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Creative use of information and communication technologies according to university professors and students

Uso criativo das tecnologias da informação e comunicação segundo professores e estudantes universitários

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Abstract

The purpose of this study was to investigate the role of technologies in fostering students' creativity and motivation in university classrooms, according to professors and students. Nine professors from three groups – those who use information and communication technologies creatively, those who make traditional use of these technologies, and those who do not use information and communication technologies –, were interviewed. Additionally, 249 students completed the Inventory of Teaching Practices for Creativity in Higher Education and the Motivation Scale for Learning. In the professors' report, it was not noticed a link between technology and the development of creativity. Students whose teachers did not use information and communication technologies evaluated the teaching practices for creativity more positively. The use of digital technologies in the classroom should be planned according to the purposes that are sought to achieve.

Keywords: Education, higher; Innovation; Learning; Motivation.

Resumo

O objetivo deste estudo foi investigar o papel das tecnologias no desenvolvimento da criatividade na motivação discente segundo professores e estudantes universitários. Nove professores de três grupos – uso criativo, uso tradicional e não uso das Tecnologias da Informação e Comunicação –, participaram de entrevista semiestruturada. Ademais, 249 estudantes

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responderam ao Inventário de Práticas Docentes para a Criatividade na Educação Superior e à Escala de Motivação para Aprender. No relato docente, não se observou ligação entre tecnologia e desenvolvimento da criatividade discente. Os estudantes cujos professores não utilizavam as Tecnologias da Informação e Comunicação avaliaram mais positivamente as práticas docentes quanto ao estímulo à criatividade. O uso das tecnologias em sala de aula deve ser planejado conforme os objetivos que se pretende alcançar.

Palavras-chave: *Educação superior; Inovação; Aprendizagem; Motivação.*

Children and adolescents growing up in today's society are immersed in the online universe. This scenario shows that the integration of technologies into education has become an imminent need to respond to the demand of these students (Newman & Scurry, 2015). The growing interest in Information and Communication Technologies (ICT) can be translated by its potential to produce new mediations in the teaching-learning process (Kenski, 2011). According to Santos and Braga (2012), there are three types of use of digital technology media: information, communication and expression. The use of ICT as information media refers to the idea that ICT grant real-time access to information, modifying the student-teacher relations meaning the teacher is no longer the sole holder and transmitter of knowledge. The use of ICT as a means of communication results in the reduction of distances among people, allowing classrooms with access to the Internet to be interactive. ICT as a means of expression provide a rich setting for communicating students' creations and thoughts. In Higher Education, the introduction of ICT has enabled the student to play a more active role in building their knowledge (Iniesta-Bonillo, Sánchez-Fernández, & Schlesinger, 2013). According to Alencar, Fleith, and Pereira (2017), Higher Education must also promote flexible, creative, and critical students.

Creativity in this study is defined as the production of something new or the re-elaboration of something that already exists and is of value to the society the creator is inserted in (Morais & Almeida, 2019). Thus, being creative is both an individual skill and a phenomenon influenced by sociocultural factors (Fleith, 2019; Nakano & Wechsler, 2018). David, Nakano, Morais, and Primi (2011) emphasize the need to fully develop university students' abilities, valuing innovative solutions and preparing professionals for the rigid demands of the labor market. Studies have discussed and investigated the use of technology to facilitate the development and expression of creativity in the classroom (Kuo, Tseng, & Yang, 2019; Pifarré, 2019; Saorín et al., 2017; Stolaki & Economides, 2018; Surgenor, McMahon-Beattie, Burns, & Hollywood, 2016). Due to their provisional nature, ICT allow for: experimentation, simulation and change of alternatives, interactivity, access to information, content manipulations, and immediate feedback (Loveless, 2007).

