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A virtual environment study in entrepreneurship education of young children

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Abstract

In this article, we present an exploratory study on the use of 3-D virtual worlds in entrepreneurship education for children of primary school in a virtual world from the Activeworlds Educational Universe: “Entrepreneurship in Basic Education – 1st cycle.” This study allowed us to identify a set of technological problems in the use of these environments for teaching entrepreneurship to children. It allowed us to define a range of requirements that must be fulfilled in order to provide a software system that supports these activities in virtual worlds.

Keywords: collaborative virtual environment; virtual worlds; entrepreneurship education; primary school; children.

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A virtual environment study in entrepreneurship education of young children

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Currently, much importance is given to entrepreneurship education, even at early stages of education. The Commission of the European Communities (2006) mission of, “Fostering entrepreneurial mindsets through education and learning,” approaches entrepreneurship education from the primary levels up to college, deeming imperative the introduction of basic entrepreneurship abilities in the curriculum of schools and universities. The Commission considers that “At the primary level, nurturing qualities such as creativity and spirit of initiative helps develop entrepreneurial attitudes . . . through active learning based on children’s natural curiosity,” and that “learning about society should also include early knowledge of contact with the world of work and business, and an understanding of the role of entrepreneurs in the community” (p. 6).

This article is divided into three sections. We first present some related work about the motivation to use virtual worlds in entrepreneurship education. Then, the project methodology is described including the procedures and the sessions with children. Finally, the findings and their implications are discussed.

Motivation and related work

The importance of the entrepreneurship in economy cannot be overestimated. Schumpeter defined entrepreneurship as the primary engine of economic development (McGraw, 1991). In the educational system (from primary school to college) value is given to teaching concepts of entrepreneurship through many initiatives spread throughout the world. However, in primary school these initiatives are not so visible, and this is a context where we consider the existence of potential for exploration. It is our aim to support entrepreneurship education (EE) at the primary levels through the use of computer software, specifically 3-D virtual worlds. In some member states of the European Union, primary schools strive to lead children towards taking initiatives and assuming responsibilities as stimuli for entrepreneurship (Commission of the European Communities, 2006).

In Portugal, EE is part of educational programs mainly at the level of high schools and colleges. However, some initiatives on the part of the organizations JA-YE, GesEntrepreneur, and of the Portuguese Ministry of Education implemented curriculums for EE in primary schools. In other countries such as Finland, Luxemburg, Norway, and Spain, the entrepreneurial spirit is explicitly included in the national programs for primary-school education, with the aim of stimulating active forms of learning and spurring the development of personal qualities like creativity and initiative in children, as well as promoting innovation.

Revisions of literature on EE can be found in several works (e.g., Solomon, Duffy, & Tarabishy, 2002; Kuratko, 2005; and Katz, 2003). From them, we can observe that initiatives

aiming to promote the development of entrepreneurial spirit in children are rare; even so, several different examples can be found. In several academic journals devoted to this field like the International Journal of Entrepreneurship Education, The International Journal of Entrepreneurship and Innovation, Journal of International Business and Economy, and Journal of Business Venturing, we have found some projects aimed to promote the EE of children. Some of those were based on tangible, real-world activities, others on computer systems developed to support EE - mostly, computer games (Pereira, Morgado, Martins, & Fonseca, 2007). Two examples of teaching entrepreneurship for children based on real activities are: “Boule et Bill créent une entreprise” (translated as “Boule and Bill create a company”), implemented in all basic schools of Luxembourg and in the French sixth grade programme that entirely integrates a unit devoted to the creation of companies (European Commission, 2001). This is based on the comic book with the same name that explains how well-known personalities had success in the business world. “*Una empresa en mi escuela*” (translated as “A company in my school”), is a program of the Astúrias region in Spain, directed to basic education of 5- to 12-year-olds. This program is managed by Valnalón, a public company of the Spanish Ministry of Labour and Industry, which works in cooperation with the Spanish Ministry of the Education for creation and implementation of programs in the area of the entrepreneurship for different grades. The learners carry out various tasks related to the creation and operation of a company (EME, 2008). Regarding computer systems for teaching entrepreneurship for children under 12-years-old, there are computer systems that do not provide the level of immersion of a virtual world and require learners to imagine the business operation. Some examples of these types of games are Lemonade Stand and Taller de Emprededores (translated as “Entrepreneur’s Office”). The level of interaction with these games is also somewhat static. But some games do incorporate a few elements of three-dimensional virtual worlds to provide a simulation of the reality. An example of this kind of games, which – we emphasize – is not a real 3-D virtual world, is Hot Shot Business, where we can find avatars, visible products and customers, and the actual space where the business operates, all attempting to provide a better approach to reality (Jason, 2003).

