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Joao Mattar;Daniela Karine Ramos

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Joao Mattar
PUC–SP & Centro Universitário Internacional Uninter, *joaomattar@gmail.com*

Daniela Karine Ramos
Universidade Federal de Santa Catarina (UFSC), *dadaniela@gmail.com*

Abstract

The aim of this article is to explore how active methodologies and digital technologies can foster a more active participation of students in their learning process and suggests possible changes in pedagogical practices. Blended learning, conceived in a stricter sense as the mix of face-to-face and online activities, and in a broader sense as the mix of different methodologies and spaces, may be considered the future of educational activities. The following methodologies are discussed: flipped classroom, peer instruction, problem-based learning, project-based learning, and game-based learning. Research shows that these methodologies, when adequately combined with information and communication technologies, result in greater motivation and involvement of the students. Although these strategies do not generate improvement in immediate retention of knowledge, more complex skills are developed when compared to traditional education methods, such as: problem solving, the transfer of knowledge to reality, and retention of knowledge in the longer term. The article concludes with a critique of the contemporary discourses that position the student at the center of the teaching and learning process, claiming for a de-centered pedagogy, in which students interact with each other, teachers and other actors, in collaboratively groups where there is no need for a center, or in which each of these actors can alternatively perform a central function.

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1. Introduction

The use of Information and Communication Technologies (ICT) can be associated with new methodologies that modify the roles and the way knowledge is produced. Many of these methodologies are based on a more active posture of the student; however, this cannot be considered a new approach. Brazilian educator Paulo Freire (1921-1977), for example, even without discussing the use of ICT, already argued for a more active attitude of students in the learning process. What he calls “banking education” would imply in mechanic memorization of content, turning the students into “containers”, “receptacles” to be “filled” by

the teacher: “The more completely she fills the receptacles, the better a teacher she is. The more meekly the receptacles allow themselves to be filled, the better students they are.” (Freire, 2005, p. 72). From this perspective education is characterized as an act of depositing, narrating, transferring and transmitting knowledge, in which learners assume the role of receiving, repeating, memorizing, and archiving contents. To this banking conception of education, antidialogic by nature, Freire opposes a humanistic and problematizing education, which presupposes the dialogue: “Whereas banking education anesthetizes and inhibits creative power, problem-posing education involves a constant unveiling of reality. The former attempts to maintain the submersion of consciousness; the latter strives for the emergence of consciousness and critical intervention in reality.” (Freire, 2005, p. 81).

But one can return much more in time, until the beginnings of Western thought in Athens. Socrates (469-399 B.C.), for example, exposed his interlocutors to a questioning process called “maieutic”, which may serve as a reference for many of the active methodologies currently used. The Greek philosopher used a method by which he did not intend to teach directly, but indirectly, using questions to take people to recognize that they did not know what they thought they knew, trying to point out a way and not just an answer.

In the contemporary context, the central position of the teacher in the teaching process began to be questioned more intensely from the moment ICT allowed the access to free information and content of quality, and in abundance, for any interested person, thus, space for the development of more active methodologies, in which the student becomes protagonist and assumes more responsibility about his / her learning process.

ICT have generated new forms of communication, thinking, work, relationships, learning and life (Coll & Monereo, 2008), creating communication alternatives and increasing the possibilities of access to information (Battro & Fischer, 2012). Thus, they exert influence on various aspects of everyday life, including teaching and learning contexts. Exponentially democratizing the access to information influences the relations established between the subjects involved, the roles played and the ways of learning.

Accessibility and flexibility related to digital technologies, which can be accessed by portable mobile devices, can provide students with greater opportunities to learn in non-classroom activity (Shin, Sutherland, Norris, & Soloway, 2012) and with a higher level of cognitive activity (Karmiloff-Smith, 2015). In addition to access, these mediums use words and images intensely to promote human understanding, since those who learn may be able to mentally integrate visual and verbal representations (Mayer, 2009), unlike methodologies based exclusively on words and verbal exposure.

The diversity of possibilities allows us to combine and create new teaching modalities, such as blended learning. In a stricter sense, it means the mix between face-to-face and distance education (more specifically online). However, there is at least another sense for the expression, which points to the combination of different learning spaces (inside and outside the classroom, for example), or even between formal and informal learning. In that sense, online would not be an essential element for the definition of hybrid.

Hybrid teaching enables students to learn online, experiencing some control over time, place, path and / or rhythm, and at other times in a physical location to learn in a supervised way, away from home (Horn & Staker, 2014).

