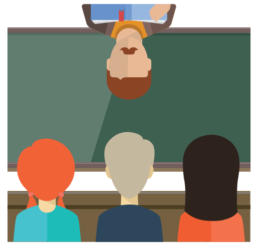
Online Learning (E-learning)

Teaching-learning processes conducted over the Internet. Synchronous and asynchronous communication maintains the instructional interaction between teachers and students. The student becomes the center of the training by having to self-manage its learning, with the assistance of tutors and colleagues.

Flexible Learning

It offers students options for when, where and how to learn. This flexibility can help students fulfill their particular needs. Flexible learning can include the use of technology for online studying, part-time studying, and studying the programs at a slower or faster pace, among other things.

Hybrid Learning
A formal educational program that combines online digital media with traditional classroom methods. It requires the physical presence of both teacher and student, with some element of student control over time, place, path, or pace, while maintaining the possibility of interacting with their teacher and classmates.



Flipped Learning
A teaching technique in which content is presented by means of videos that can be freely consulted online, while classroom time is devoted to discussion, problem-solving, and practical activities under the supervision and guidance of the teacher.

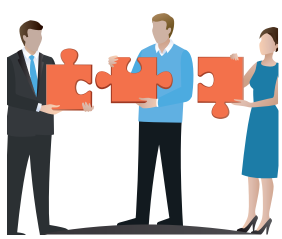
Just-in-time Learning
Learning system that delivers formative contents to students at the time and place of their choosing. Students can concentrate on just the information that they need to resolve issues, perform specific tasks, or quickly update their skills.

Experiential Learning
Learning model that implies living an experience in which the student can feel or do things that strengthen their learning.

Service-learning
Didactic technique that links two complex concepts: community action, the "service" and the efforts for learning from the action, connecting what is learned from it with already established knowledge, the "learning". Service-learning projects can be utilized to reinforce the contents of the course and to develop a variety of competencies in the student related to civic responsibility.

Instructor-led Class
Teaching model structured around the presentation of learning contents by the teacher. Students attend class for the presentation, study the contents and demonstrate their knowledge in the exams.

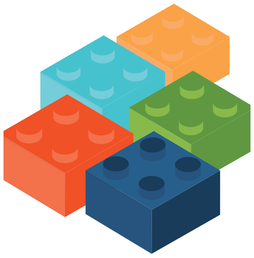
Connectivism
A theory that states that learning occurs as result of many and diverse connections. The goal is to build networks, with the support of information and communication technologies, and generate new knowledge while learning.



Constructionism
Theory of learning that highlights the importance of action in the learning process. Students learn more effectively by building tangible objects thereby building on their own knowledge structures.

Competency-Based Education
Centered on student's learning and focused on the development of knowledge, skills, and attitudes that must be demonstrated in a tangible manner and based on performance standards. The competencies allow the subject to have an active adaptation to the change process by developing comprehension and resolution of increasingly complex problems.

Self-organized learning environment
Teaching methodology where the educators are guides and observers of what happens in the session and the students themselves decide to begin the search for new concepts. The academic curriculum is based on questions that awaken the curiosity of the student, giving rise to investigative, autonomous, and collaborative work, so students can internalize the new knowledge, which can be reinforced by the educator.



Makers Space
A space in which students learn by making their own creations, using design software, as well as tools and equipment to develop their own projects in fields such as 3D printers, laser cutters, numerical control machines, welding equipment, and textiles.

Gamification
It involves the design of an actual or virtual educational environment to define tasks and activities using gaming principles. The goal is to take advantage of the natural predisposition of students towards gaming activities to enhance the motivation to learn, the acquisition of knowledge and values, and the development of competencies in general.

Mastery Learning
Modality of the teaching–learning process in which the contents are divided into learning units that clearly indicate the goals students must attain. Students work through each block of content in a series of sequential steps and must demonstrate a certain level of success in the mastery of the knowledge, prior to moving on to new content.

Maieutic
A method that consists of interrogating a person to make them attain knowledge by means of their own conclusions and not by means of learned knowledge and pre-conceptualized concepts. Maieutic is based on the intrinsic capacity of each individual, which assumes the idea that the truth is hidden inside oneself.

Mentoring
An interpersonal relationship that promotes the development of the student with the help of a person with greater experience or knowledge. The person that receives mentoring has traditionally been known as a disciple or apprentice.

Peer learning
A reciprocal learning experience that involves students sharing knowledge, ideas, and experiences among each other. It can be viewed as a strategy to take students from an independent form of learning to one that is interdependent or mutual.

Case Method
The case method is a didactic technique where students build their learning from the analysis and discussion of real life experiences and situations. They are involved in a process of analysis of problematic situations for which they must propose a well-founded solution.

Glossary of trends in technology

Adaptive Learning
A method of instruction that uses a computer system to create a personalized learning experience. Instruction, feedback, and correction are adjusted based on the interactions of the student and the level of performance demonstrated.