A growing number of researchers have used virtual worlds as educational platforms, typically referring to them as educational Multi-User Virtual Environments (MUVES). These environments are comprised of a virtual world in which learners control avatars that represent their online persons, explore the world, interact with objects, communicate with other users and create and test hypotheses while they explore (Nelson, 2007). Some examples of educational MUVES are: Zora, which was implemented in Virtual Worlds Platform, aimed to help children explore their identity by creating a virtual city and its social organization; Vertex, aiming to work with teachers and children to investigate the creative teaching and learning possibilities of shared 3D virtual worlds, and to develop and disseminate innovative practical strategies for their use across the primary curriculum; Round Earth, which investigates how virtual reality technology can be used to help teaching concepts that are counter-intuitive to learner's currently held mental model, in particular, teaching young children that the Earth is spherical when everyday's experiences tell them it is flat; Quest Atlantis, here students 9- through 12-years-old can take part in a great number of quests to save the people of a virtual Atlantis from destruction through environmental, moral and social decay; River City, a virtual city with a river and various neighborhoods, industries, and institutions, such as a hospital and a university, where students learn to behave as scientists while they collaboratively identify problems through observation and inference, form and test hypotheses, and deduce evidence-based conclusions about underlying causes assessments in biology and ecology; NICE, which provides an engaging setting where children construct and cultivate simple virtual ecosystems, collaborate via

networks with other children remotely, and create stories from their interactions in the real and virtual world (Bers, 1999; Bailey & Moar, 2002; Johnson, Moher, Ohlsson, & Gillingham, 1999; Barab, Thomas, Dodge, Carteaux, & Tuzun 2005; Ketelhut, 2007; and Johnson, Roussos, Leigh, Vasilakis, Barnes, & Moher 1998). These virtual environments revealed the potential to engage children learners in learning. Along the same line, we present some of the advantages pointed out by several researchers regarding the use of MUVES in children's education:

- Virtual worlds are playful, engaging, and interactive alternatives to more passive media, and the child tends to be more involved with the educational content and learns more;
- The child is becoming a creator and having control over elements of a world;
- A virtual world helps create mental maps, exploring, and understanding a new world and its systems;
- Children rehearse having responsibilities and looking after things while at the same time developing their social skills;
- Virtual worlds provide tools for self-expression and enhance computer literacy;
- Virtual worlds can act as enablers for children with physical and communicative needs, stimulating the active participation of the child, making the passive child more active;
- Virtual worlds remove barriers to learning for children who have difficulties in learning in traditional classroom contexts;
- Virtual worlds allow collaboration and sharing of knowledge, improving the children's skills of communication and collaboration;
- Virtual worlds better illustrate some concepts and complex processes;
- Children show enthusiasm and motivation for using these technologies because of the high degree of entertainment that these environments provide;
- The use of virtual worlds in educational contexts could make significant links between information and communication technologies and other content curriculum (such as Mathematics and English); and
- Virtual worlds as learning modules stems, from their ability to implement contexts and relationships, are not possible to achieve in a traditional learning setting.

