Learning with platform SOLL

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ABSTRACT

Technology has become fundamental for distance learning and the establishment of social interaction. In this way, the Internet of Things (IoT), has emerged with great potential for education due to its being a network composed of various objects and devices connected to the Internet, therefore allowing for the performance of interdisciplinary activities. Thus, the SOLL (Smart Objects Linked to Learning) platform has been introduced which, supported by a set of technologies that collect and store data from a greenhouse, allows for dynamic, interactive and interdisciplinary learning, with synchronous and asynchronous assessment. In this article, the platform’s architecture is described and from a mixed methodology, student questionnaires and teacher focus group interviews, the data obtained show that this platform responds to the learning community structure, by adopting a different learning model, based on the exploration and enrichment of educational experiences.

KEYWORDS

Education, Technology, Internet of things, Motivation, Learning process

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1 INTRODUCTION

In the perspective of Díaz and Hernández de Frutos [1], which is of a way, has inspired the perspective of this study, knowledge and learning result from the ability to create and share the connections that emerge in the network of interaction within a group. However, although these interactions may arise spontaneously, it is something that should be actively encouraged [2].

Therefore, technologies “allow the distance learning paradigm to be created” ([3], p. 120) and provide some of the informal social interactions students have at school, through connectivity, defined by Siemens in 2004, as a network of knowledge and learning, with an emphasis on the use of digital technology to improve and extend online interaction. This is echoed in the words of the European Commission [4], which considers that “digital technologies have an impact on education, training and learning, through the development of more flexible learning environments adapted to the needs of a highly mobile society.” This will have to evolve into a model based on the “cultivation of skills,” ([4], p. 98) in which the student plays a more active role. Given the high speed of information and knowledge dissemination in today’s society, students will need to maintain lifelong learning, and it is necessary that they be equipped with the to allow them to evaluate and assimilate new knowledge.

However, new media do not necessarily lead to new pedagogies or new learning [5], as the expository model of content transmission is often maintained, with the novelty of “we can see the teacher from a distance, or watch recordings of your classes, follow your expositions without the special restriction of the classroom and without the temporal restriction of the fixed schedule” ([3], p. 120).

What is intended is that the teaching-learning process is understood as a construction that involves an active role on the part of the students. It is imperative that they develop the ability to establish their own goals, to plan and monitor their efforts towards better academic performance, and to direct to a certain extent, their learning in the school context [6]. According to Adrião ([4], p. 134), the interactivity provided by digital educational resources can help both in the task of teaching and in the task of learning and encourages and supports constructivist pedagogy [7], which is more likely to reach all students who wish to participate in the process of knowledge construction. Furthermore, teachers who have implemented constructivist pedagogy have given evidence of improved learning in technology-focused learning environments [8], and it is believed that it may yet result in a previously unseen democratization of education, and as an aid in the fight against school failure [7].

In this context, “the fundamental paradigm that emerges is teaching in a project environment” ([3], p. 122), which due to its dynamics and interdisciplinary characteristics “captures more attention and involvement from students” ([3], p. 122), in relation to expository classes.

For this reason, the Internet of Things has introduced “a novel paradigm that is rapidly gaining ground in the modern wireless telecommunications scenario” [9]. Some authors argue that it is an unprecedented technology [10] and is such an innovative technology, that its impact on society will be equivalent to that of an Industrial Revolution [11].

The classic Atzory et al [9] states that: “The basic idea of this concept is the pervasive presence among us of a variety of things or objects – such as Radio-Frequency IDe ntification (RFID) tags, sensors, actuators, mobile phones, etc. – which, through unique addressing schemes, are able to interact with
each other and cooperate with their neighbors to reach common goals."

In this way, Internet of Things "is not a single technology; rather it is an agglomeration of various technologies that work together" (Sethi & Sarangi, 2017, p.1) through the interconnection of everyday objects, which are often equipped with ubiquitous intelligence [12] and which exchange ample information between themselves [13]. This technology will increase the ubiquity of the Internet because it will integrate all objects into an embedded system, which will give rise to a strongly present network of objects communicating with humans or other objects. For Gubbi et al. [14], IoT is considered as something more user-centered and not restricted to communication protocols, that is, it is the "Interconnection of detection and actuation devices, providing the ability to share information across platforms through a unified framework, developing a common operational framework to enable innovative applications. This is achieved by ubiquitous detection, data analysis, and information representation with cloud computing as a unifying structure "([14], p.1647).

In other words, it is a technology that allows, through sensors, to connect objects to the Internet so that information about the environment or activity can be obtained which provides feedback and control [11].