In addition, classroom spaces have naturally been forced to reform, as the lecture room, chairs lined up, chalkboard and chalk, with the teacher in front of the class, is no longer the only way to teach and learn. The development of active methodologies has gone hand in hand with redesigning face-to-face learning environments, which now need to accommodate hardware, projectors, monitors, mobile furniture, simulation spaces and other technologies, all based on wi-fi, enabling more socialization, interaction and collaboration, even with students who are in other places, far away.

In this sense, one of the trends, especially in basic education, is what is called "makerspaces", directly associated with the maker movement. These constitute environments that provide tools and opportunities for hands-on and creative learning, located in community spaces and educational institutions. Cavalcanti (2013) differentiates the concepts of hackerspace (that originated in common spaces for programmers), makerspace (originated in public spaces for design and creation, connected to the maker movement), TechShop (for-profit network that offers manufacturing spaces) and FabLab (MIT-initiated network that includes tools for manufacturing).

This trend makes it clear that hybrid teaching is not synonymous with simply using classroom technology but involves a pedagogical change in which the student assumes more control over his / her learning. Blended learning, in this broader sense, is directly linked to less teacher-centered learning and more student-centered learning by doing.

In the interlacing of ICT insertion and the methodologies that conceive the students as active, this article aims to describe and analyze the combination of active methodologies and digital technologies, which generate the displacement of learners from their traditional passive position to an active posture in the learning process, to point out possibilities of changes in pedagogical practices. This active stance, as Clark and Mayer (2011) argue, can occur even when the student is watching an animation (or even a lecture) that provokes meaningful learning, in which new ideas begin to shift and combine with old ones. All the methodologies discussed in this article invite the students to abandon their receptive position and participate in the learning process by new and different perspectives, as decision maker, creator, player, teacher, actor, researcher and so on. Active methodologies analyzed include flipped classroom, peer instruction, problem-based learning, project-based learning, and game-based learning.

2. Active Methodologies

Although this section explores active teaching and learning methodologies, its presentation and discussion is, whenever possible, related to the use of new technologies.

2.1. Flipped Classroom

Flipped classroom is characterized by the proposition that events that used to occur traditionally in the classroom to be carried out outside the classroom and vice versa (Lage, Platt & Treglia, 2000; Bergmann & Sams, 2012). According to the Flipped Learning Network (2014), flipped learning moves the moment of instruction directly from the classroom to the individual learning space, so the group space becomes a dynamic and interactive learning environment, in which the educator guides the students as they apply concepts and engage creatively.

Since 1996, Lage et al. (2000) have already proposed the inverted classroom for introductory courses in Economics at Miami University, concerned with attending different students' learning styles. Such a reversal would have been made possible by the development of technologies, especially multimedia, such as the Web. Thus, students were expected to come to classes having previously accessed the content and asked questions, so the class was conducted with practical experiments or activities, ending with tests and review questions, answered in small groups. Teachers evaluated the experience positively, noting more motivation in the students, who generally also liked to work in groups and felt more comfortable asking questions during the lesson, and most of the students had a positive impression of the subjects, the practical activities, tests and group work (Lage et al., 2000). In its most recent version, which has become popular since the 2000s, Educause (2002) defines flipped classroom as a pedagogical model that alternates the typical elements of the classroom and the homework by making use of video lessons or pre-recorded audio that are watched at home, so the time of classroom is dedicated to performing exercises, projects or discussions.

Many researches have been evaluating the contributions of the use of the flipped classroom methodology in different areas of knowledge and teaching levels. Among the results described: the students' perception of achievement of learning objectives and performance in exams (Lombardini, Lakkalae, & Muukkonen, 2018), improved academic performance, improved self-learning skills, increased study satisfaction, increased expression of critical thinking, and problem-solving skills (Tan, Yue, & Fu, 2018). Comparing the flipped classroom with three different learning contexts, such as blended learning, traditional classroom and e-learning, in offering a course at a University in Vietnam, Thai, De Wever and Valcke (2017) noted that the learning performance was superior in the group that participated in the flipped classroom and observed a positive effect on the beliefs of self-efficacy and intrinsic motivation.

Flipped learning allows teachers to use various methodologies and activities in their classrooms (Flipped Learning Network, 2014). For this, the teacher needs to re-plan his or her classes using active methodologies such as cases, problems and projects. In this way, it is possible to say that flipped classroom is an active methodology, but, to materialize, it needs to include other active methodologies, characterizing itself as a meta-methodology for carrying, as a shell or a snail, other methodologies.