For all the reasons presented above, we decided to use 3-D 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. The entrepreneurship activity that children will develop is the creation of a business in a virtual world which can provide rewarding learning experiences that are difficult to obtain otherwise. The virtual business can always be open, so the products can be sold at any time and without the presence of a real person. The virtual world can be effective for helping children understand abstract concepts like the ordering processes into more concrete ones (Bricken, 1991). Children can observe the effects of their changes, such as the dimensions and colors of the store and the positioning of the products for sale, among others. Children can pass from the imagination to the concretization of the business. The products sale can reach a greater number of people/customers. Children can interact and collaborate with one another while developing projects. The creation of a virtual business involves a large variety of different activities that gives children the possibility to create something original and themselves. The costs to create a virtual building are not a problem. In the virtual world, children not only learn to

create the business but also to make work a business that can move from year to year. It is possible in the virtual world to recreate real world elements, through the avatars (persons), the businesses, and the environment, as well as through the operations and challenges of a real business.

Design and Methods

In most software engineering methodologies, there are four phases: analysis, design, implementation, and testing. These phases attend to what and how it will be built, the actual building, and its testing.

The main objective of this article is defining the engineering requirements (analysis phase), which is the process of discovering the purpose for what the software was intended (Nuseibeh & Easterbrook, 2000). According to Zave's (1997) point of view, engineering requirements are concerned with the "real-world goals" that motivate the development of a software system. These represent the "why" as well as the "what" of the system, providing the basis for analysing requirements, validating and defining what designers have to build, and verifying that they have done correctly upon delivery.

Through a real camp experience of the use of virtual environments in entrepreneurship education for children in primary school, we identified technological issues regarding the use of this environment in teaching entrepreneurship for children and that allows defining the engineering requirements that motivate the propose of the development of technical solutions.

The data presented in this article was obtained by the researcher through direct observation in the field and through elements recorded on video, image, and text. The teacher involved also made some class reports of what she had observed.

Participants

This study involved sixteen children, aged 8- and 9-years-old in the third grade at the primary school Macieira de Sarnes, Portugal; a teacher; and the collaboration of two assistants of the project *Net sobre Rodas* (translated "net on wheels"). *Net sobre Rodas* (NR) is a project of a regional digital inclusion project in Northern Portugal, EDV Digital (2008). NR has two vans equipped with twelve laptops with internet access, that visit institutions like schools, businesses, and communities, among others with four assistants who provide support for people to better use computer technology.

The children involved in this project are from low-income families with little regular contact with the computer. In a questionnaire distributed to the sixteen children, nine of which have a computer at home and use it for the school homework. Most children said that they used computer mainly to play games and do internet searches. Only two children have an email address.

The teacher has about ten years of experience in teaching children and this was the first project in which she participated that involved the use of a virtual world. She enthusiastically contributed for the development of this project dedicating some of their classes to the themes of entrepreneurship and was always present at the NR sessions.

Technology

To carry out this activity, we needed a virtual world that allowed: development of technological solutions (i.e., no closed solutions); access to educators and children less than 10-years-old; user creation and editing of objects; and support for collaborative learning. Therefore, amongst all MUVES, we are not looking into games, but into environments that support the above requirements. These MUVES devoted to three-dimensional collaborative and social activities are known as Massively Multiplayer Online Social Games (MMOSG). In MMOSGs the emphasis is on socialization between users and personal expression or creation of virtual elements. MMOSGs include, for instance, Active Worlds, Second Life, and There. From the range of available MMOSGs, the Active Worlds Educational Universe (AWEDU, 2008) was selected to develop this activity because it fulfils the requirements listed above. Although Second Life and Teen SL fulfil some of them, they could not be used due to age restrictions, as Second Life is for adults only and Teen Second Life is for teens 13-17-years-old. Another reason we choose AWEDU was the possibility to get an isolated world, accessible only to authenticated/professional users: in this case, educators and children.

Active Worlds is not just a single virtual world but also a network of networks to hundreds of individual worlds where users can create, explore and communicate (Dickey, 2000). In 1991, Active Worlds created the Active Worlds Educational Universe (AWEDU), which is an entire Universe devoted to the exploration and exploitation of the educational applications of Active Worlds Technology; it was made available to educational institutions, teachers, students, and individual programs. A very important aspect of the AWEDU is that it provides a Software Development Kit (SDK) for programmers to develop applications that interact with the virtual world. The core component of this SDK is a Windows DLL file that implements the entire Active Worlds client/server protocol. The most common type of application developed using the Active Worlds SDK is called a “bot” – typically an automated avatar that inhabits in a virtual world and interacts with users, but which is driven by a computer program instead of a human being. Bots are intended to be helpers, to automate tasks, to control building of objects, or to automatically interface with other visitors.

