Digital storytelling and blockchain as pedagogy and technology to support the development of an inclusive smart learning ecosystem

Published in: Conference proceedings WorldCIST 2020

Publisher: Springer, Cham

DOI: https://doi.org/10.1007/978-3-030-45697-9_39

ISBN (electronic): 978-3-030-45697-9

Narración digital y Blockchain como pedagogía y tecnología para apoyar el desarrollo de un ecosistema de aprendizaje inteligente inclusivo

Resumen:

Este estudio presenta la implementación en progreso de un ecosistema de aprendizaje inteligente para apoyar la pedagogía centrada en el alumno, como la narración digital y las tecnologías recientes, como blockchain y micrositios. La implementación del ecosistema sigue el marco de investigación de la ciencia del diseño y las guías de accesibilidad universal para proporcionar a los usuarios un entorno de aprendizaje inteligente, accesible y receptivo. Además de ayudar al maestro a analizar el progreso de los estudiantes a través del componente de análisis de aprendizaje, este ecosistema ayudará al estudiante en el acceso al contenido de aprendizaje independientemente de sus discapacidades y otras limitaciones.

Digital storytelling and blockchain as pedagogy and technology to support the development of an inclusive smart learning ecosystem

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Abstract. This study presents the work-in-progress implementation of a smart learning ecosystem being developed to support learner centered pedagogy such as digital storytelling and recent technologies such blockchain and microsites. The implementation of the ecosystem follows the design science research framework and the universal accessibility guidelines to provide the users with a smart, accessible and responsive learning environment. Besides helping the teacher to analyze students' progress through the learning analytics component, this ecosystem will help the student to access learning content irrespective of their disabilities and other constraints.

Keywords: Smart learning ecosystem, Digital storytelling, Blockchain, Inclusion.

1 Introduction

In recent times, there has been a massive interest to revamp the educational environment to be open, accessible, trustworthy, and meeting the expectations of all stakeholders, including teachers, students, parents, regions, and governments. These growing requests led to the birth of a joint project, Smart Ecosystem for Learning and Inclusion (SELI, seliproject.org) supported by the European Union, Latin America and Caribbean [1] [16]. SELI addresses the crucial gap of 21st century educational goals through the design science research framework [2] by identifying the needs and requirements of different regions; outline the learning ecosystem and define the requirements; design and develop the ecosystem; and finally, validate and evaluate the solution. Emerging pedagogies, methods, strategies and technologies that are capable of supporting the seamless implementation of the learning ecosystem were identified and developed according to the universal accessibility standard [3][4][5]. The main aspects of the SELI ecosystem includes: authoring services, microsites (a small cluster of web pages that presents the course with all didactic contents, independent of the authoring tool), learning management system (LMS) and content management system (CMS) services, digital storytelling pedagogy, learning analytics services, and block-

chain support. An ecosystem can be defined as “a community of organisms in conjunction with environmental components interacting as a (semi-) closed system” [6]. Briscoe and DeWalde [7] define a digital ecosystem as “an artificial system that aims to harness the dynamics that underlie the complex and diverse adaptations of living organisms in biological ecosystems”. Boley and Chang [8], brought the following definition: “an open, loosely coupled, domain clustered, demand-driven, self-organizing agent environment, where each agent of each species is proactive and responsive regarding its own benefit/profit but is also responsible to its system.” Many researchers have been developing digital ecosystems-based solutions to address different problems in our society. As an example, Mendoza et al. [9] developed a digital ecosystem for the digital literacy gap. Before them, Silveira et al. [6] proposed LAT-In, a digital ecosystem for open textbooks in the context of Latin American Higher Education. More recently, Burns and Dolan [10] proposed a set of policies, platforms, and systems as an ecosystem to help to include people as participants of the so-called “digital economy”. However, SELI ecosystem addresses the problem of inclusive education using new technologies and pedagogy.

2 Blockchain Technology and Digital Storytelling for Inclusion

2.1 Blockchain Technology from an Inclusive Perspective

Inclusion is defined as the degree to which an employee perceives that he or she is a valued member of the work group or educational community. It is important to discern that inclusion is not autonomous from belonging, but that both are key elements in company initiatives and in a similar way in learning, where learning is perceived as a collaborative process. Collaborative learning is based on several psychological currents; among them, Vigotsky's sociocultural theory, which conceives man as an entity product of social and cultural processes. Belonging from the employee point of view is, “I can be authentic, I matter, and am essential to my team.” Learning group diversity is a well-researched topic, where more diverse in the learning group, the most learning is achieved. This means that, when we think of an inclusive learning environment, we are intrinsically thinking of a learning environment designed for diversity. According to Bourk et al. [19] traditional diversity is defined by gender, race, nationality, age, and demographic differences, but from a new perspective, diversity is defined in a broader context, including concepts of "diversity of thought" also addressing people with autism and other cognitive differences.