Student motivation also plays an important role in classrooms. Ryan and Deci (2000) define a motivated person as one who is impetus and has inspiration or energy to act and achieve a goal. Intrinsic motivation is defined as an inherent tendency to engage in an activity that is pleasurable in itself, provides satisfaction, and is related to more successful performance and greater wellbeing. Extrinsic motivation refers to engagement in an activity to achieve a result or reward, whether social or material, beyond the nature of the task itself and, in turn, is often associated with poor performance. Research has shown that the implementation of ICT favors student engagement and persistence in school activities (Beluce & Oliveira, 2016; Huang, Su, Yang, & Liou, 2017; Hung & Young, 2017; Jeno, Grytnes, & Vandvik, 2017). The interactive nature of ICT may enable students to have learning experiences that would not be possible in a traditional classroom, such as the exchange of experiences with students from different parts of the world (Ertmer et al., 2011).

However, scholars argue that the development of creativity and the increase of motivation are not automatic products of the use of ICT and also emphasize the importance of interaction between their resources and the factors that stimulate creative processes (Ferguson, 2011; Loveless, 2007). Conlon and Simpson (2003) discuss difficulties in the pedagogically appropriate inclusion of technologies in school, including previous training of teachers to use ICT. In this sense, when ICT are well-used in a way that encourages creative expression in pedagogical work, students' creative potential can be developed (Ferguson, 2011)

and can motivate them to learn (Jeno et al., 2017). Little research has been done on this subject thus far (Vilarinho-Rezende, Borges, Fleith, & Joly, 2016).

The purpose of this study was to investigate the role of technologies in fostering students' creativity and motivation in university classrooms, according to professors and students. The research questions investigated were: (a) How do professors assess the role of ICT in developing creativity and increasing motivation to learn in the classroom? (b) How do professors plan their classes and choose strategies, with or without the use of ICT? (c) Are there differences among students in classes in which ICT are used in creative ways, in traditional ways, and in which ICT are not used regarding the perception of the teaching practices for creativity in the classroom and the motivation to learn?

Method

Participants

Nine professors and 249 university students from a public Higher Education institution, located in the center-west region of Brazil, participated in the study. Professors and students were selected and divided into three groups, namely: those who used ICT creatively (ICTCreat, n = 3), those who used ICT in a traditional way (ICTTrad; n = 4), and those who did not use ICT (NoICT, n = 2). Creative use of ICT was defined as the implementation of some kind of novelty in teaching practice that is valuable to students' learning and development. Traditional use has been defined as "conservative innovation" (Cysneiros, 1999), which means using digital technologies to replace analogue technologies, changing only the aesthetics of practices while maintaining the same teaching structure and logic. The NoICT group included professors who did not use ICT for support or as a requirement for completing activities within the classroom. The mean age of these participants was 47.25 years (SD = 8.24). Eight were male and one was a female professor. The average teaching experience was 18.78 years (SD = 10.43). Two taught Life Sciences courses; three taught Exact, Technological, and Multidisciplinary Science courses; and four taught Humanities courses. Professors in the ICTCreat group used: (a) an intelligent system, within the Moodle platform, in which the level of difficulty of the course content available in Moodle increased or decreased according to the students' performance; (b) videos produced by the professors and posted on YouTube, while face-to-face classes were used to answer student questions (Flipped Classroom model); (c) WhatsApp for communication; and (d) live streamed demonstrations. ICTTrad professors used: (a) Moodle as a repository for course material; (b) PowerPoint for lectures; (c) Facebook for communication and posting course materials; and (d) YouTube videos. NoICT professors used the class blackboard, traditional lecture, and class discussions. The mean age of the 249 students was 21.07 years (SD = 4.59), 154 (61.85%) were male and 94 (37.75%) were female. One student did not report gender. Fifty-one students (20.48%) were enrolled in Life Science courses; 69 (27.71%) in Exact, Technological and Multidisciplinary Sciences; and 129 (51.81%) in Humanities.

