

Persuasive Technology: Applications in education

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Abstract—The first Persuasive Technology (PT) emerged in the 1970s, and was being defined as an interactive computer system used to change human behavior. Research has shown the viability of these technologies in a variety of contexts such as advertising, reducing energy consumption, promoting healthy or well-being behavior and education. This research identifies and systematizes this area of knowledge, from the identification of the main works that relate the use of PTs in education. The methodology used was review of the works published between 2010 and 2017 of the state-of-art, in the bases of Google Scholar, Springer, Elsevier, ACM. As a result of the analysis of the articles, we highlight as main focus the use of (i) PTs adapted to different user profiles; (ii) PTs applied in different pedagogical activities; (iii) PTs for different methodologies of educational activities; (iv) PTs developed in different technological languages. The PTs can be applied as learning aid instruments, acting directly and/or indirectly in the areas of Social Assistance, Health, Environment, Research and Development, Education and Advertising. Given this scenario, we observed the need to foster publications that problematize the interfaces of PTs in Education, especially architectures and/or technologies that involve, for example, Cyber-Physical Systems, that can extend the educational (physical) environment to the virtual world, in order to leave the student immersed constantly in a teaching environment.

I. INTRODUCTION

According [1], it is important to have an education based on complex thinking, environmentalist, able to relate, contextualize and rebind different knowledge or dimensions of life. Humanity needs more open-minded, sensitive listening, people responsible and committed to the self and the world transformation.

It is necessary new pedagogical practices for transformative education, that is centered on the human condition, the development of understanding, sensitivity and ethics, cultural diversity, plurality of individuals and that favors the construction of a knowledge of transdisciplinary nature, involving relationships individual – society – nature. This is the fundamental condition for the construction of a viable future for present and future generations [1].

In [2] is mentioned that the use of technological resources comes with much more power than persuasive philosophy of a thinker, and in all its various manifestations offers new opportunities to create alternatives. [3] reinforce the need for analysis technologies, so as not to handle them as mere tools.

The educational process is a relationship between human beings, which is permeated by a set of values, social practices, customs and traditions that are part of each subject involved in this process [4]. Human behavior is a response to pre-established goals or a choice away the fears of each individual [5]. The persuasion of the study uses the behavior as the main element of assessment of ability and motivation. Because people develop common responses to certain situations according to their culture. Thus, it is possible to predict certain behaviors and thus persuade the individual. Persuasion can be defined as a strategy of communication that is to use logical-rational or symbolic resources for the purpose of getting people to adopt certain lines of conduct, theories or beliefs [6].

Persuasive technology (PT) can be defined as an interactive computer system, which is used to try to change human behavior. They consists of the intersection of technological element with persuasion in order to design, verify and analyze the impact of an interactive computer product developed to change attitudes or behaviors [7].

According to [7], PTs can be used at school or external environments to motivate people to acquire new knowledge or skills. In addition, PTs can motivate individuals to start a certain process of learning, tasks, review when necessary materials as well as to continue the particular activity. In this way systems can be developed to assist in the learning process, providing teaching people at any time and space. In this context, this paper presents a review of research done in the period 2010 to 2017 (period that includes the definition of the term coined by FOGG and the actuality). It presents a study of concepts and practices that can help in the education process of expanding the boundaries of learning, not only limiting the class room.

This article is organized as follows: in section II. We approach the references involved in the work emphasizing the relations between the PT and the process of teaching learning. Section III, presented the methods and steps performed in the development of the study. In Section IV, is presented the discussions about the proposed theme. In Section V, is presented the considerations regarding the objectives achieved and outlining the future steps of the research.

II. USE OF TECHNOLOGIES IN EDUCATION

The discussion of the concept of learning is far from being a simple task and its complexity intensifies when we assume the problematization of knowledge from the perspective of digital media. The relationship between education and technology allows the increase of the learning process, and breaks the dialectic of formal or informal education, to a ubiquitous space to learn [8]. In a society with access to mobile media, the acquisition of knowledge, is now empowered by the opportunity to access the information at anywhere and anytime [9], [10]. This permanent interactivity develops in the user a sense of belonging to the digital environment, which acts directly on the decision making processes, facilitating and instigating the constitution and cohesion of informal groups of common interests and concerns. In addition, mobile features offer individualized and personalized connection that enhances collaboration or interactivity in real-time that enable informed decision making.