In a collaborative diverse environment, inclusion can then be defined as: Individual is treated as an insider and also allowed/encouraged to retain uniqueness within the work group. Inside SELI Project, we see the learning environment as an "ecosystem". In other words, ecosystem is the union of individuals or services with an environment where different interactions occur. From a technical perspective, Blockchain is the platform that gives support in order that these interactions occur in a transparent and secure way. From a social perspective, Blockchain is the environment that allows inclusion preserving the individuality (without intermediates). Therefore inside SELI project, using blockchain as an inclusive digital ecosystem is seen from two perspec-

tives [11]: (1) from an infrastructure perspective: Blockchain is a useful tool to support the ecosystem of services (for example, content authoring tools services, LMS, CMS, recommendation services, learning analytics services). Blockchain provides a distributed platform, with transactions between these services with secure identifications. This is the more traditional use of Blockchain, as a secure environment for transactions. There are several projects that follow this line in education, where Blockchain is used for certificate issuance for example. (2) from the social perspective of inclusion: Blockchain democratizes the education, gives possibilities, voice and value from each student and teacher. Our contribution in this direction is to encourage the use of Blockchain through giving support to storytelling as a tool for social interaction. Perret-Clermont [22], based on Piaget's work, focused on fluence of social interactions for cognitive development, with the assumption that learning takes place within each other, but it is dependent on social exchanges, and assigns interactions a major role in the cognitive development of the subject. We are of the opinion that digital learning ecosystems must tear down the boundaries of current education, one of them being the physical limits that are imposed on possible interactions. In this sense, a distributed environment like Blockchain can be a great solution.

2.2 Digital Storytelling as an Active Pedagogy in Inclusive Education

As we discussed in our previous paper our dialogue among scholars coming from diverse disciplines brings front the use of workshop-based digital storytelling rather than the tool based digital storytelling [12]. Creating learning environment and habits of co-creative processes gains importance for both students and educators in the SELI ecosystem. We aim to provide this holistic approach throughout implementing 6 following phases of a well-known workshop-based digital storytelling defined by Lampert [13], which were originally designed as face to face workshops (Fig. 1).

Fig 1. The 6 phases of workshop-based digital storytelling by Lampert [13].

We use workshop based digital storytelling for enhancing teacher education with a inclusion in mind as the process provide opportunities for teachers to make reflections on their practices on handling diversity in the classroom. SELI team support teacher's professional development through workshops by allowing the teachers to tell their stories based on their experiences with those that have similar interest in working with the disadvantaged groups. SELI ecosystem allows to create a community of practice

with an area of shared interest in inclusion, relationships built through discussions as well as stories of their practices. SELI ecosystem also provides storytelling tool for the use of students. This allows teachers to transfer their experience in workshop-based digital storytelling into their classroom.

3 Design Science Research Methodology

The design science research addresses real-world problems in a holistic and innovative ways. According to Johannesson and Perjons [2], the design science framework follows a feedback-loop process including problem explication, outline artifact and define requirements, design and develop artifact, validate artifact and evaluate artifact (Fig. 2). SELI's design and creation of learning ecosystem started by bringing together diverse stakeholders from EU, and LAC to explicate the challenges of digital exclusion and the inaccessibility of education for disadvantaged groups. As part of the requirement definition, SELI discovered the needs and requirements of implementing and integrating emerging pedagogies, methods and technologies such as blockchain, global sharing pedagogy, digital storytelling, flipped learning, and educational games, through workshops, and focus group sessions with stakeholders and target groups across the regions. The design and development of the smart learning ecosystem follows integrative process of agile, open and co-design approaches, in which researchers, software developers, students and business experts collaborate through several online meetings. At the moment, we are on the design science research phase of validating the learning ecosystem through workshops with teachers in different forums such as conferences, seminars, and other strategic events.