Instruments

Professors were interviewed using a semi-structured interview protocol aiming to investigate (a) the role of ICT in their teaching practice in developing creativity and increasing student motivation, and (b) their processes for planning the use of ICT or other educational strategies and tools for pedagogical support. Students completed the Inventory of Teaching Practices for Creativity in Higher Education (ITPC-HE) (Alencar & Fleith, 2014). The purpose of this inventory was to evaluate the participants' perceptions of the extent to

which their professors' teaching practices favor student creativity development and expression. The inventory consists of 37 items, on a 5-point scale ranging from "I completely disagree" to "I completely agree". This inventory includes four factors: Encouragement of New Ideas ($\alpha = 0.93$), 14 items; Climate for Expression of Ideas ($\alpha = 0.72$), 6 items; Teaching Assessment and Method ($\alpha = 0.85$), 5 items; and Interest in Student Learning ($\alpha = 0.72$), 12 items. The students also completed the *Escala de Motivação para Aprendizagem – Universitários* (EMA-U, Motivation Scale for Learning – University Students) (Boruchovitch, 2008). The instrument has 26 items, on a 4-point scale ranging from "I totally disagree" to "I totally agree". This inventory has two factors: Intrinsic Motivation ($\alpha = 0.84$), 14 items; and Extrinsic Motivation ($\alpha = 0.76$), 12 items.

Procedures

Initially, unit (e.g., departments, institutes) administrators provided names of professors who had received grants supporting the development and use of ICT in creative ways to improve the quality of teaching and learning in undergraduate education (ICTCreat), professors who used ICT in traditional ways (ICTTrad), and those who did not use ICT (NoICT). Next, the selected professors were invited to participate in the research and an interview was scheduled for the beginning of the semester. The interviews were conducted in private rooms (e.g., office or laboratory), with an average length of 34.88 minutes ($SD = 11.75$). All interviews were recorded and later transcribed. At the end of the semester, at a time arranged with the professors, the students were invited to participate in the research. This was done so that the students had more contact time with their professor during the semester. Students completed the ITPC-HE and the EMA-U, as a group and in the classroom. The ethical principles of research with humans and/or animals, in accordance with Resolution nº 466/2012, Resolution nº 510/2016, and Law nº 11.794/2008, were respected. This study was approved by the Research Ethics Committee of the Institute of Human Sciences at the University of Brasilia, under the number 1.253.742 (CAAE: 48077715.0.0000.5540).

Data analysis

Interview data was analyzed using a Grounded Theory approach and the constant comparison method was used (Corbin & Strauss, 2014). Data was divided into units of meaning (codes), which were then compared with one another in order to find similarities and differences. Similar units were conceptually grouped, and categories were generated, considering their properties and dimensions. Next, the different categories were integrated around core categories. To increase the reliability of the results, the following techniques were used: data analysis and review, researcher's notes and triangulation of information sources (e.g., multiple instruments and data from professors and students). Quantitative data was analyzed using descriptive (mean and frequency) and inferential statistics Univariate Variance Analysis (ANOVA), using the IBM®SPSS® Statistic (version 21.0).

Results

The role of ICT in developing creativity and motivation to learn, according to professors

Two categories related to the role of ICT in developing creativity and increasing motivation were identified: Fundamental and Facilitator. To keep the participants' identity confidential, professors were identified as P1-P3 (ICTCreat); P4-P7 (ICTTrad); P8 and P9 (NoICT).

Fundamental

The Fundamental category represents the idea that digital technologies are not merely supplemental tools that aid the teaching-learning process, but they are central to the education of current and future generations of students. These results were grouped into three subcategories: Mastery Necessary for Everyone, Trend Monitoring, and Teaching Feasibility.

The Mastery Necessary for Everyone subcategory refers to the perception that the mastery of technologies should not be restricted to professionals in the field. The ability to deal with information from digital media is crucial to any society. P3 stated "*Nowadays, it is not just knowing Portuguese and Mathematics. People have to know how to deal with the new media and how to process the new media*". The Trend Monitoring subcategory means that professors realize that it is necessary to stop competing with ICT and join this trend, which requires being constantly learning about new educational technologies. P2 compared the use of analogue and digital technologies: "*They [students] are very connected with technology, so I think it might be easier to get their attention (…) if I record the video on the camera up there and post it on Facebook*". Another subcategory, the Teaching Feasibility, was related to how ICT not only facilitate teaching, but also make it feasible, since it would not be possible to teach certain topics without the use of these technologies. P2 reported: "*In the laboratory I think the use of these ICT today is favorable, it is what allows us to teach well, it is not something that is improving, it is allowing*" (P2).