2.2. Peer Instruction

Peer instruction was systematized by Professor Eric Mazur in introduction physics courses in Science and Engineering at Harvard University. In 1990 he realized that his students were not learning to solve real-world problems, although they succeeded to solve the problems proposed by books and tests. So, he decided to change his teaching methodology, proposing that students talked to each other about an issue, instead of he, the instructor, trying to explain. In a situation where he tried to explain for ten minutes a question for a class, which was still confused, he suddenly did something for the first time: "I said, 'Why don't you discuss it with each other?'". The class became a chaos, but after three minutes the students said, "OK, we've got it, let's move on." (Lambert, 2012).

Since then, Mazur developed an interactive teaching style in which students actively participate in their learning process. The methodology has been refined and improved since its implementation in 1991, and

ten years later an important article took stock of this period (Crouch & Mazur, 2001). It was proposed that the textbook be read before the lessons; the reading tests that were answered in the classroom were replaced by open-ended questions that were answered before the classes; and cooperative learning was incorporated into the discussion moments during the lessons. These improvements were designed to help students learn more from reading and increase their involvement in discussion moments, which has led to better learning outcomes.

In the pedagogical practice there is the phase of discussion, in which the theme is resumed and the students begin to talk with their colleagues, encouraged by the teacher, trying to convince them that their answer is correct (hence the expression "peer instruction"), while the teacher circulates around the room, participating in some of the discussions, which should last between two to four minutes. This is a time of intense interaction between students and, in some cases, also with the instructor. Finally, students use the same resources to respond again to the same initial conceptual test.

In the peer instruction methodology, the simpler language used by the student during the discussion phase in comparison with an explanation of the instructor that tends to be more technical contributes to the better understanding of the concepts, which can be observed in the increase of the correct answers given by the students (Mazur, 1999). As Mazur reflects, sometimes it seems that students can teach each other concepts more efficiently than their teachers. One likely explanation is that students, who can understand the concept behind the given question, have just learned the idea and are still aware of the difficulties they had to overcome to understand the concept involved. Consequently, they know exactly what to emphasize in their explanation. Similarly, many experienced teachers know that their first lesson in a new discipline is often their best, marked by clarity and lightness that usually cease to exist in later, more polished versions. The reason behind this is the same: as time goes by and a teacher remains exposed to the same material, it seems that the conceptual difficulties disappear and, consequently, are no longer being examined carefully.

Researches have revealed contributions of this methodology, describing results that indicate greater motivation and involvement, improvement of conceptual reasoning and problem-solving skills, and increase of grades (Crouch & Mazur, 2011). One of the possible explanations for these positive outcomes may be the collaborative environment created when students study in groups, discuss various topics and even take on teacher roles. In addition, after answering a question (and making mistakes), a student would be more open to listen to both the teacher and his or her classmates. In comparison with more traditional teaching methods, a greater impact on learning is observed when using peer instruction (Balta, Michinov, Balyimez, & Ayaz, 2017). These impacts are identified, for example, in the best performance on difficult issues and the perception of higher student satisfaction (Michinov, Morice, & Ferrières, 2015).

The retention of knowledge is also greater with peer instruction, compared to traditional education, probably because active learning helps to move information from short-term to long-term memory. In addition, the improvement in learning outcomes among women was greater than among men in Mazur's (1999) led studies. The refinement of pedagogy, designed to help students learn more from pre-lesson readings and intensify their involvement in the discussions, helped to further increase understanding and learning outcomes.

In this type of methodology, it is also necessary to consider the resistance of the architecture: the classrooms are still, for the most part, inadequate not only for peer instruction, but for active methodologies in general. As stated by Mazur, they are built with a single goal: to focus the attention of many on the active teacher, while the audience simply sits, receiving information. Instead, we could abandon this format and set up rooms as we see in kindergarten schools, where children sit around a table looking at each other, and suggested activities to be performed in a group: this would truly mean active learning.

> It's no accident that most elementary schools are organized that way. The reason is, that's how we learn. For some reason we unlearn how to learn as we progress from elementary school through middle school and high school. And in a sense, maybe I'm bringing kindergarten back to college by having people talk to each other! (Lambert, 2012).

We must not only coax students out of their rooms, but into each other's minds: "If learning is indeed a social experience, then a "party school"—of a certain kind—just might offer the richest learning environment of all." (Lambert, 2012).

Lectures are a way of transferring the instructor's lecture notes directly to students' notebooks without passing through the brains of either, Mazur quips (Lambert, 2012). It is important to note that peer instruction also involves practical experiments in laboratories and art studios. Thus, active learners are constantly invited to apply new information and new knowledge, rather than simply taking notes. Students cease to be students and become managers of their own learning process and even teachers, which characterizes an active methodology of teaching and learning.