Fig. 2. Design science research framework

4 Smart Learning Ecosystem

SELI ecosystem involves a solution framework to improve the teaching-learning process. As shown in Fig. 3, it is divided into four views: service bus, concept, supporting infrastructure and philosophical foundations. Service bus are the general services as authoring, CMS, LMS, digital storytelling, collaboration, among others to support teachers and students in building and consuming learning material. The concept view is about the open licenses to ensure community access to content. The supporting infrastructure are the tools to support the educational innovative technologies such as blockchain to aid the global sharing of pedagogy, microsites to ensure accessible content and analytics to inform the learning process. And, finally, the philosophical foundations are the theoretical background about emerging pedagogies, methods and technologies that permeates the SELI project. Some methodological practices in education presuppose a collaborative perspective to enrich the process of teaching and learning. Technological

pedagogical supports strategies capable of mobilizing teachers and students in different times and spaces, in a collaborative perspective such as shared pedagogy. Universal design sets principles for creating products, services and spaces that can be used by people, regardless of age, size, skills or disability. The idea is not to create specific items but to include both those with a disability and those who do not have them. In this context the Universal Design for Learning (UDL) suggests the access and guarantee of learning to all students in the school context, from offering multiple and varied ways of organizing and making available scientific knowledge [16]. Universal design is an element of accessibility behind the services offered by the service bus view.

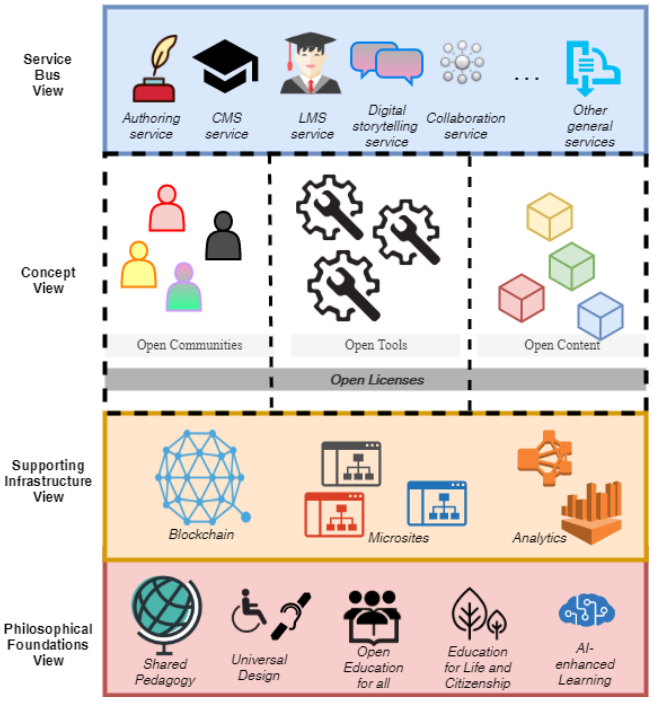

Fig 3. Smart learning ecosystem

In the following sections we present the main aspects of the SELI ecosystem.

4.1 Authoring Services and Microsites

The authoring service offer resources to the teacher to support creating and adapting media for the construction of digital didactic material (with or without accessibility). In addition to the teaching material, the authoring tool aids the construction of accessible material for specific disabilities and finally she/he can verify the rate of accessibility for a specific disability of the didactic content built. It allows teachers to create lesson strategies that can be used according to specific declines of students with disabilities, for example. It is possible also choose instructional design to facilitate and guide the pedagogical strategy. The teacher is able to insert different media such

as text, images, links, videos, audios, created by him/her or downloaded from the internet with open access copyright, for example. Each of these media can meet the accessibility criteria set by the literature and the W3C [14]. So they may insert accessibility aspects such as: descriptive text, audio description, sign language, etc. to improve the inclusion of digitally disadvantaged groups. When the teacher creates a course and publishes it, it is done through microsites that are linked to the CMS. This gives the student access to this course. The microsite is a web page that will present the course proposed by the teacher with all didactic content, independent of the authoring tool and should execute in the same way in different architecture and should be able to display correctly in diverse devices. This will provide the student with content presentation like selected matter for the class (previously selected text readings, video lessons and/or podcast) about concepts that will be learned. In addition, it may provide activities that explore skills acquisition to make the student verify how much he/she understood about the subjects presented so far, like practical activities. Seizing the dynamic features offered by microsites the content presented will encourage discussion and collaboration between the student through some collaborative tool. With the microsite, the teacher can verify the acquired skills allowing a student to present the ability for example, asking the students make a video with a storytelling about the concepts learned.

