A Technological Proposal Using Virtual Worlds to Support Entrepreneurship Education for Primary School Children

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Abstract. The importance of entrepreneurship education from elementary school through college is now recognized as an important aspect of children's education. At the level of basic education, the development of entrepreneurial activities using Information and Communication Technologies, specifically three-dimensional virtual worlds, is seen as an area with potential for exploration.

The research presented herein is a model that allows the development of entrepreneurial activities in virtual worlds with children attending primary education. This model allows the preparation, monitoring and development of entrepreneurship education activities in virtual worlds, including safe interaction in virtual worlds between the children and the community. For this, we identified a set of requirements that would allow the teaching and learning of entrepreneurship in virtual worlds, from which a technological model was implemented through an application, EMVKids (after the Portuguese expression "*Empreendedorismo em Mundos Virtuais com Crianças*", entrepreneurship with children in virtual worlds).

Keywords: Entrepreneurship · Primary education
Three-dimensional virtual worlds · Collaborative learning
Educational virtual environment · User-Centered Design

1   Introduction

Entrepreneurship is widely recognized as one of the basic skills to be acquired through life-long learning. Educational systems can make a significant contribution towards this, encouraging the development of entrepreneurial attitudes and skills, starting with youths and school-aged children.

Changes in educational practices have come to recognize the potential of Information Communication Technology (ICT) in teaching and learning. One of these technologies are the three-dimensional online virtual worlds that can promote playful, immersive and interactive learning experiences, allowing users to test, explore and interact through a visual learning environment, as well as real-time communication and collaboration with other users [1–3]. These three-dimensional virtual worlds can be projected to support the design and implementation of educational activities and not just for the reproduction of traditional educational content.

To explore the potential of entrepreneurship education in virtual worlds with children attending primary schools we conducted an early empirical study [1]. To accomplish this activity, we needed a virtual world that allowed the following: the development of technological solutions; access to educators and children under 10; create and edit objects by users and support for collaborative learning. From the range of available Massively Multiplayer Online Social Games (MMOSG), the Active Worlds Educational Universe (AWEDU) was selected to develop this activity because it has the possibility of obtaining an isolated world accessible only to authenticated/professional users, in this case educators and children.

From the previous study developed by Pereira et al. [1] several technological problems for the use of virtual worlds in entrepreneurship education were identified and had to be solved manually. We classify these problems in three phases according to the evolution of activities: First phase - Virtual World preparation for a new educational activity; Second phase - children development activities related to entrepreneurship inside the Virtual World; and Third phase - Connection with adult virtual world community.

This paper reports the architectural model to support the development of entrepreneurial education activities in AWEDU virtual world for elementary school children and its prototype implementation, in order to validate it. We began by situating the study in the current literature, discussing what is known about entrepreneurship education practices, defining what virtual worlds consist of and how they can be used for educational purposes, and discussing studies that have been conducted in this field. Next, the architecture model and its components are described. Finally, we present the conclusions and the future work.

2   Related Work

Entrepreneurship must be seen as a dynamic process that involves the perception, the conception and the concretization of a business opportunity, which presupposes the involvement of people and processes that, together, lead to the transformation of ideas

into opportunities. Its importance has been recognized for more than 50 years in the development of economies and studied by many authors in various parts of the world [4, 5]. Education can make an important contribution to entrepreneurship by stimulating the development of entrepreneurial attitudes and skills, starting with young people and with schooling [6–8].

Regarding to initiatives in the field of entrepreneurship education, a documentary research of good practices implemented in some countries has been carried out on specific programs related to entrepreneurship education in the 1st cycle of basic education.

In all basic schools of Luxemburg the program of 6th grade French class entirely integrates a unit devoted to the creation of companies. This unit is based on the comic book of the same name Boule et Bill créent une entreprise [9]. That comic book explains how well-known personalities became successful in the business world. This program was also adopted by schools in the French region of Nord-Pas-de-Calais.

"Una empresa en mi escuela" (EME) – is a program of the Astúrias region (Spain) directed to basic education (5 to 12-year-olds). This program is managed by Valnalón, a public company of the Ministry of Labour and Industry, which works in cooperation with the Ministry of the Education for the creation and implementation of programs in the area of entrepreneurship for different grades. The learners carry out various tasks related to the creation and operation of a company, the aim being the creation of business skills and to establish relations between schools and companies [9, 10].