Facilitator

The Facilitator category refers to the characteristics of digital technologies that, when used properly, allow for greater benefits to the professor and his students. This category included five subcategories: Intentionality, Expression Medium, Skill Development, Visualization of Abstract Concepts, and Information Medium.

The Intentionality subcategory represents the idea that the use of ICT, like any other pedagogical strategy, needs to be linked to the objectives of the proposed activity. In this way, both digital and analogue technologies have the potential to facilitate the teaching process, as P4's discourse made clear: "*... So it depends a lot on each person, but for me it is the purpose of the activity itself*". The Expression Medium subcategory refers to the use of ICT as a means of expression, in which students would make use of digital technologies to create and publicize their own products. P9 described how students' use of ICT should take place: "*I think that giving students the freedom to use their tools creatively is usually very positive*" (P9). The Skill Development subcategory refers to digital technologies as facilitators of the development of skills such as critical thinking, memory, attention. P9 perceived these relationships: "*I think that, more than learning certain contents, the most important is to be able to develop a critical approach to that content. I think these technologies make it easier, he can obtain certain contents*". The Visualization of Abstract Concepts subcategory refers to the fact that ICT, by allowing the transmission of information through visual or auditory media, using static or moving images, favor the visualization of abstract concepts that are difficult to understand. P5 explained his opinion: "*It's motivating when you are studying a theoretical field usually quite abstract, that you merge this process of exposing the abstract elements with elements that generate concreteness, for example, … a video that shows the functioning of that phenomenon*". In the Information Medium subcategory, ICT allow students and even professors to access a range of information. As professor P4 reported: "*I see it [ICT] as a source of instant research, to see what has already been done, to see what kind of information he has on that subject so they can have resources to create and everything else*".

Table 1 shows the number of participants and the frequency of reports per group in each category and subcategory. The results indicate that the participants from the three groups converged on the Facilitator category, especially with the subcategory Information Medium. This was also the category with the highest frequency of reports (*f* = 19), followed by the Fundamental (*f* = 8). The ICTTrad Group presented reports in the three categories. The participants in the NoICT Group did not mention the Fundamental category. Only two professors, one from ICTTrad group and another from NoICT group, did not identify the influences of ICT favoring the teaching-learning process. For P5, "*there is no essential element of information technology that is associated with creativity in an umbilical way*".

Table 1

Number of participants and frequency of reports in each category and subcategory related to professors classes and planning strategies and the role of ICT in developing creativity and motivation

Categories/Subcategories	Groups					
	ICTCreat		ICTTrad		NoICT	
	Part. (*n* = 3)	Reports *f*	Part. (*n* = 4)	Reports *f*	Part. (*n* = 2)	Reports *f*
Professors Acess						
Fundamental	2	5	2	3	0	0
Mastery Necessary for Everyone	1	2	0	0	0	0
Trend Monitoring	2	2	2	2	0	0
Teaching Feasibility	1	1	1	1	0	0
Facilitator	1	4	3	9	2	6
Intentionality	0	0	1	5	0	0
Expression Medium	0	0	0	0	2	3
Development of Students Skills	0	0	2	2	1	1
Visualization of Abstracts Concepts	0	0	1	1	1	1
Information Medium	1	4	1	1	1	1
Professors Plans						
Constant Recycling	2	3	2	2	0	0
Strategies	3	13	4	23	2	4
ICT Use	3	9	3	12	0	0
Combination of Strategies	1	2	1	1	1	1
Analog Method	1	2	4	10	2	3
Planning	3	4	4	11	2	2
Flexible	1	2	4	11	1	1
Structured	2	2	0	0	1	1

Note: The same professor may have mentioned the same (sub)category more than once during the interview.

F: Frequency of reports; ICT: Information and Communication Technologies; ICTCreat: ICT Creatively; ICTTrad: ICT Traditional; NoICT: Not use ICT; Part.: Participants.