Thus, we acquired a virtual world and named it “Empreendedorismo no Ensino Básico - 1º ciclo (EEB1)” (translated as “Entrepreneurship in Primary Education – 1st cycle”) as seen in Figure 1. It is a secure space separated from the public network we used to develop entrepreneurship activities. During ten sessions of 120 minutes each, eight groups of two children, with the support of two NR assistants plus a researcher and the children’s teacher, used the virtual world EEB1 to develop activities related to the creation of virtual businesses.

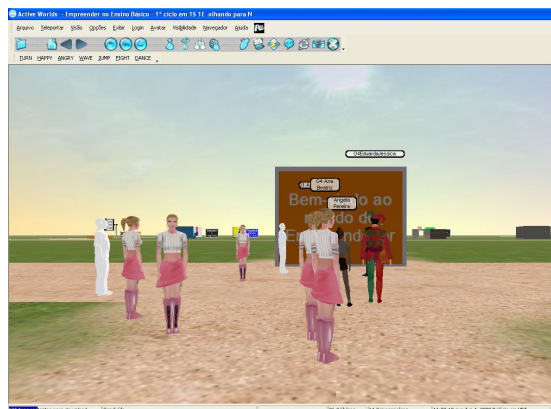


Figure 1. Virtual World EEB1 from AWEDU.

Materials

Before starting the activities of entrepreneurship in the primary school Macieira de Sarnes, several weekly meetings were prepared with the NR assistants and their manager. Our goal was to train the assistants on educational entrepreneurship activities and on the use of the AWEDU virtual world. To this end, several materials were produced to support the activities, including: user’s guide of AWEDU (Figure 2); teacher guide book which allows the teacher or assistant develop the activities (Figure 3); an exercise book for the learner which contains activities related with entrepreneurship ideas (Figure 4); and PowerPoint presentations to support the sessions with the NR assistants (Figure 5).

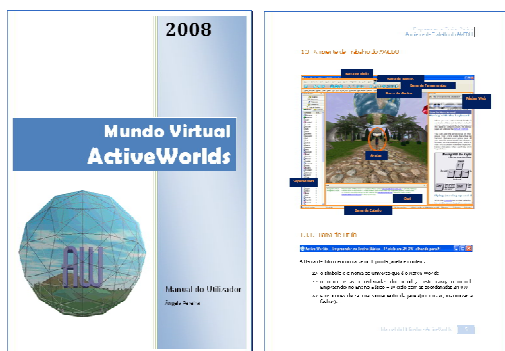


Figure 2. Sample Pages from User’s Guide of AWEDU.

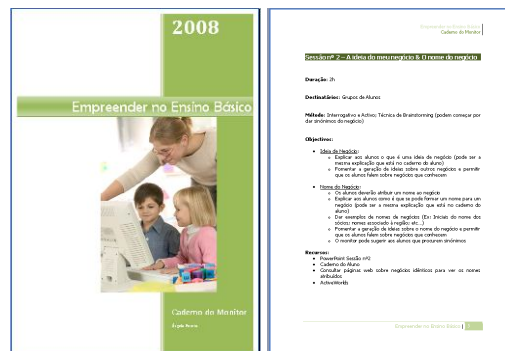


Figure 3. Sample Pages of the Teacher’s Guide Book.

