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USING WEB ANALYTICS TOOLS TO IMPROVE THE QUALITY OF EDUCATIONAL RESOURCES AND THE LEARNING PROCESS OF STUDENTS IN A GAMIFIED SITUATION

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Abstract

In this paper we propose a *businessification* approximation to measure and analyse students' engagement in a gamified learning context. Gamification in education is used to enhance students experience and improve learning outcomes. Its technics such as points, leaderboard, badges or ranking are also used in learning instructions with the aim to improve students' engagement. This engagement can be considered as the metric to measure the success of gamified instructions.

The gamification model can also be used in an online learning environment. In this virtual context teachers have to have some tools to see what happens during the learning process. Such virtual context is usually web based. In this specific context the resources used such as images, videos or audios are fundamental to engage students. In order to help teachers to enhance engagement we propose the use of web analytical tools in such web based gamified learning contexts to track, analyse and finally enhance such resources.

Keywords: Learning analytics, gamification, tpack, businessification, learning media, flipped classroom, clickstream.

1 INTRODUCTION

Learning media resources such images, videos or audios has been increasing since the apparition of new pedagogical approaches as the learning model Flipped Classroom, gamification or other technological ones. The consumption, comprehension and utility of this learning media is crucial to students in order to learn the available concepts and success in their learning process. The easiness of video and audio registering, powered by the vast available media publication and sharing platforms, contrasts with the difficulty of analyzing their impact in the learning process. In this paper we have a *businessification* proposal in benefit for students and teachers in any gamified situation.

Businessification is the idea of applying business rules to any no business context. Web analytics tools are mainly a business approach to enhance business incomes. Used as a student's behavior tracking tool could improve their learning (academic analytics or learning analytics). The proposal consists of treating the learning media container, such as a Learning Management System (LMS), as a business website in order to track and comprehend student's behavior for learning media enhancing.

The gamification in class helps improve the connection between the resource, knowledge and the student. It offers the opportunity to reflect on a topic in depth and allows positive changes in behavior [1].

Web analytics tools used in business offers a perfect analytical framework to analyze learning media in any web based educational context. Web analytics can be understood as the measurement, collection, analysis and visualization of web data for visitors' behavior understanding and web experience optimizing. Thus, track URLs traffic of a website is the main aim of such tools. However, this website tracking technology can be used to track URLs but objects inside the URLs. Images, videos and audios are the most common media used in websites. Web analytics can track its use and understand how visitors behave in the interaction with these media objects. Actions such as play, stop, rewind, forward or repeat videos can be tracked with web analytics tools. This tracking could result in

a profound comprehension of visitors' behavior. Currently the teaching-learning methods enhance the use of digital tools, tools for learning themselves properly or for learning other disciplines. The TPACK model is a framework that allows the technology to fit perfectly into this learning context. This framework plus the addition of business-oriented web analytics tools ensures to learning media creators new enhancing ways in order to improve students learning.

The proposal of *businessfication* and the analysis of the data generated in this process is perfectly applicable in educational models and especially in the learning processes such as computational thinking or robotics. These disciplines, among others, can be validated if are inspired by the TPACK model. Within the TPACK model, the use of didactic resources in computational thinking is based both on the improvement in the learning of knowledge and the learning process. The analysis of the evolution in the learning of computational thinking, understood as a discipline of the school curriculum, is one of the fundamental goals of this paper.

The use of these analytical tools can be a great help to improve the learning process of all students and guide them to a more effective and meaningful learning. Computational thinking acquires great relevance in the demand of engineers and programmers for technology companies, and therefore, the inclusion of these STEAM disciplines in school curricula must be accompanied by good analytical tools in order to be developed in all the educational stages of the students.

2 LITERATURE REVIEW AND METHODOLOGY

2.1 Gamification in education

Gamification refers to the application of game technics to non-gaming contexts with the aim of enhancing processes and experience of those involved. In recent years, this gamifying model has been used in education to enhance learning processes and student's experience. This enhancement has a direct impact to urban wellness. As Francesco Tonucci says in regards to urban policies and development, "allowing children to play according to their needs guarantees healthier, more serene and more productive adults" [2].