Learning with Wearable Technologies
Learning strategy that incorporates the use of electronic devices in clothing and accessories worn by students with the purpose of performing a learning activity.

Learning in Social Networks and Collaborative Environments
Use of existing or proprietary platforms, often hosted in the cloud, that strengthen social and collaborative learning regardless of where the participants are located. It makes use of such different technological resources: social networks, blogs, chats, online conferences, shared board, wikis, among others.

Mobile Learning
Use of mobile technologies, such as portable computers, tablets, MP3 players and smartphones for supporting the teaching- learning process. Access to educational resources can be made from the device that the student carries at all times.

Ubiquitous Learning
Educational strategy where learning happens anywhere and at any time thanks to the use of technologies that form part of our day-to-day activities in the most routine objects. These technologies make educational contents and activities available to students at all times.

Virtual Assistant
An artificial intelligence application capable of interacting with human beings in their own language. In education, a virtual assistant could facilitate interaction with the teacher and the student offering greater accessibility and improving the personalization of learning by providing information, tutoring, administering exams, and more.

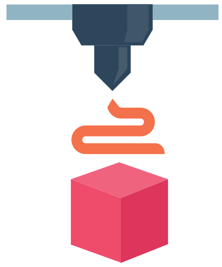
Big Data and Learning Analytics
Use of tools and techniques that handle large amounts of data on students available in learning platforms, entrance exams, academic history, interactions of students in discussion forums, library, among others. Handling the students' data makes it possible to determine their current learning status, formulate a forecast on their performance, and take corrective actions.

Affective Computing
A computer system capable of detecting the affective status of the users. This technology can have a major impact on education since learning is associated not only with cognitive skills, but also emotions, expectations, prejudices, and social needs. There are many technologies that can be used to create an emotionally deep learning environment, for example, simulations, role-playing, language detection, facial recognition, among others.

Massive Open Online Courses
Online courses that use connectivism, a didactic strategy that has the potential for having thousands of participants in a single virtual space, which is accessible to anyone who has the Internet. Besides videos, readings, and learning activities, they provide forums where the teacher and the students engage in an exchange of knowledge.

E-Books
Electronic version of a book that can be accessed in computers and mobile devices, allowing the student to interact with the content in a more rewarding manner.

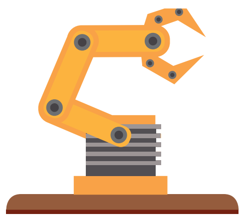
Personalized Learning Environments
These are systems that students can configure on their own to take control of and manage their own learning. This includes setting learning objectives, managing content, and communicating with other students. These environments can be comprised of one or several subsystems, for example, an LMS, blogs, feeds, etc. It can be a desktop application or comprised by one or more web services.



3D Printing in Education
Use of printers that allows students to create parts, prototypes or volumetric models from a design made in a computer. Helps teachers and students to visualize in 3D concepts that are difficult to illustrate in another manner. Students can design and print their models, test and assess them, and, if they do not work, work with them again.

Badges and Microcredits
Badges are a mechanism for granting a certification to students for informal learning in the form of microcredits. Students can gather, organize and publish them to demonstrate their skills and achievements, in different websites, such as social networks, professional networks, and virtual communities, among others.

Internet of Things
Refers to the interconnection of day-to- day objects with the Internet. This interconnection allows the exchange of relevant data generated by devices, thus facilitating daily life. Applications of this technology are being developed in education. For example, a student can learn a language by touching physical objects, since the objects will reproduce their name by means of a message or voice.

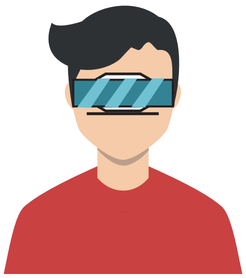


Remote and Virtual Laboratories
Virtual laboratories are web applications that emulate the operation of an actual laboratory to practice in a safe environment. Remote laboratories provide a virtual interface to an actual laboratory. Students work with the equipment and observe the activities by means of a web camera from a computer or a mobile device, which allows them to have an actual viewpoint of the behavior of a system and access professional laboratory tools whenever they need them.

Augmented Reality
Use of technology that complements the perception and interaction with the real world and allows the student to superimpose a layer of information onto reality, thus providing richer and more immersive learning experiences.

Open Educational Resources (OER)
Teaching-learning resources open to the general public to be used freely and at no charge, with no start/closing date, allowing the participants to learn at their own pace. OER may include complete courses, course materials, modules, textbooks, videos, exams, software, and any other knowledge resource.

Telepresence in Education
The use of audiovisual technologies with educational purposes that allow students and teachers to interact in a remote, synchronic manner in conversations, classes, teamwork, among others.



Virtual Reality
An immersive technological environment made up of a three-dimensional simulation in which the user involves several senses to interact with the simulation. The user feels like they are mentally immersed in the artificial medium.

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