Classes and strategies planning, and the use of ICT by professors

Professors had the opportunity to describe, explain and justify their teaching. Based on their reports, three categories emerged: Constant Recycling, Strategies, and Planning.

Constant Recycling

The Constant Recycling category refers to the idea that professors are constantly seeking to improve their practice and to be able to pass on to their students the best and the newest in their field. P2 described his way of recycling: "*I'm going to revise something that has come out again in the literature, I'm updating my theoretical lectures, selecting readings for the students*".

Strategies

The Strategies category covers the myriad tools and activities professors choose to deliver the content to students and develop the skills necessary for their future work. The results were grouped into three

subcategories: Use of ICT, Combination of Strategies, and Analog Methods. The Use of ICT subcategory refers to the professors' reports mentioning the use of digital technologies for teaching purposes. P2 talked about his experience: "*It's a document camera that keeps filming what I'm doing on the manikin and transmitting it, then, in the projection on televisions installed in the three benches that we have in our current laboratory*" (P2). In the subcategory Combination of Strategies, the reports containing the combination and the interaction among different strategies, used to address a specific theme throughout a class. P2 explained how he combines some strategies:

> *For today's class, the student receives a text the previous week to read. Then, before he has the class, he already comes prepared with a reading, answers a small pre-test before class, corrects that in the end. … We do a quick class, just reviewing concepts they've been researching back then. And mostly move on to practice. So we try to review the theoretical concepts in this simulation they do on the dummy. … We often use Internet searches for literature, Moodle, YouTube videos that we record and some that we can recommend to them sometimes* (P2).

The Analog Methods subcategory refers to strategies used by professors that do not involve digital technology, such as practical activities, images and videos, text reading, teaching material, examples, and lectures. P9 explains how he performs his interactive lectures: "*I give lectures, which I usually also call interactive lectures, I always like to provoke students a bit to ask questions. Sometimes, the discussions stem from the questions they have about the issue of legislation*" .

Planning

The Planning category refers to how the participants deal with the formulation of the syllabus and the extent to which they are willing to adapt it to the students' demands. These results were divided into two subcategories: Flexible and Structured. The Flexible subcategory refers to professors who reported adapting the program of their discipline to the class, as well as being open to the students' demands in each class. P4 explained that he is open to suggestions from his students, opening the space for them to bring their interests regarding the theme of the class: "*I select topics that I consider important in advance. But sometimes in class there are people who come up with a topic I did not highlight … The lesson plan immediately changes*" . The Structured subcategory refers to the professors who reported following the course program and did not express flexibility in content to accommodate students' interests. It can be noticed in P1's discourse that the structuring axes are theory, technique, application and there are no signs of how the interaction with the students can interfere in this process: "*Well, let's say, [I plan] the old way, I have the course syllabus, I set the program objectives, the topics that I have to discuss, and I use those to develop the flow of contents*" (P1).

Table 1 also shows the number of participants and the frequency of reports per group in each category and subcategory. The Constant Recycling category was the only one without any report from participants in the NoICT Group. Another highlight was the diversity of Strategies the professors presented. There were 40 reports describing the tools and activities used for educational purposes. The subcategory Use of ICT obtained the highest frequency of reports (f = 21), although there were no participants from the NoICT Group. Regarding the Planning category, the four participants from the ICTTrad Group reported at least one content classified as Flexible and none as Structured. One participant from the ICTCreat Group and one from the NoICT Group presented a Flexible report. In the Structured subcategory, there were two professors from the ICTCreat Group and one from the NoICT Group.

Teaching practices for creativity and motivation to learn: differences among students from ICTCreat, ICTTrad and NoICT groups

Table 2 shows the mean, standard deviation, *F* and *p*-values for students' perceptions in the ICTCreat, ICTTrad, and NoICT groups regarding the teaching practices for creativity. Interest for Student Learning and Climate for Expression of Ideas had the highest averages for the whole sample and for students in the ICTCreat group. The factors Interest in Student Learning and Encouragement of New Ideas received the highest averages from the ICTTrad group. The NoICT group, in turn, obtained higher averages in the factor's Climate for Expression of Ideas and Encouragement of New Ideas.