2.3. Problem-Based Learning

Problem-based learning is a methodology developed by the McMaster University School of Medicine in which students learn in small groups and with tutors from problems, which are patient cases, to identify and meet their learning needs.

The institution's website1 presents information about the methodology, noting that in 1969, the McMaster University Medical School introduced a practical approach to learning medicine. In problem-based learning the problem is used to help students identify their own learning needs as they try to understand it; they need to gather, synthesize and apply information to the problem and start working effectively to learn from group and tutors. Among the fundamentals of problem-based learning are: small-groups, teacher facilitation, use of patient-based cases, and the definition of learning objectives.

A study of dozens of teachers who used problem-based learning in their high school economics classes in California and Arizona found that their students scored higher on exams and activities that measured problem solving skills and application to world economic dilemmas than traditional students (Finkelstein, Hanson, Huang, Hirschman, & Huang, 2010). Yew & Goh (2016) conducted a review to examine the effectiveness of problem-based learning discussion on various naturalistic and empirical studies, concluding the methodology is effective in retaining long-term knowledge and in applying knowledge. When comparing to traditional teaching methodologies, Strobel and Van Barneveld's (2009) qualitative meta-analysis of meta-analyzes reinforces the greater effectiveness of problem-based learning. The results

[1] http://mdprogram.mcmaster.ca/mcmaster-md-program/overview/pbl---problem-based-learning

indicated that problem-based learning was superior when it came to long-term retention, skill development and student and teacher satisfaction, while traditional methodologies were more effective for short-term retention, which can be assessed by standardized tests.

2.4. Project-Based Learning

Project-based learning is grounded in collaborative work on authentic real-world issues and problems, which are a guiding, challenging, and complex task involving the production of various artifacts and with rubrics for evaluation (Bender, 2012). Project-based learning methodology presupposes the participation of the student in several steps that go from the planning, the research and the application of the knowledge to the solution of some problem (Bender, 2012). And ICT makes it possible to access information to assist in the projects, facilitating the attribution of meaning.

Several studies have been developed to evaluate the contributions of this methodology. A quasi-experimental research developed by Eskrootchi and Oskrochi (2010) included 72 eighth grade students, divided into three groups: a first group had a traditional class; another group used a simulation model; and a third group used a simulation model and an experimental model. The results suggest that students learn best by actively building knowledge from a combination of experience, interpretation, and structured interactions with peers and teachers when using simulation in a project-based learning configuration.

One of the interesting models linked to project-based learning came from a partnership between the Harvard School of Education and Outward Bound2: expeditionary learning (EL Education)3. In a stricter sense, the learning process involves the study of a reality, the field visit (expedition) and the elaboration of projects by the students to solve the identified problems. More than 150 schools in the United States adopt the model. In expeditionary learning, students are expected to become critical thinkers, problem solvers, and efficient learners; develop the skills to deal with complex ideas, problems and texts; develop the character and habits necessary for success in college, in their careers and in life; and experience the curriculum through research and application.

In project-based learning it is possible to develop creative ideas, improve metacognition and improve cognitive skills (Sart, 2014). At the same time, one of the distinguishing characteristics of project-based learning from other methodologies is that its result is, in general, a product.

2.5. Game-Based Learning

In game-based learning we play extremely active roles because it is possible to choose how to learn to draw one's own learning goals; even when those goals are already predefined, players are usually free to hit them in the way they choose. For Lehto (2009), the need for participation defines a game, which is not simply read but also written by the player. The game constitutes an exploitable dynamic system, which can be built by the free choices of the player. The game reveals itself as an interactive immersion, in which we have a structure that is filled by the acts of the player (Lehto, 2009). Thus, the player of a game simultaneously

[2] http://www.outwardbound.org/
[3] https://eleducation.org/

assumes the position of an author, as it contributes to its construction. In addition to interpreting, the player of a game must strive to progress in the story (Juul, 2001).

Games are based on the aesthetics of experiences by presupposing interaction (with other players) and interactivity (with their own elements), i.e. their exploration should not be configured as a planned and guided visit, but must include the possibility of construction of the path by the user, freedom and a certain degree of uncertainty that reinforce his / her sense of immersion (Fortugno & Zimmerman, 2010). The interaction experiences with games favor active learning by exploring the game environment and solving challenges. The resulting learning involves different domains: cognitive, affective and psychomotor, because when playing it is necessary to participate and contribute to the construction of the game narrative, to plan and evaluate actions, to compare and explore the environment, to control impulses, and to attribute value to actions and behaviors (Kapp, Blair, & Mesch, 2014).