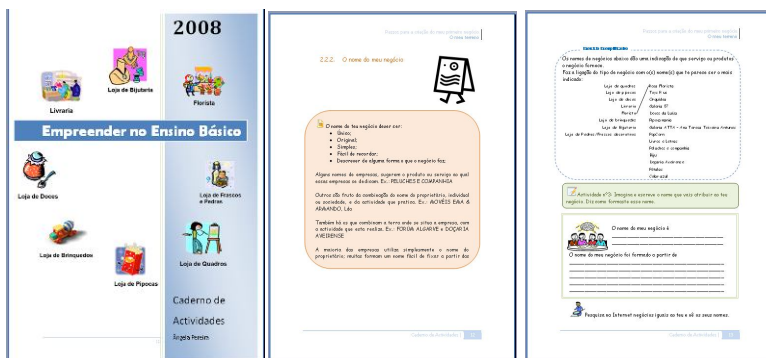


Figure 4. Sample Pages from Learners’ Exercise Book.

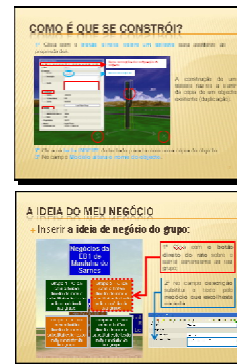


Figure 5. Sample Slides “How to Build” and “My Business Idea.”

This printed material was produced based on the experience of other projects that we mentioned earlier in this article (*Una empresa en mi escuela* and *Hot Shot Business*, among others). However, we decided to make our own materials because we needed to combine traditional classroom activities with the use of a virtual world. In the printed materials produced, we incorporated both digital (e.g., activities to be implemented in the virtual world EEB1) and non-digital approaches to develop activities in the classroom, which were related with the creation of a business.

For carrying out this project we needed computers with an internet connection. The EDV Digital project released eight laptop computers so each group of two children could work on a laptop with a 2 Mbps internet connection. The teacher divided the class into eight groups of two children and each group used a laptop computer to access the EEB1 world through a unique avatar character, as illustrated in figure 6.



Figure 6. Pair of Learners Developing Activities in the EEB1 World.

Procedure

Before starting this project in the primary school of Macieira de Sarnes, several meetings were done for training of NR assistant, in the AWEDU virtual world and in the activities of entrepreneurship to be developed because these assistants had never contacted a virtual world nor the development of entrepreneurship education activities. As mentioned earlier, the teacher's guide book and users guide to AWEDU were produced to guide these monitors through the activities. Before we started the project, we also made some meetings with the class teacher. In these meetings, we presented the materials produced, and defined with her that before each NR sessions, she would have to develop with the children the entrepreneurship activities (following the learners' exercise book) to be implemented afterwards with the help of the NR assistants, in the EEB1 virtual world.

In this project, we had lessons that were developed only with the teacher and children and other activities that took place in sessions with the presence of children, teacher, NR assistants, and a researcher. Both activities were developed inside the classroom and the lessons and sessions alternated (i.e., lesson 1 – session 1 – lesson 2 – session 2, and so on through session 10). During the project, we held meetings with the teacher at the end of each session and several other contacts were established by email.

In the lessons, children followed a range of activities through the learner exercise book related with the creation of virtual businesses. Some of the activities were the idea of the business, its name, the logo design, specification of the range of products to be commercialized, creation of the product, and the plan of the store. For these activities, children needed to work closely together in pairs. Significant discussion and collaboration emerged between children as part of the process.

During the ten sessions of 120 minutes each, the pairs of children put into practice in the EEB1 virtual world what they had done in the lessons. In a typical session, children converted to AWEDU (EEB1 world) the knowledge from the lessons, using the learner's exercise book, as illustrated in Figures 7 and 8.

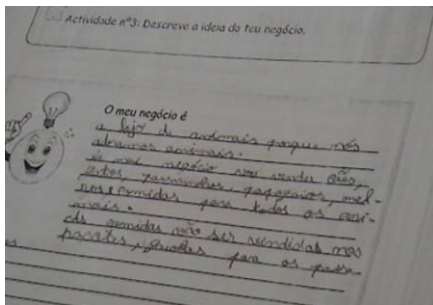


Figure 7. Sample Page “My business is” Resolved by a Children Group from Learners’ Exercise Book.