Table 2

Mean, standard deviation, F (H) and p-values concerning students' perception in the ICTCreat, ICTTrad and NoICT groups concerning the teaching practices for creativity and motivation to learn

Factors	Total		Groups						*F*	*p*
	(*n* = 249)		ICTCreat (*n* = 86)		ICTTrad (*n* = 92)		NoICT (*n* = 71)			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Encouragement of New Ideas	3.70	0.77	3.42	0.86	3.68	0.73	4.07	0.50	27.13	< 0.001
Climate for Expression of Ideas	3.74	0.74	3.53	0.76	3.59	0.75	4.20	0.47	22.92	< 0.001
Teaching Evaluation and Method	2.86	0.82	2.61	0.76	2.80	0.87	3.23	0.70	12.61	< 0.001
Interest in Student Learning	3.84	0.69	3.75	0.78	3.82	0.72	3.98	0.50	2.70	0.260
Intrinsic Motivation	3.19	0.38	3.16	0.46	3.15	0.48	3.26	0.33	2.09	0.13
Extrinsic Motivation	2.34	0.57	2.47	0.47	2.33	0.44	2.20	0.43	7.07	0.001

Note: ICTCreat: ICT Creatively; ICTTrad: ICT Traditional; NoICT: Not use ICT; M: Mean; SD: Standard Deviation.

The Levene test was performed to verify the homogeneity of variances of the four factors, in order to perform tests to compare means of the three groups. Results did not reveal homogeneity of variance between the factors Encouragement of New Ideas ($p = 0.01$) and Interest in Learning ($p = 0.01$). For these variables, the Kruskal-Wallis test was used. For the other factors, variance analysis (ANOVA) was performed. Results indicate significant differences among the groups related to Encouragement of New Ideas, $H(2) = 27.13$; $p < 0.001$. The students in the NoICT Group ($M = 4.07$, $SD = 0.5$) evaluated the professor's encouragement of new ideas more positively when compared to the ICTTrad ($M = 3.68$, $SD = 0.73$) and ICTCreat Groups ($M = 3.42$, $SD = 0.86$). The participants in the ICTTrad Group, on the other hand, presented a more positive perception of this factor than in the ICTCreat Group. Significant differences were found in relation to Climate to Express Ideas, $F(2) = 22.92$; $p < 0.001$. The students' evaluation in the NoICT group ($M = 4.20$, $SD = 0.47$) was more favorable than in the ICTTrad ($M = 3.59$, $SD = 0.75$) and ICTCreat Groups ($M = 3.53$, $SD = 0.76$). Although participants in the ICTTrad Group presented higher means when compared to those in the ICTCreat Group, no significant differences were found between the two groups. The analyses also found significant differences regarding Assessment and Teaching Method, $F(2) = 12.61$; $p < 0.001$. The students of the NoICT Group ($M = 3.23$, $SD = 0.70$) judged the evaluations and teaching method of their professors more positively than students in the ICTTrad ($M = 2.8$, $SD = 0.87$) and ICTCreat Groups ($M = 2.61$, $SD = 0.76$). The averages of the ICTTrad and ICTCreat Groups, on the other hand, were not significantly different. As for Interest in Student Learning, no statistically significant differences were found among the groups, $H(2) = 2.69$; $p = 0.26$.

Table 2 also shows the mean, standard deviation, *F* and *p*-values for the Motivation to Learn factors of students in the ICTCreat, ICTTrad, and NoICT groups. The means of the Intrinsic Motivation factor were higher than those of the Extrinsic Motivation factor for all groups. The Levene test was performed to verify the homogeneity of variances of the two motivation factors for student learning, in order to perform tests to

compare the means of the three research groups (ICTCreat, ICTTrad, NoICT). The results revealed homogeneity of variance and, therefore, the analysis of variance (ANOVA) was performed. The results did not indicate significant differences among the groups in Factor 1 – Intrinsic Motivation, $F(2) = 2.09$; $p = 0.13$. As for Factor 2 – Extrinsic Motivation, there was a significant difference among the groups, $F(2) = 7.07$; $p = 0.001$. Students in the NoICT Group ($M = 2.20$, $SD = 0.43$) had lower mean scores than those in the ICTCreat Group ($M = 2.47$, $SD = 0.47$). No other significant difference was identified among the groups.