4.2 Learning Management System (LMS) and Content Management System (CMS) services

The CMS service is used to support the student to gain access to different courses, at different learning levels, in different languages, created through the authoring service and made available by teachers connected to the ecosystem in different countries and cultures. The LMS service allows the teacher not only to offer courses, but also to provide exercises, activities of different types, such as quizzes and storytelling, as well as tests and assessments. The teacher can also track the student performance through learning analytics component.

4.3 Digital Storytelling Service

Although there are several ways of creating digital storytelling, SELI ecosystem encourage users to create first-person narratives based on their experiences by combining their images with recorded voice. We implemented each of the 6 phases of the workshop-based digital storytelling framework [13], supported within the SELI ecosystem as an innovative solution. The digital storytelling service in the SELI ecosystem provides a simple looking story flow where the user can add different scenes and change the order of the scenes as shown in Fig. 4. Users are given the option to choose to make their stories public. Since some of the stories may involve sensitive content asking for consent of the user is very essential for ethical concerns. For each scene users can write short description, upload an image and record voice over image as shown in Fig. 5. Combining with this audio and visual elements user is allowed to preview and share story in social networks and classroom activities.

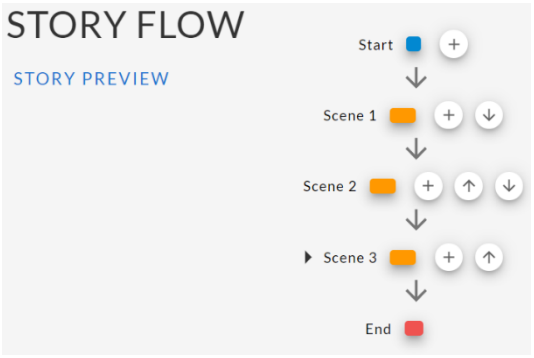

Fig 4. Flow of digital story on the SELI ecosystem

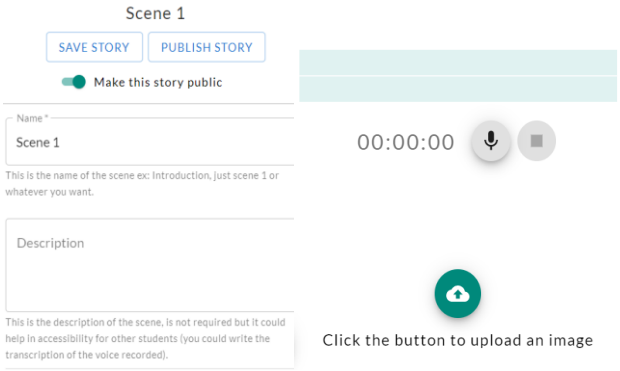

Fig. 5. Features of digital storytelling scene

4.4 Learning Analytics

The main goal of analytics is to support students in the learning process, moreover, in the SELI ecosystem, the learner and the teacher are living entities interacting. Thus, the teacher requires help to support the learner in the learning path. The tool will help in the prediction of risks in the learning process and give suggestions to improve learning. The process, according to the framework proposed by Chatti in [15], takes three stages: data collection and preprocessing; analytics and action; post-processing. These three stages iterate over time.

During the first stage, the first task is to identify the roles targeted by the analysis, followed by the identification of the indicators for monitoring to evaluate the learning process, assessment of the effectiveness of the learning process, and provide feedback to teachers and students related to the learning process. In the SELI ecosystem, the first stage is the one in process. In this stage the following roles are the target for analysis: students and teachers.

In Fig. 6, we present the general architecture view of the learning analytics component. The data is collected from the Service Bus view components. These components

follow the microsite infrastructure, where events are trapped to feed the Ecosystem memory with raw event data related to each indicator. The Ecosystem Memory concept is the databases across the Ecosystem services and tools. The event capture is a requirement to be implemented inside each service in order to feed the memory with data related to user events and behavior detected for each indicator. The capturer is a Javascript event handler in the client-side; it follows the W3C standards. The data collector interface will gather all data sent by the service component side (Tool) and feed the corresponding part of ecosystem memory. The ecosystem memory is not as simple as depicted in the Fig. 6; it is evolving during the development and testing process (the current stage of the project). Our memory repository is MongoDB databases and File System but is open to other technologies like PostgreSQL in the future. The ETL implementation is with ToroDB. It produces a database living in PostgreSQL. After ETL guided by ToroDB, the SELI team cleans the data manually, however, we are working on the automatization of this task with scripts. The automatization requires maturity in understanding the raw data gathered and the way ToroDB performs the PostgreSQL database. The techniques for analysis will be statistics and information visualization. Techniques related to classification and clustering will be discussed and implemented in the future when the Ecosystem get a large amount of data.