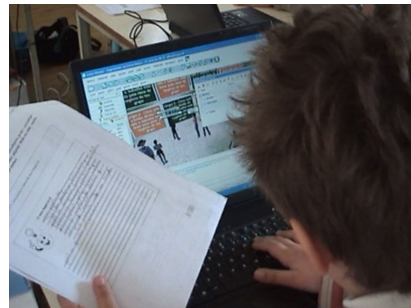


Figure 8. Children During an NR Session Converting to EEB1 What had Been Done in the Learners’ Exercise Book.

The teacher was very committed and involved in this project and approached during her lessons various topics related to this activity. She was always present at meetings with the NR. This allowed the assistants to focus only on the activities that had to be developed within the AWEDU, as illustrated in Figure 9.



Figure 9. Session with the NR Assistants.

Sessions

The teacher made the presentation of this project during one of her lessons. Afterward, the NR assistants began their first session in the primary school of Macieira de Sarnes. The first session was dedicated to the familiarisation with the basic functions of the Active Worlds

interface. Children learned to login, navigate in AWEDU, change the avatar, communicate via chat, add contacts, and explore different worlds from the AWEDU. Before this session, the teacher showed the AWEDU to learners so some of the concepts were not new for these children. The NR assistant during the presentation of AWEDU made some questions to the class:

NR assistant: *“What did your teacher say about a virtual world?”*

Children’s answers: *“That I could change the toy,” “[C]hange the world,” and “We can do a factory, shops.”*

NR assistant: *“What is an avatar?”*

Children’s answers: *“An avatar is a toy,” “Could be an animal,” “A bicycle,” and “A robot.”*

NR assistant: *“What can you do in Active Worlds?”*

Children’s answers: *“We can build things,” “Visit other worlds,” and “The toy can move, jump.”*

NR assistant: *“What English words from the animation bar do you know?”*

Children’s answers: *“Yes,” “Jump,” and “Karate.”*

After this presentation, the children started up the activities of exploration in AWEDU. The NR assistants projected the AWEDU in a panel and showed the steps to perform the tasks. The students began to introduce the login and password to enter AWEDU. Then, the monitors asked them to access the world EEB1. After entering the world, they were asked to change their avatars, and one of the children said: *“I want one that has shorts.”* Then, the NR assistant showed how they could navigate. Before moving to the explanation of teleporting, the NR assistant asked *“What is teleporting?”* And someone replied: *“Go to another world.”* They were taught to set the EEB1 world as their residence so that the next time they would access Active Worlds, they would enter directly there. The NR assistant continued the session with an explanation of some of the taskbar buttons, including buttons relating to the vision and the ways of viewing the avatar. Moreover, the NR assistant taught the children to type messages in chat and use the keys with special characters to show their emotions. Then, children added the contacts of each other, including the teacher’s. Finally, the children visited other worlds beyond the AWEDU and EEB1, including the Egypt world and Dirticity, among others.

The second session was devoted to a presentation by each group of the idea and name of the business which had been previously determined in the teacher’s lesson. The eight businesses proposed by children were a: decoration store; art gallery; cushions store; stationery store; pet store; sports store; florist; and jewellery store. The names assigned to these stores were: *“Decorate to Shine”*; *“Art Colour”*; *“Little Cushions”*; *“Paper and Company”*; *“Small Funny Animals”*; *“Sports and Company”*; *“Beautiful Flower”*; and *“Golden Ring,”* respectively.

The teacher made some observations about the activity undertaken by children in this lesson:

“I was quite surprised (positively!), not only with the ideas that were emerging for the names of business, but also with the care that they put into creating palpable business”

(Classroom Teacher).

“[T]hey are exploring the possibility of construction and development of the final product for sale, the fact that they could be doing what they will sell in their shop”
(Classroom Teacher).

In this session, children began to develop their business in the EEB1 world through the presentation of panels with the idea and name of their businesses. The suggestion for the creation of this activity was based on the idea of an area where everyone can view the business of each other and from this area has access to business.

To insert a text panel in the AWEDU is necessary in order to duplicate a pre-existing object, modify the object model to a panel, and write the text that should appear in the panel. Since this was the children’s second contact with AWEDU, this task could be difficult for them. Thus, we facilitated this process by pre-creating the panels for each group to insert the idea and name of business, as illustrated in Figure 10.