Discussion

From the professors' perspectives, it is interesting to first point out that the use of ICT was not directly related to the development of creativity, although the question asked to the participants focused on this relationship. In addition, two professors (one from the ICTTrad group and one from the NoICT group) suggested that there is no relationship between the use of these technologies and creativity or the teaching-learning process in general. Although creativity is considered an important element for the training of students at distinct educational levels, and different studies indicate positive effects of ICT use in their development (Ferguson, 2011), the lack of reports highlighting this relationship seems to indicate that creativity is still a subject rarely explored in the university context, as David et al. (2011) argued. Another aspect concerning the role of ICT and reported by the participants is to consider their use as fundamental, reflecting the thinking of researchers in the field who understand that one of the functions of the implementation of digital technologies in the classroom is to enable students to use them in different contexts and thus promote their insertion in the job market (Kenski, 2011). On the other hand, by pointing out the facilitating role of ICT, professors perceive the potential of digital technologies to expand human capacities (Coll, Mauri, & Onrubia, 2010); for example, when they mention in their statements skills related to attention, reasoning, critical thinking and perception.

When evaluating the subcategory that presented the largest number of reports – Information Medium –, it is noticeable that the professors' understanding remains focused on the transmission of information, in which the ICT are the mediation between student and content. Although we understand that all types of ICT use can be innovative and transformative (Coll et al., 2010), it is interesting to note that, from this perspective, the space for the student to create and express himself is in the background. Thus, the student plays the role of knowledge consumer rather than producer. Regarding the participants' planning of the classes and choice of strategies, a first point to be highlighted is that, in general, there was a diversity of responses. When analyzing the number of strategies each professor uses, most of them used three or fewer strategies. This suggests that, in general, professors do not diversify their methods. This can help to explain the low evaluation by students in all groups of Teaching Assessment and Method – in the ITPC-HE, which presented the lowest mean among the four factors evaluated. When evaluating the professors' reports in the three groups regarding planning and teaching strategies, it is interesting to note that the professors made an effort and committed to offering important information regarding the content, aiming to benefit the students' teaching-learning process. This perspective seems to converge with the results the students presented in relation to Interest in Student Learning from the ITPC-HE, in which there was no significant difference between the three groups. This was the highest evaluated aspect among the participants in the ICTCreat and ICTTrad groups and, although it was not the best evaluated in the NoICT Group, the average score was as high as in the other groups.

The quantitative results regarding the students' perceptions of teaching practices for creativity in the classroom also revealed important aspects to understand the implementation of ICT. Teaching Assessment and Method received the lowest mean in all groups. In this study, remarkably, not even groups that use digital technologies considered innovative were better evaluated in this regard. This suggests that the use of digital technologies did not potentiate opportunities to go beyond informative content and its reproduction, to

diversify methods and evaluations, and did not increase the course assignment alternatives to be developed when compared to strategies of professors who did not use ICT. This result contradicts the characterization of digital technologies by Loveless (2007), according to whom ICT allow greater versatility and profusion of possibilities in educational practice. On the other hand, Ferguson (2011) argues that, regardless of the use of ICT, it is possible to create an environment conducive to the development of creativity. In this sense, the use of ICT, even by the group classified as those who use the technologies in a creative way, did not favor the teaching practices for the development of creativity, according to the students. The evaluation of ICTCreat students was less satisfactory than the evaluation of the NoICT Group (factors 1, 2 and 3) and similar (factors 2, 3 and 4) or lower (factor 1) than in the ICTTrad Group. One hypothesis is that the creative use of ICT in the ICTCreat Group is more related to creative ways professors found to solve teaching difficulties or challenges, such as the use of the document camera that favored the classroom dynamics of one of the professors in that group. It is observed that the type of technology used still operates as an information medium (Santos & Braga, 2012) and involves, to a large extent, mediation between student and content (Coll et al., 2010). According to Coll et al. (2010) for a true transformation in the teaching-learning process, the involvement of three elements is fundamental – student, teacher or professor, and content. Even what is considered creative still seems to reproduce the "conservative innovation" described by Cysneiros (1999) in a similar way to the use among professors in the ICTTrad Group.