There are different technics available in gamification to apply in the learning process that define learner's outcomes such as experience points, levels, leaderboards, challenges, badges, points, progress bar, prizes, in-game rewards, customization, stages or goals. Each of these technics can improve learning process and students experience in a specific manner. These improvements can be summarized as engagement, participation, motivation, enjoyment, productive learning experience, sense of achievement, sense of accomplishment or performance [3].

Education can benefit from this technics in quite different manners. One of the benefits is the increase of student's motivation through gaming. Gamification makes subjects and curriculum more fun and less hard to comprehend and work. In consequence, applying game technics to education can enhance learner engagement and improve learning outcomes [4].

Teachers can also benefit from applying gamification in their classrooms. The cited gamification technics can be analyzed so teachers could know the state of students. Knowing when the student started to play a resource, which resources have read, view or played, in which stage is actually working on, with whom have been interacting during the gamified learning process or how many points have acquired in regard to maximum available points can leverage tutoring and evaluation. All this engagement states can be treated as a measurable metric [5] so can be analyzed and visualized.

In an online environment such metric may be more difficult to measure. Hence, an analytical tool is needed in order to accomplish good engagement analysis.

2.2 Learning analytics

A learning analytics tool is used to show all the collected students interactions in the learning environment in a visual and understandable manner. Students' interactions are saved into a log, which can be understood as a file or a table full of records in a database containing data in a raw format.

In an online environment each student's interaction generates a line or database record of personal information. The collected information usually consists of the IP of the user, day and time of the success, URL, user identifier, resource identifier and additional data. Trying to understand or extract trends from raw data is almost impossible for teachers with not enough knowledge to do it. Hence, a tool is needed to extract useful data such as trends, possible drop-outs, summaries or simple visualization to democratize student's data analysis with the aim of enhance tutoring and evaluation.

Learning Analytics is the field that expose an analytical model to be applied in education in order to enhance and optimize the learning environment [6] and also educational urban design environments [7].

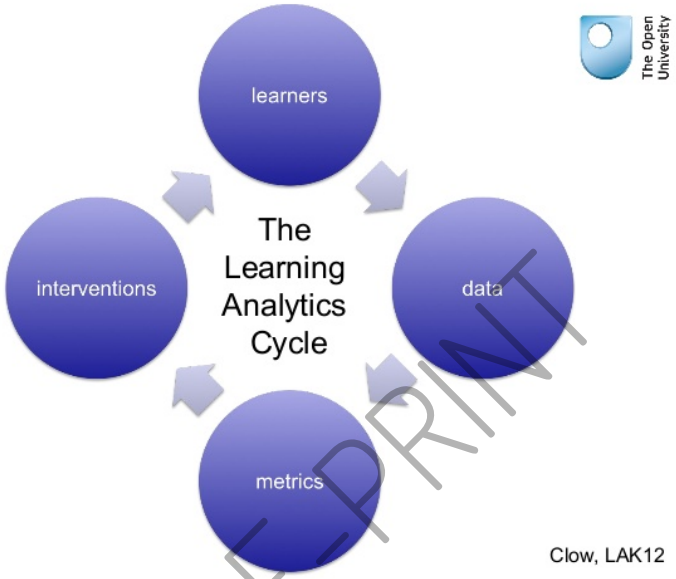

Figure 1. The learning analytics cycle.

This analytical model can be used to track and measure engagement in online learning and gamified environments. Almost every online learning environment runs on a website and the interaction of students in such website is performed through clicks. This flow of clicks is called clickstream and can be easily tracked by a website analytical tool. These types of tools can track clicks per user, pages viewed, exits or bounces and can be used to track learning resources consumption.