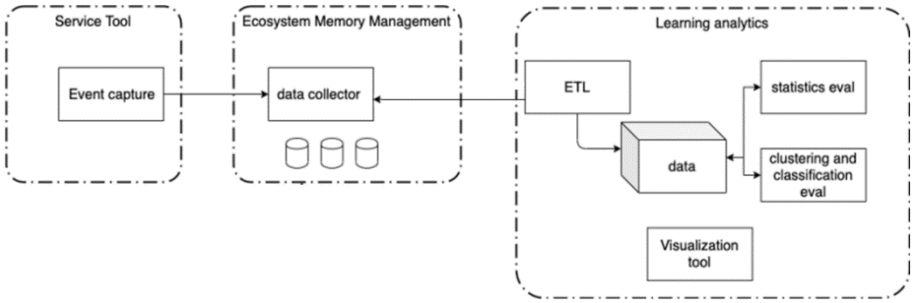

Fig 6. Learning analytics infrastructure

5 Discussion and conclusion

New media have been permanently integrated into the learning and teaching process. However, this simple statement has many important implications. The transformation concerns mainly opportunities related to increasing the effectiveness of learning and social inclusion [17]. Undoubtedly, new technologies make it possible to cross many borders. These are not only territorial restrictions, but also those resulting from disability or belonging to disadvantaged groups. Pedagogy as a science on educational ideals may currently use the potential of new technologies, thus developing the highest objectives related to social inclusion. Such an example of ideal synergy between social sciences and new technologies is the SELI platform.

The digital storytelling and flipped learning used in the SELI ecosystem shows the possibility of symmetry in the transfer of knowledge and skills. The openness of the platform creates an opportunity to combine fragmented content, both from professional sources and from sources not representing the higher education. Reverse learning is also

the use of activation methods using new technologies that allow effective interaction with the use of everyday content, classical didactic methods transferred into digital space to exchange experiences. This is especially important when we consider the fact that participation in SELI brings together people with different cultural, and organizational experiences. Therefore, in the text, the authors repeatedly refer to the concept of "smart". This keyword shows the flexibility of education, which is manifested by openness (not only to integrate different contents into the whole), but also the lack of borders for people with disabilities, and the possibilities offered by the mix of technology and pedagogy.

The SELI platform is a learning environment that exploits the potential of fast data collection and transfer. The pedagogy of sharing has its own exemplification also in the dimension of effective use of digital storytelling. This inconspicuous technique, which is rarely used, has an extraordinary potential. The SELI platform has implemented the possibility of collecting valuable research and teaching material for almost every course, referring to the sharing of experiences of the learning platform users. Based on the collected stories relating to courses such as the prevention of cyberbullying or preparation for being an educator of excluded people, a powerful database of cases is built up [18]. Based on the experiences and stories of cyberbullying, it is possible to redefine the content of online courses or to use archived cases (in the form of digital written stories or recordings) to learn from other people's biographies. Besides, digital inclusion cases (e.g. didactic failures of trainers) provide an opportunity to combine digital storytelling with the reversed classroom method.

The presented SELI ecosystem has several important perspectives. It is a perspective of knowledge, skills and biographical experience transfer between selected European and Latin American countries. SELI ecosystem also creates the possibility to quickly connect and refer to distributed data, to authenticate the effects of didactic activities (certification through blockchain). The wisdom of the described solution is primarily broadly understood inclusiveness, i.e. inclusion regardless of physical, linguistic, state or age restrictions. Within SELI ecosystem, there is also a perspective of scientific research, didactic activities, exchange of experiences, transfer of values and, above all, construction of wise solutions, i.e. allowing to keep up with the universal needs of learning subjects.

Acknowledgement

This work was supported by the ERANET-LAC project which has received funding from the European Union's Seventh Framework Programme. Project Smart Ecosystem for Learning and Inclusion - ERANet17/ICT-0076SELI, including funding from FAPESP, 2018/04085-4.

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