Regarding motivation results, a first point to be highlighted is that, for all groups, the mean scores of the Intrinsic Motivation factor were higher than those of the Extrinsic Motivation factor. This result is similar to that found by Boruchovitch (2008). High levels of intrinsic motivation are favorable to the teaching-learning process, as they reflect the positive potential of human nature, through the tendency to seek novelties and challenges, stimulate their capacities, explore and learn about the environment around them (Ryan & Deci, 2000). Another result that deserves attention is the fact that the use of ICT, whether in a creative or traditional way, did not imply higher levels of intrinsic motivation. Regarding the extrinsic motivation, in turn, the ICTCreat Group presented a higher level than the NoICT Group. This finding goes against studies suggesting that ICT increase students' intrinsic motivation, who in turn also tend to present less extrinsic motivation (Beluce & Oliveira, 2015; Giesbers, Rienties, Tempelaar, & Gijselaers, 2013).

The final aim of this research was to investigate whether ICT, when well used in order to encourage creative expression in pedagogical work, have the potential to develop student creativity and motivate them to learn in the context of Higher Education. The results indicate that the use of ICT, whether in a creative or traditional way, did not present significant changes in student perceptions regarding teaching practices for the development of creativity and their level of motivation. The search for the creative use of ICT seems to stimulate professors' creativity more – use of ICT as a means of expression for professors –, than the students' creativity and motivation to learn. This scenario seems to replicate the already well-known educational practices that still place the teacher as the position of source of knowledge and fail to provide experiences in which the student can create, produce, and express. In addition to implementing digital technologies, education needs to undergo a much deeper paradigm shift, starting with a changed concept of what the teaching-learning process is. This call extends not only to educational agents, but also to students, parents and society as a whole. This study has limitations, such as the number of professors participating in the research, which was relatively small. Another limitation concerns the lack of standardization of the ICT analyzed in this study. Being a convenience sample, their use had to be evaluated in general. Suggestions for future research include: (a) replicating the study with a larger sample and including classroom observations and student interviews; (b) standardizing the ICT used by professors, aiming to control the variables related to the specific characteristics of each technology; and (c) developing an instrument that evaluates students' perceptions of teaching practices for creativity specifically linked to the use of digital technologies in face-to-face, blended-learning, and distance learning courses.

Conclusion

This study contributed to the advancement of knowledge in the area by noting that, although students from all groups evaluated the teaching practices for creativity positively (except for Teaching Assessment and Method) and presented favorable levels of intrinsic and extrinsic motivation, using information and communication technologies in a creative or traditional way was not characterized as leading to higher levels of creativity development in the classroom and increasing student motivation compared to those who did not use these technologies. It seems that other variables of the educational context should be considered with regard to the development of creativity and motivation to learn. This does not mean that ICT do not have a positive effect on other aspects of the teaching-learning process that have not been investigated in this research, such as academic performance, metacognition, and self-efficacy. Therefore, it is not argued that digital technologies should be excluded from the educational context or that they are not important in the teaching-learning process – but we need to find other ways to use ICT, such as expression medium. In addition to increasing the implementation of ICT, there needs to be a radical change in the educational paradigm that will affect the teaching-learning process so that students have more autonomy to create and express their ideas through the use of ICT.

Contributors

D. R. VILARINHO-PEREIRA was responsible for the study conception, data collection and analysis, discussion, and manuscript writing. D. S. FLEITH guided on data collection and analysis, as well as contributed to the discussion and review and approval of the final version of the manuscript.

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