In Scotland, an infrastructure was created to provide education for the development of entrepreneurship in basic education [11]. The programs are aimed at school-aged children from the age of five and involve them in the creation of mini-enterprises and in the development and commercialization of for-profit products or services. There are many other examples of good practice in stimulating entrepreneurship since an early age like in some countries of the European Union. After Estonia, Luxembourg has the 2nd highest Total Early entrepreneurship Activity (TEA) among European countries. Luxembourg's neighbors have a TEA rate of about 6%. In 2015, Belgium reported a TEA of 6.2%, Netherlands 7.2% and Germany 4.7% [16].

A growing number of researchers have used virtual worlds as educational platforms, typically referring to them as educational Multi-User Virtual Environments (MUVEs). Some authors [12, 13] point out that three-dimensional virtual worlds have the potential to promote various educational and collaborative activities, allow-ing their users to communicate and collaborate with others in a virtual shared space that is created by the users themselves. This generates opportunities to develop creativity, the creation of new ideas and experiences that are not always possible to achieve in the real world. Educators have been including three-dimensional virtual worlds as an alternative to improve students' learning experiences, from primary education to higher education.

A study carried out by Bers and Chau [14] involved children in the construction and social organization of a virtual city in a three-dimensional multi-user virtual environment, with the aim of learning about moral and civic values. The results of this study show that virtual environments allow access to a wide range of information and resources, as well as communication tools and support for collaboration, and are platforms with potential for the development of civic education programs.

Quest Atlantis (QA) is a teaching and learning project developed by Barab et al. [15] that uses the virtual environment ActiveWorlds for the development of educational activities with children between the ages of 9 and 12. The results revealed an increase in students' participation in the curriculum, progress in explaining processes and conclusions, and a significant increase in knowledge about content.

In this context we decided to use three-dimensional virtual worlds in entrepreneurship education for children. Three-dimensional virtual worlds can offer several contributions specifically to entrepreneurship education of children, by allowing the creation of learning activities where children may reproduce the operation of a business or the organization of a social activity [1].

An exploratory study was conducted to verify the possibilities of using virtual worlds for education purposes for children, which revealed some constraints on their use.

Thus, the need arose to develop a technological solution that allows the use of these worlds in an effective way. The next section presents the proposed solution.

3   Architecture Model

From the previous study [1] we identified several technological problems in the use of virtual worlds in entrepreneurship education that had to be solved manually. We classified these problems in three phases: First phase – Preparation of the educational activities related with the organization of the virtual world for a new activity; Second phase – Development of the activities related with the implementation of the entrepreneurship activities by children inside the virtual world; and the Third phase – Connection with the community. A number of specific requirements to promote the learning activities was identified. A requirements summary are presented in Table 1.

Table 1. Requirements

Phase	Found requirements
Preparation and monitoring of the educational activities	Management of information about schools, classes, learners, groups and avatars; Division of the virtual learning space; Monitoring the learner's activities
Development of the activities	Presentation of business information; Inserting images (logos and products); Supporting the creation of objects; Providing products/element information
Connection with the community	Secure interaction between entrepreneurs and targets; Monitoring entrepreneurial activities

These requirements drive the recognition of three key areas, which are:

1. Management system: prepare, monitoring and show to the community the educational entrepreneurship activities.

2. Automate processes: assist students in the development of entrepreneurship activities in a virtual world.
3. Online ordering: allows purchases, orders and statistical data about the projects (businesses).

The technological model key areas that interact with the virtual world are presented in Fig. 1.
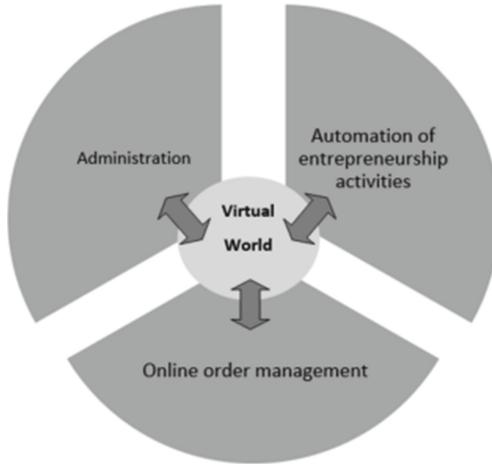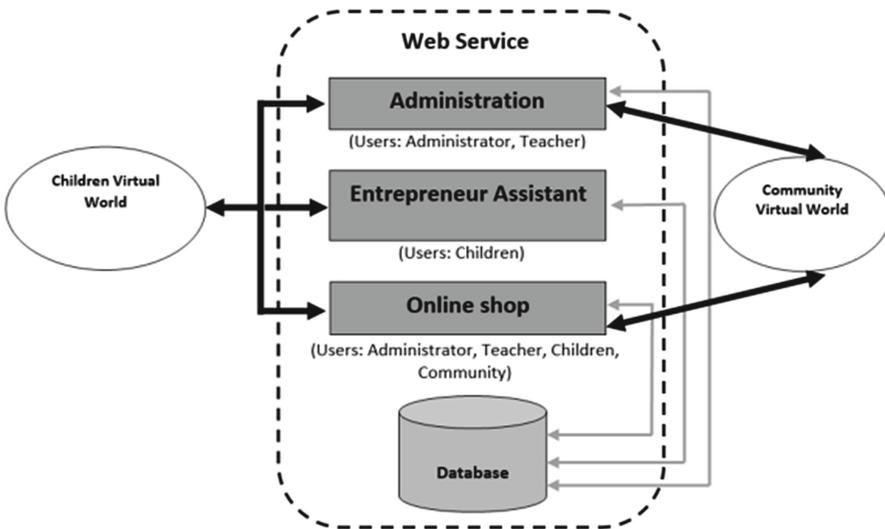