The idea of using these analytical tools in education can result in benefits for teachers in their role of tutor, evaluator, content creator or learning instructor. Used to track learning resources could give visualization trends and help teachers to decide which resources needs to be improved, which have to being deleted or also guess what kind of resources students need to improve their learning.

2.3 TPACK as an educational model

Technology has been the basis of a large part of the new education in the 21st Century. The Technological devices, their services and the use in educational centers has revolutionized the way in which teachers and students interacted. The TPACK model exposes the three basic knowledge within a technological field that teachers must have so that they can develop the maximum potential in their teaching and in the students' learning [8].

This educational model goes beyond the application in the training of teachers, since the TPACK framework connects technology to curriculum content and specific pedagogical approaches and describes how teachers' understandings of these three knowledge bases can interact with one another to produce effective discipline-based teaching with educational technologies.

In this framework (Figure 2), there are three interdependent components of teachers' knowledge: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK).

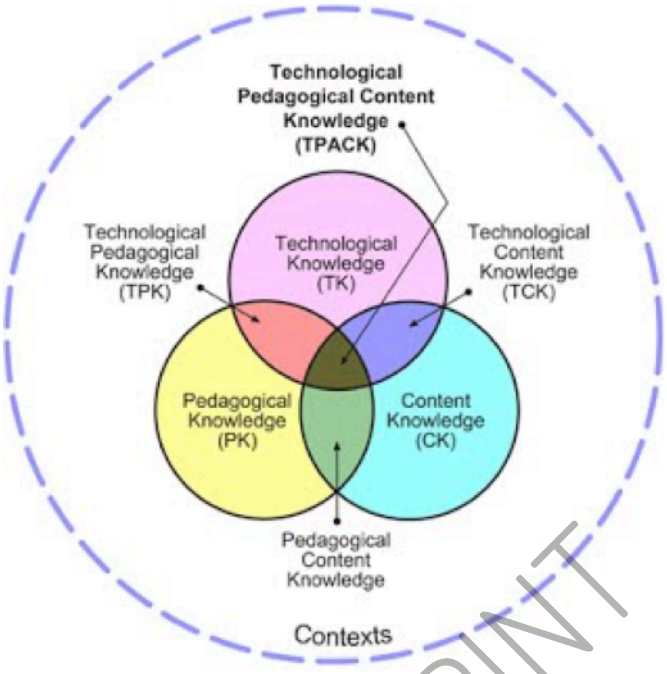

Figure 2. The Components of Technological Pedagogical Content Knowledge.

The TPACK framework has had a significant impact on both research and practice in the area of educational technology [9]

Despite being based on the knowledge and practice of teachers, in work with students we can see how the relationship between areas is also affected in a significant way [10], causing in most cases an improvement in the relationships between the three areas Basic of the model:

Technology and content (TCK), technology and pedagogy (TPK), technology, pedagogy and content (TPACK), all improved over time. Surprisingly, students' knowledge about the interaction between pedagogy and content (PCK) changed too.

2.4 Methodology

We propose to use a business web analytical tool such as Google Analytics. This tool is able to track and summarize pageviews, number of visitors of a website and any click in a webpage or in a resource of a webpage.

Learning resources such images, videos or audios are also website resources. Hence, Google Analytics can track user behavior in their interaction of these types of resources. It can be know if a video or audio was played, stopped, replayed or the forward or backward buttons were pressed [11]. Such actions can give a lot of information to teachers:

- Usefulness of a resource
- Inadequate use of a resource
- Obsolescence of a resource
- Necessity of a specific resource
- Replacement or update of a part or full resource

Google Analytics provides an API (Application Programming Interface) that enables programming and the ability to fully personalize tracking in the learning environment. Our purpose is to use this API to track learning resources and enhance the gaming experience.

3 RESULTS

The use of Google API in a gamified learning environment with video embedding produced different events fired in percentages of visualizations. In consequence, we could have a clear idea of which videos where played, stopped or fully or partially viewed.

This information gives the opportunity to see what is happening in the gamified situation, which resources are useful or which have to be deleted. Replacing videos give a new opportunity to test its function to enhance student's engagement.