Another aspect resulting from a ubiquitous interaction is the capacity, presented by technology, to facilitate and instigate the creation and cohesion of informal groups with common interests and concerns. When shared, the interests make people join, in the sense that help develop a state of readiness for cooperation and mutual assistance. Being ubiquitous access, contacts and exchanges, accelerate the possibilities of acquiring knowledge [11].

If the acquisition of knowledge implies learning, what emerges from this relation is called ubiquitous learning (UL), an individual or group type of open learning that can be obtained at any time, circumstances, and contexts [11], [12]. The most important feature of UL is spontaneity. Wherever the user is, from an occasional curiosity, it can be instantaneously satiated, and if there is a doubt about some information, there is no shortage of instantaneous personal contacts to solve it, thus creating a process of collaborative learning. Without restrictions of time, space, and external pressures, emphasizing on the free spontaneity that triggers the whole process. It is a search and an acquisition of information in the open and out of any planning and systematization, so what you have there is a form of unpredictable, disperse, fragmentary and even chaotic learning, not always incorporated into memory.

However, there undeniably learning, insofar as it brings the knowledge before nonexistent now acquires the possibility is not always effective to be incorporated into the learner's repertoire. And the only evidence that we have that it was incorporated or not when the occasion arises to put it into practice, the only type of evaluation that the ubiquitous learning can submit. Although it is a kind of new learning and therefore, again, it is, to some extent, related to other forms of learning networking, online, with the educational processes that have been called e-learning and m-learning [12]. But the free and open spontaneity that characterizes him, puts the very near ubiquitous learning informal education, more traditional *autoformação* processes.

However, this context of "autonomy to learn", given to the

individual by the ubiquity, needs to be mediated in order to avoid that it is dispersed of its learning process [11]. Faced with this other challenge, we identified in the researches about the development of Persuasive Technologies (PT), technological mediators for Education. PTs are characterized by the application of the concept of Persuasion to Technology. Being defined as a communication strategy, Persuasion uses logical-rational or symbolic resources for the purpose of getting individuals to adopt certain behaviors, theories, and / or beliefs.

In [7] is presented six advantages of computational persuasion agents: (1) persistence, no human being can be as persistent as a machine that does not get tired, nor frustrated with a refusal. (2) anonymity, it is easier to obtain information anonymously through an interactive computer program than to another human being. (3) the ability of computers to store, access, and manipulate data that goes far beyond human capacity, which gives interactive technology the potential to be more persuasive than people; (4) ability to use multiple media modes at the same time; (5) ability to scale rapidly; Lastly, (6) ability to be in most places, their ubiquity.

Studies have pointed out the advantages regarding the use of PTs in different areas, reaching important results regarding the use of PTs in the search of the desired behavior. Research related to the designer, highlight methods to improve the processes of development of PTs ([13], [14], [14]–[31]). In the health area, smart technology networks offer opportunities by supporting long-term health care behavior, contributing to patients' self-awareness, knowledge and literacy in the face of a better quality of life ([32]–[46]). In the social area, research highlights PTs as tools whose purpose is to motivate and assist people in the adoption of behaviors that bring benefits to themselves and to society ([47]–[71]e [72]). Marketing and the advertising industry represent the most significant domain in which PTs, as these technologies are widely used as a motivational tool for customers who need to constantly consume products and services ([73]–[76]). In Education, PTs have been investigated from their potentiality to motivate students in building knowledge or skills can be accessed in school or in outdoor environments ([73], [77]–[94]).

Currently, educational models seek approaches that promote student participation as the central agent of their formation, making them individual and collective author of their own knowledge [95]–[97]. Active methodologies are examples of these approaches that use problem-solving to motivate students, however, process customization and student self-learning are still limiting factors that can lead the student to demotivation [98]. It is noted at this point that the inclusion of FBM based in TPs, as tools to aid the teaching-learning process, allows to explore the motivating character of individuals, changing their behavior in order to initiate a particular learning process as, execution of tasks, material review, activity segment, suitability to good study habits, etc.