Fig. 1. Model key areas

Fig. 2. Architecture to support the activities of teaching entrepreneurship to children in virtual worlds

The next step was the creation of the architectural basis (Fig. 2) that allowed the development of technological solutions for the entrepreneurship education activities with primary school children inside the virtual world AWEDU. The architecture supports different users' profiles; each of them has access to a specific part to manage their activities.

The interaction takes place with two virtual worlds that have different purposes. A virtual world reserved for students (children) for the development of their educational activities. Another virtual world with free access to the community (adults) in which the activities developed by the children will be presented. This virtual world's separation was to ensure the safety of children against malicious users. Since it is important that business developed by the children is available to all community, it was necessary to create a safety way to make the business public. The solution found consisted in the creation of a replication mechanism. This mechanism copies all the businesses from the children's virtual world to the community virtual world and allows children to manage all their business inside the safety of their virtual world.

3.1   Administration

The Administration component consists of two modules: **Resources management** – enables the development of entrepreneurial educational activities in the virtual world, such as creating the users' profiles, register the virtual world server, configuration of the world such as the division of virtual space in areas for each group of students work, define avatars, schools, classes and groups; **Virtual world management** – allows the administrator or teacher to initiate entrepreneurship activities, monitor the progress of these activities and replicate to the virtual world community.

3.2   Entrepreneurship Assistant

The Entrepreneur Assistant component is used only by students through their avatar. This component helps the students develop their business inside the world. The assistant consists in four modules which are: Project Information, Building Construction, Product Management and Advertising. **Project Information** – helps the students structure all their business, such as: name, logo, products information, among others. **Building Construction** – allows the students to build and personalize their shops. **Product Management** – helps the students to manage all their business specially defining the prices, quantities and manage the sales. **Advertising** – enables the creation of advertising for the community's virtual world.

3.3   Online Shop

The Online shop was designed to manage the orders from the clients and consists of three modules: Promotions, Businesses and Administration. **Promotions** – shows to the community all the promotions that exist in the children's businesses. **Business** – displays the products from the children's businesses to the all community. **Administration** –

manages the orders from the clients for each business. The next step consists in the creation of the design prototype in order to validate the architecture model.

4   Prototype Design

In order to validate the architecture proposed we developed the EMVKids prototype. In the prototype development a User-Centered Design (UCD) process was used, which is an effective approach to satisfy users' needs and to improve the interface. More specifically, the UCD includes three major activities: design, evaluation, and re-design. These three activities were repeated until users were fully satisfied with the functionalities and inter-face provided by the system. This prototype was tested with primary school teachers and students. The prototype made possible a better organization of the virtual world and activities, such as: help improve students' performance in performing their tasks in the virtual world and allow teachers to monitor the activities developed by the students. This technological solution allowed the use of a virtual world for education purposes with young children.

5   Conclusions

The developed model allowed to realize several results: the development of real economic activities in small scale through the production and sale of real products; the development of entrepreneurial skills, personal qualities and transversal skills of students; the execution of students' ideas and the development of creativity; team-work in a business project; the secure interaction of entrepreneurs with the community through the asynchronous data replication system.

Some recommendations to be implemented in the future are that of an alert system to register clients who visit the virtual world (virtual world of community access) and the possibility to send a warning (via email or SMS) to the teacher. Another one is the integration of activities in social networks such as Twitter and Facebook so that the teacher can spread the business and new products.

As future work the researchers intend to validate the prototype developed in a real context.

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