According to Aldowah et al [15] "new forms of information exchange lay the foundation for more interactive and personalized learning" and real-time data "are useful for analysing actions, interactions, preference trends and changes in student skill levels" [15]. The teacher remains "essential for guiding students to and through learning objects" and "must also take students away from the variety of disconnected experiences to develop meaning and assimilate their new knowledge, skills and emotions" ([16], p. 35).

This technology, according to Area [17], should mobilize and integrate pedagogical dimensions, such as: information and materials, texts, videos; practice, experience and learning activities, individuals and groups; communicative, social interaction between students and teachers and tutorial, monitoring and assessment of learning by the teacher.

As for the pedagogy to be used, according to Mortimer [18], pedagogy is the conscious activity of a person designed to improve the learning of another. Thus, the teacher should use several pedagogical models to focus discussion on the essential topics, while acting as a guide and a facilitator of learning [19]. The teacher must help to contextualize and to expand the universe reached by the students and to help in the discovery of new meaning [20]. In a social dimension, the teacher should act as a discussion advisor [19] motivating participation [21] and facilitating interactivity in the learning community [22].

For the teacher to guide students towards meaningful learning in a dynamic learning environment Garrison & Aderson [23] establish a set of indicators of teaching presence, which includes cognitive and social presence and which, shown in Table 1, cited by Monteiro & Moreira ([24], p. 41) taken and adapted from Garrison & Aderson [25].

Table 1: Indicators of teaching presence cited by Monteiro & Moreira [24] taken and adapted by Garrison & Anderson [25]
Thus, opportunity arises for the development of new learning skills, recognized in the Profile of Students Leaving Mandatory Schooling [26], approved by Order 6478/2017, July 26, which constitutes a common matrix for all schools and educational offers within the scope of compulsory education. This is primarily focused on the curriculum, and aims to help students develop the skills need in order to become successful students, confident and creative individuals, as well as active and informed citizens [27].

In this sense, the use of technology-rich environments which replicate the interdisciplinarity of the real world is a determining factor and the Internet of Things is an excellent ally, to motivate and involve students in learning, particularly younger ones, due to their lower capacity for self-regulation.

In order to operationalize the above, the SOLL platform: Smart Objects Linked to Learning, which is supported by a set of technologies that collect and store real data for later interdisciplinary analysis was developed.

1.1 Learning Online Platform – SOLL

In order to take advantage of technology to create special learning conditions for students "so that, they are able to critically select and seek the knowledge they wish to acquire, and integrate them into the set of knowledge that they already have and are capable of conducting a practice based on them" ([28], p.69), the SOLL: Smart Objects Linked to Learning [29] project was created, which is based on the construction of a greenhouse, monitored by sensors that, through the Internet of Things, transmit real data in real time and is constantly updated by the SOLL platform. From this, the students, aged between 12 and 15 years, performed a set of activities which fulfilled the Essential Learning of the subjects of the 3rd Cycle of Basic Education, and intervened in the environment, acquiring new values. From the interaction between the different project targets, as shown in figure 1, all the work was developed by students in an integrated and interdisciplinary manner.

As can be seen from the diagram, students have access to activities, questionnaires and observations of actual data from the greenhouse. On this learning platform, students are offered activities, which comply with the Essential Learning of the respective disciplines and which encourage action on the environment.

Each activity has an associated notepad, useful for noting links for information research, for recording informational documents and present work done.

After the activity was carried out, students were asked to fill in a questionnaire about it and, were then given access to their results for task and an explanation for any wrong answers. In this way, "the assessment is continuous and systematic in the service of learning, and provides the teacher, the student, ( . . . ) with information on the development of the work, the quality of the learning done and the ways to improve it" ([30], p. 3790-(4)) and "the information obtained as a result of the evaluation also allows the revision of the teaching and learning process" ([30], p. 3790-(4)).

With this interdisciplinary resource, students achieve what is required in the Student Profile to Exit Compulsory Schooling, in which "Areas of Competence" understood as complex combinations of knowledge, skills and attitudes that allow effective human action in diverse contexts are developed. They are of a diverse nature: cognitive and metacognitive, social and emotional, physical and practical and is important to emphasize that competences involve knowledge (factual, conceptual, procedural and metacognitive), cognitive and psychomotor skills, attitudes associated with social and organizational skills, and ethical values. ([31], p.9).

The teachers have access to a student activity management system on the platform and, the same learning platform, allows teachers to monitor, in real time, the activities carried out by the students through observation of the notepad, and their answers to the questionnaires.