III. METHODOLOGY

In order to perform this study, the chosen methodology was Bibliographic Review for providing a systematic analysis [99] of a set of knowledge of a certain scientific field. In the first step of the analysis we proceeded to identify the totality of the set of productions associated with PT in the following query bases: Google Academic ¹, ACM ², Springer ³ and ScienceDirect ⁴. The following studies were identified in the following areas: Social Action, Health, Environment, Research and Development, Education and Advertising in the period from 2010 to 2017. 290 papers were identified related to the criteria: "persuasive technology education", "Persuasive technology research", "persuasive technology health", "persuasive technology education", "persuasive marketing" and "persuasive social". After this stage, we analyzed the articles by pre-reading titles, subtitles, tables, keywords and images in order to identify the themes of this work. A total of 82 related studies were identified. The last stage of the research consisted of the analysis of the chapters, as well as the final paragraphs. As a result, 19 articles were identified that had a direct relationship with the context of PT in Education.

IV. ANALYSIS OF THE STATE-OF-ART

In this section we present the approaches used by works directly related to the context of education according to the proposed methodology. As a result of the analysis of the articles, we highlight as main focuses (i) PTs adapted to different user profiles; (ii) PTs used with different pedagogical approaches; (iii) PTs for different methodologies of educational activities; (iv) PTs developed in different technological languages and can act directly and/or indirectly in the educational process.

A. Study Population

During the study, one can notice a variability of environments and groups of users to whom persuasive technology was applied in the educational scope. This evidence supports [7] argumentation by believing that PTs can be applied to a variety of contexts and target audiences.

In the construction of this argument the works [80], [82], [90], [92] present the application of PTs in the educational process of children and adolescents with special needs, and [73] present the use of PTs in the education of university students from a wide range of fields (Medicine, Computing, Nursing) and the work [85] present the use of persuasive technology in education, aimed at adult learning about sustainable development. [92] investigated the effect of designing PTs on the behavior of children with special needs.

B. Teaching Methodology

According to [7], in addition to the PTs that motivate individuals to start a particular learning process, they also

allow the implementation of different teaching methodologies to facilitate this process.

During the study, several didactic practices were detected in the works. They are: Stimulus-Response ([80], [83], [90]), Lessons Learned ([78], [81]) Problem Based Learning - PBL ([84]), ([73]), Gamification ([85], [88]) and Information Search ([79]).

C. Activity Types

In view of the one presented by [7], applications involving PTs can motivate different types of activities in the learning process. This study can prove this idea, where different activities were identified and are presented below:

- A [90] proposes a tool for cooperation between the adolescent and his teacher, in order to assist him in the execution of daily tasks and routines.
- In [84] specific didactic activities are presented. When the student is accessing facebook, they present information to him, following a flow of steps with defined content, respecting the methodology Problem Based Learning (PBL).
- At work [85], a gamification activity is presented with the aim of educating and informing effective cooling methods for natural heat reduction of residences. For this, a 3D game was developed and through it it is possible for the user to use sustainable items for the improvement of residence cooling. It seeks, through its results, to provide Education and Behavior Change.
- In [79], a Virtual Learning Environment was developed that provides information with potential to affect student behavior. The environment also enables this information to be sequenced and personalized in the most effective way for each student.
- In [81] presents a case study with the purpose of evaluating two tools (PLOTMaker and PLOTLearner) developed based on the use of PTs to teach and learn.
- The study of [80] reports the introduction of thefts with different forms of persuasive interaction to teach, stimulate and motivate children with autism.
- In [73] it is reported the adaptation of the MSLQ (Motivated Strategies for Learning Questionnaire) questionnaire to investigate students' habits.
- In [78] presents a case study comparing the effects of courses with traditional teaching methodologies and persuasive content in teaching Malay language of children with speech difficulties.
- The work [82] reviews techniques used in the development of educational technologies.
- In [83] the impact on student learning was analyzed by sending small messages in the SMS format.
- The study presents the case study with an interactive virtual reality environment aimed at learning history

D. Technologies Involved

In order to reach the desired behavior, during the review one can note the insertion of several technology channels in