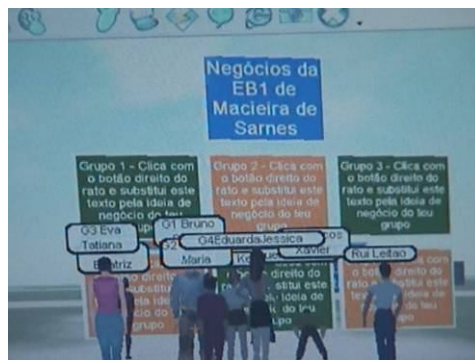


Figure 10. Text Panels for Each Group to Insert the Idea and Name of the Business in the EEB1 World.

With the help of the NR assistants, every group could create their panel with the idea and name of business - the final result is illustrated in Figure 11. However, there were some problems in fulfilling this task, discussed ahead in the results section.



Figure 11. Presentation in the EEB1 World, the Ideas and Names of the Businesses of the Eight Groups.

The third session was devoted to the creation on MS Paint of the business logotype that has been previously designed in the learners' exercise book during the lessons. All logotypes have elements related to the business and include its name. One of the eight logotypes sketched by the learners in their exercise book is shown in Figure 12 and its reproduction in MS Paint is shown in Figure 13.



Figure 12. Logotype of “Almofadinha”/“Little Cushion” Business Sketched in the Learner’s Exercise Book.

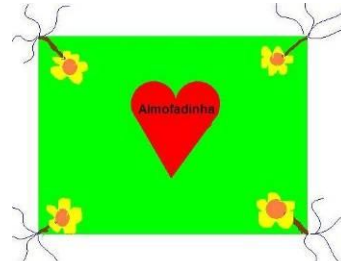


Figure 13. Logotype of “Almofadinha”/“Little Cushion” Business Reproduced in Microsoft Paint.

After the conclusion of the logos creation, the NR assistants led the children into the EEB1 world, because this revealed to be a complex task for children (we discuss this in the results section).

The aim of the fourth session was to teach children how to build their business in AWEDU. In the lesson before this session, children were encouraged to design their ideas through activities such as writing and drawing in the learners' exercise book. These drawings formed a working blueprint for the design of the business in the virtual world. In this session, the NR assistants taught children how to construct their own virtual buildings using the duplication and built-in editing tools, using lists of downloadable building objects existing in the Megapath and Building worlds of the AWEDU. Children took some notes of relevant objects regarding their work from Building and Megapath worlds, such as walls, doors, and floors to household objects such as chairs, tables, and beds from which to select and customize.

From the fifth to the ninth session, children developed their buildings for business through duplication and editing tools built from AWEDU. This task was revealed to be little complex for children. The problems detected in this task are discussed in the results section. Two of the finished business buildings done by children in the world EEB1 are shown in Figures 14 and 15.