Event Action	Total Events	Unique Events	Event Value	Avg. Value
	292 % of Total: 0.88% (33,027)	150 % of Total: 0.52% (28,867)	0 % of Total: 0.00% (6,887,379)	0.00 Avg for View: 208.54 (-100.00%)
1. Play	**125** (42.81%)	43 (28.67%)	0 (0.00%)	0.00
2. Pause	**94** (32.19%)	35 (23.33%)	0 (0.00%)	0.00
3. 10%	**27** (9.25%)	26 (17.33%)	0 (0.00%)	0.00
4. 25%	**19** (6.51%)	19 (12.67%)	0 (0.00%)	0.00
5. 50%	**11** (3.77%)	11 (7.33%)	0 (0.00%)	0.00
6. 75%	**7** (2.40%)	7 (4.67%)	0 (0.00%)	0.00
7. 90%	**5** (1.71%)	5 (3.33%)	0 (0.00%)	0.00
8. Watch to End	**4** (1.37%)	4 (2.67%)	0 (0.00%)	0.00

Figure 3. Events in Google Analytics tool to know which videos are fully or partially viewed.

4 CONCLUSIONS

The use of web analytical tools to track students' interactions generated through the clickstream on web based gamified resources seems to be useful to understand what happens in a gamified learning environment. This analytical knowledge is needed to improve learning resources such as videos, images or even audios. Improving these types of resources could have a positive impact into student's engagement and on the improvement of the learning process and computational concepts. Hence, *businessification* seems to be a good approximation to test the utility of resources to improve student's gaming experience and so student's engagement and learning process.

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REFERENCES

[1] D. Fonseca, S. Villagrasa, I. Navarro, E. Redondo, F. Valls, and A. Sánchez, "Urban Gamification in Architecture Education," Springer, Cham, 2017, pp. 335–341.

[2] F. Tonucci, "Citizen child: play as welfare parameter for urban life," *Topoi*, vol. 24, no. 2, pp. 183–195, 2005.

[3] F. F.-H. Nah, Q. Zeng, V. R. Telaprolu, A. P. Ayyappa, and B. Eschenbrenner, "Gamification of Education: A Review of Literature," Springer, Cham, 2014, pp. 401–409.

[4] J. Hamari, J. Koivisto, and H. Sarsa, "Does Gamification Work? -- A Literature Review of Empirical Studies on Gamification," in 2014 47th Hawaii International Conference on System Sciences, 2014, pp. 3025–3034.

[5] C. I. Muntean, "Raising engagement in e-learning through gamification." .

[6] D. Clow, "The Learning Analytics Cycle: Closing the Loop Effectively," in Proceedings of the 2Nd International Conference on Learning Analytics and Knowledge, 2012, pp. 134–138.

[7] F. Valls, E. Redondo, D. Fonseca, R. Torres-Kompen, S. Villagrasa, and N. Martí, "Urban data and urban design: A data mining approach to architecture education," Telemat. Informatics, Oct. 2017.

[8] P. Mishra and M. J. Koehler, "Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge," Teach. Coll. Rec., vol. 108, no. 6, pp. 1017–1054, Jun. 2006.

[9] M. J. Koehler, T. S. Shin, and P. Mishra, "How do we measure TPACK? Let me count the ways," in Educational technology, teacher knowledge, and classroom impact: A research handbook on frameworks and approaches, IGI Global, 2012, pp. 16–31.

[10] T. Shin, M. Koehler, P. Mishra, D. Schmidt, E. Baran, and A. Thompson, "Changing technological pedagogical content knowledge (TPACK) through course experiences," in Society for Information Technology & Teacher Education International Conference, 2009, pp. 4152–4159.

[11] D. A. Filva, M. J. C. Guerrero, and M. A. Forment, "Google analytics for time behavior measurement in Moodle," in 2014 9th Iberian Conference on Information Systems and Technologies (CISTI), 2014, pp. 1–6.