¹Academic Google: <https://scholar.google.com.br/>

²ACM : <http://dl.acm.org/>

³Springer: <https://link.springer.com/>

⁴ScienceDirect: <http://www.sciencedirect.com/>

the experiments. The following are a few:

- Facebook. [84]
- 3D application. [85]
- Virtual Learning Environment. [79]
- EuroPLOT. [81]
- Persuasive Robberies for Education and Entertainment (PEERs). [80]
- Mobile application. [78], [94]
- Application developed in the HANDS project. [90] [82]
- Games based on occupational therapy, conversation counseling and simulated environment. [77]
- SMS (short messaging service) [83]
- Virtual learning object [93]
- Virtual Reality [88]

According to Fogg [7], in addition to PTs enabled the motivation of individuals to initiate a particular learning process, also enable the implementation of different teaching methods for this process to be facilitated.

V. DISCUSSIONS

We live in a technological moment, in which at all moments about processes and technological devices among them: cell phones, computers, software, internet. All these contemporary changes transform as relations with knowledge. When technologies are embedded in everyday environments or environments, they can intervene accurately at the right time and in the right place, increasing persuasive power.

During the review of the work the following points were detected:

- The use of PTs in various areas was identified: Social, Health, Environment, Research and Development, Education, Advertising, etc.
- PTs for different types of users.
- Persuasive technology for various methods and types of educational activities.
- PTs developed in various technologies.
- Although the articles studied not explicitly present its relations with education, it was noticeable in their studies, the PTs are directly related and indirectly to the education process.
- Courseware improvement possibility based on the use of PTs.

In observing the impact of technologies as a motivational agent of learning processes, we find that most investigations highlight the motivation associated with the activity, that is, how motivated one is to acquire new knowledge or skills ([7]), the resolution of problems associated with study habits [73], initiate a specific process of learning, tasks, review materials when needed, as well as continue a certain activity [92], being able to act in the formal or informal learning process [8]. However, there is a need to act directly on the levels of this motivation because we consider its influence on the behavior of the individual [100] and learning [101]. As much as an environment can generate external elements of enhancement of motivation, the internal factor is what effectively incites

a person to action. We believe that this action on motivation can and should be mediated by technological artifacts [9], [10] since students at all levels of education can enjoy access to educational resources anytime, anywhere .

From the analysis of the points mentioned above, are identified the following caveats:

- Absence of more PTs present throughout the day to day life, in order to provide interactions that enhance their learning process full time and in real time.
- Few studies that directly relate to the application of persuasive technology in education.
- Explicit application of education in several areas.

From these observations, we note the need for works that better explore and argue the points presented in this study. Architectures and/or technologies involving, for example, Physical-Cybernetic Systems, which can extend the educational environment (physical) to the virtual world, so as to leave the student constantly immersed in a teaching environment, could bring a great advance in PTs in education.

Having these impressions put forward, it is believed that the development of PTs with the involvement of devices present in the student's daily life, such as mobile phones and their applications, can be a good way to reach the constant immersion of the student in his learning process. In this sense, the approach presented in this paper contributes by pointing out the PTs not only as simple objects, but as active and motivational agents of the teaching-learning process, a vision that, once identified, can be the guide for new developments regarding the involvement of PTs in education.

VI. CONCLUSION

This work aimed to highlight the potential of the use of PTs, with an emphasis on education. From the analyzes made, it was detected that PTs offer interesting opportunities in relation to teaching-learning. The results obtained from this analysis reinforce the statements of works that discuss the relations of technologies in general and the process of teaching and learning, more precisely the ubiquitous learning and the application of PTs in order to obtain new pedagogical methods and practices to motivate people acquire new knowledge or skills at school or in the outdoors.

Through the research, one can perceive the variety of contexts in which the PTs can be applied, as well as the potential that they provide to activities carried out in the area of education. It is important to mention that in this period, few studies were directly related to the area of education.

Reading the works shows the ability of these technologies to deal with the teaching-learning process through formal and informal means. It is hoped by this work to expand the ideas of the concept of "education beyond the classroom", as well as to make available a material that will serve as the basis for the development of tools (media, teaching methods, materials, etc.) to assist the teaching-learning process,

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