In addition, playing games develops the ability to manipulate complex systems and deduce rules by observation. For Johnson (2006, pp. 42-45), most videogames differ from traditional games, such as chess, for how they restrict information about the rules underlying the system. In the universe of videogames, on the other hand, the rules are rarely fully established before starting to play, ending up being presented in the manipulation of objects or characters, that is, many of the rules are revealed only from the exploration of the game.

In videogames, players can also assume different identities, build multiple virtual personalities (Gee, 2005), interact and experiment with different positions such as engineers, urban planners, journalists, architects, and other innovative professionals (Shaffer, 2008). McGonigal (2011) goes even further, arguing that multi-user games lead players to develop skills such as critical thinking, creative problem solving, and group work, generating thus solutions to social and environmental dilemmas and, consequently, changing the world.

The combination of the characteristics of games provides rich and fun learning experiences, which have been evidenced by many scholars and researches in different areas and contexts, highlighting them in the assimilation of content in a playful way (Herrero et al., 2014; Epstein, Noel, Finnegan, & Watkins, 2016); in the development of executive functions (Thorell, Lindqvist, Bergman, Bohlin, & Klingberg, 2009; Diamond & Lee, 2011) and in increasing motivation to learn (Hsiao, 2007).

Thus, it becomes evident how intensively the use of games is strongly associated with active methodologies. Games assumes an active student who exploits the environment and the possibilities, applying his / her knowledge to overcome the challenges, while still learning the consequences of his / her actions and receiving feedbacks.

3. CONCLUSION

What is possible to conclude from researches on some of the methodologies combined with digital technologies and discussed in this article, such as problem-based learning, project-based learning and game-based learning, is that active methodologies, although almost always result in greater motivation and involvement of the students in activities, do not generate learning improvement results when traditional assessments are performed, such as tests that attempt to measure the immediate retention of knowledge.

However, when assessing the development of more complex skills, such as problem solving and transfer of learning to reality, and even retention of knowledge in the longer term, the results of students using active methodologies combined with digital technologies are generally better than those who used traditional teaching methodologies. In the future, the adequate mix between active methodologies and technologies in blended learning tends to be an essential differential of schools, companies and educational institutions that will be able to lead their students to reflect on their own learning process, abandoning their position of vessels and positioning themselves as self-actors-observers.

Derrida (1989) discusses the obsession of Western civilization by the center in structures. Defining a center neutralizes and reduces the flexibility of the structure, relates it to a point of presence, to a fixed origin. If the center of a structure has the function of guiding, balancing and organizing the coherence of the system, it also ends up limiting what it calls freeplay – the transformation and the displacement of its elements are interdicted. The center guarantees a certain stillness that reassures, dominates the anguish involved in being immersed in the game, being involved in the game, starting to play. According to Derrida, successively and closely, the center receives different forms or names. The history of metaphysics, as well as the Western history, would be the history of these metaphors and metonymies on the foundation and principle: origin, end, arché, telos, eidos, energeia, ousia, aletheia, essence, God, man, and so on.

But we are now set to conceive a world without the law of a central presence, without the security of a fixed place. We are challenged to live in a world in which there is no more central, original or transcendental meaning, a de-centered structure. We are forced to abandon the references to a center, the obsession to look for a center, a subject, the rationality of instructional design by the threat of design thinking "chaos" in a decentering movement. Derrida explores some examples in the text: mythical or mythological discourse, ethnography, bricolage, the works of Freud and Heidegger, the innocence of becoming, and Nietzsche's jubilant affirmation of the free play of the world without truth, without origin, offered to an active interpretation. But it is not enough simply to admit the loss of the center – we are also forced to recognize that the philosophical or epistemological requirement of a center was a historical illusion, to admit the non-center. Playing without security, in a world of floating meanings.

Besides that, the ways of being, living and learning influenced by use of digital technologies lead us to a de-centering configuration, where the access to information is diffuse and available from various points and places and communication flows into various directions and multiple subjects in a simultaneous and connected way, with an interflow of senses and sharing that operates much more in a network style instead of a centered environment.

In the discourse on education, however, we still maintain the need for a fixed center. If we placed the teacher for a long time as the center of the teaching process, we replace him or her - following Derrida's reading - by the student "at the center" of the learning process. In fact, in the practice that we seek with the blending of active methodologies and digital technologies, which mimics learning in the real world, there is no center: there are students, there are groups, there are teachers (who can give lectures that generate active learning), there are tutors, there are designers, there are several anonymous contributors to the official academic practice and discourse (like doormen, cleaners and so on), there are technologies — increasingly human, there are robots ... If the word "teaching" is associated to the teacher at the center,

many argue that "learning" would represent today the student at the center. But there is a much older word, "education," which represents an active process of "teaching and learning", without obsession with centers.

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