In this way, the teacher has a sense of the students’ performance and/or difficulties and can provide more personalized teaching, since it allows for the real-time verification of individual or group work.
2 RESULTS

Regarding the students’ data that compare the impact on motivation, Graph 1, shows the results of the diagnostic survey before the activity (pre-test) and the final survey after the activity (post-test), using the sign test. This test is a nonparametric alternative to the t-test for paired samples, which allows one “to analyse differences between two pretest and posttest conditions in the same group of subjects” ([46] , p. 478), which should be as similar as possible in aspects that may affect their responses in ordinal or higher level variables. For $\alpha = 0.05$, the hypotheses for the nonparametric statistical test, sign test, are: $H_0$: There are no differences regarding the topic between pre-test and post-test, ($X_i = Y_i; p=0.50$) e $H_1$: There was an improvement in the topic at the end of the activity, ($Y_i > X_i; p=0.50$, unilateral test).

The same study was done for the learning process category, as shown in Graph 2.

From the focus group of teachers, some opinions were collected regarding the categories of motivation and learning process that are presented in Table 2.

3 DISCUSSION

As for the results obtained by the different data collection instruments, we can confirm that the classes, in general, obtained good and homogeneous results. In other words, as well as Carr, (2012) and Hur & Oh (2012), some positive effects on student performance are recognized. In the opinion of teachers, activities using the IoT aim to provide greater ease of learning, to improve general knowledge and to motivate students more towards learning. It therefore presents itself as an asset for improving students’ learning, which is in line with Lei & Zhao (2008), who posit that technology has come to provide new ways to explore interests and enrich learning experiences, and to improve students’ motivation for learning, due to their involvement while carrying out activities.

Regarding the cognitive processes, because of the results that were obtained, the teachers affirm that the IoT allows for interdisciplinary activities with access to real data, which is important for the sharing of content. Teachers claim that it promotes interdisciplinarity, which was clearly evidenced in this project; it facilitates deep down it forces them to interpret, to be critical of the data they are receiving ... so it ends up building, consolidating and structuring knowledge.

| Table 2: Teachers’ opinions regarding the motivation and learning process |
|-------------------------------------------------|
| **Motivation**                                   |
| “they liked it... are motivated ... Yes, I agree” |
| “Yes... it is . another impact ... here it is not quite that but when it is applied... Reality makes more sense, doesn’t it ...” |
| “yes, they liked it... were always asking when the next activity was ...” |
| “they even wanted to know more ...”               |
| **Learning process**                             |
| “they feel closer to what they like, which is their interests ... at least at first, it’s not ... later sometimes ... when it comes to the content part ... but it’s more appealing to them, it is a different way of exploring certain subjects ... in a much more interesting way ...” |
| “Often students have to be guided. It is not... also sometimes they do not know how to distinguish the essential from the auxiliary very well... have to be very orientated and even in research ...” |
| “it promotes interdisciplinarity ... and we could even use this in the future to develop more aspects” |
| “we can easily join 4/5 areas here”               |
| deep down it forces them to interpret, to be critical of the data they are receiving ... so it ends up building, consolidating and structuring knowledge. |
| “there is no better construction of knowledge than that ... I think it’s the best way ... they even realize that ultimately, all areas of knowledge are bound together ... and that complements ... in terms of knowledge...” |
the construction of knowledge, because it forces students to interpret and to be critical of the data they are receiving and this results in the building, consolidation and structuring of knowledge, which students appreciate because it is their own data that they are working with.

4 CONCLUSION

This platform has emerged as an asset to motivate students to learn and to involve themselves in the learning process through the realization of dynamic, contextualized and real activities that are conducive to the development of various skills, “useful for analysing actions, interactions, preference trends, and changes in student skill levels,” as noted by Aldowah et. al [15]. As such, the teacher can take advantage of this to “plan and structure the educational process in an open and flexible way, allowing for diversified approaches, where resources and dynamic, current and motivating teaching materials are inserted, using for this an interactive and cooperative methodology, placing at the service of its teaching several communication channels” Goulão & Henriques ([51], p.28) and to enjoy this technology to accompany, to motivate, to create dialogue, to be a leader and mediator, and to foster and mediate positive human interaction” ([36], p.28 e 29).

In short, the SOLL platform demonstrates robustness in allowing for the interdisciplinary development of the learning process of the 3rd cycle students and is excellent ally in motivating and involving students in their learning, particularly among young ones, due to their lower capacity for self-regulation.

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