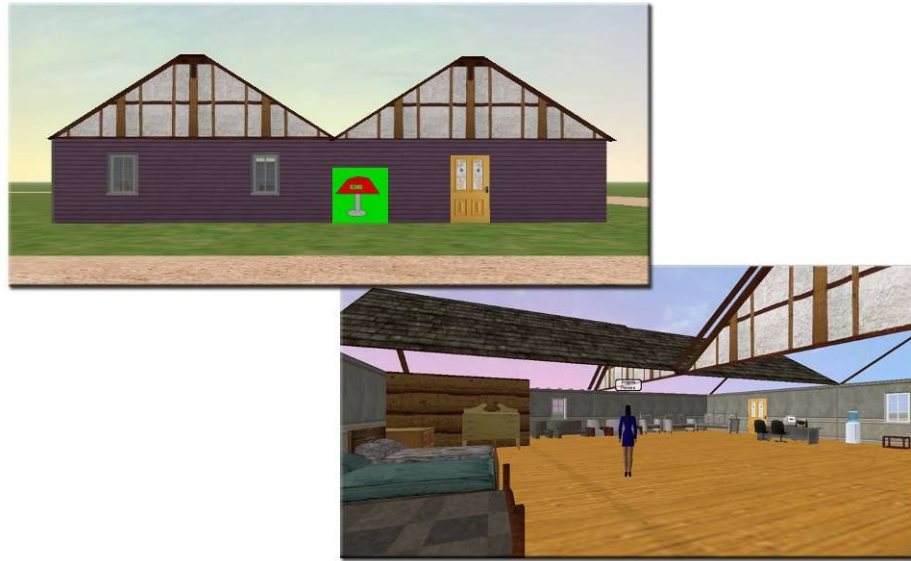


Figure 14. Inside and Outside of the Business “Decorate to Shine.”



Figure 15. Inside and Outside of the Business “Beautiful Flower.”

Since these activities were initiated near the end of the school year and considering that it is a work in progress, the children did not create real products for their businesses. Instead, we initially suggested that children search the internet for images of products that were related to their business, but this was not the proper option. In Dewey (1966) and Piaget’s perspectives (1973), defenders of constructivism learning theory, learning is a process of actively constructing knowledge from experiences in the world and people construct new knowledge with particular effectiveness when they engage in constructing personally meaningful products, which are meaningful to themselves or to others around them. Furthermore, Papert (1980) believes that learning takes place when engaged in the construction of a personally meaningful artifact, such as a piece of art work, a story, or an interactive computerized object. Thus, we consider that in future works, the children should create their own products and use those images. Moreover, it is important that the learning environment can be authentic and situated in real life.

Bearing this in mind, the teacher started with her children the physical creation of leather bags (from leather leftovers offered by several businesses operating in the region), as illustrated in Figure 16, to be sold in the last day of classes, during the school party described as “*Feirinha*” (translated as “Little market”). There, some products made by children of the various school classes were sold to raise money for the school.



Figure 16. Examples of Leather Bags Created by Children.

Thus, in addition to the business already created by the children, the teacher also decided to build a store called “*A carteirinha*” (translated at “The little bag”) in the EEB1 world to exhibit the bags created by them. Together, the researcher and the teacher created the store building in the EEB1 world to present the bags created by children, as illustrated in Figure 17.

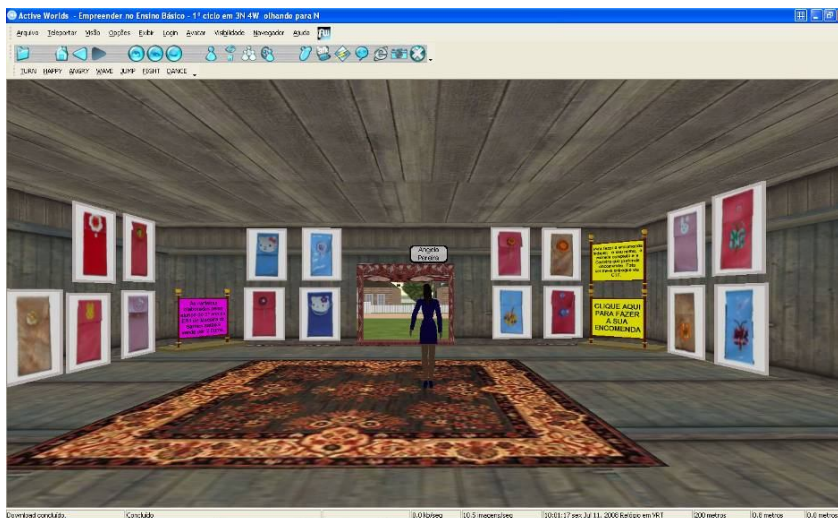


Figure 17. Inside of the “Little Bag” Store.

The last session was held on the final day of classes of the school year, and the NR assistants provided two laptop computers with AWEDU for parents, teachers, and other children from school so they could visit the eight virtual businesses and the virtual “Little Bag” store, developed by the third grade class. Figure 18 shows students from other classes visiting the EEB1 world.



Figure 18. Students from Other Classes Visiting the EEB1 World.

Children also showed their parents their businesses in the EEB1 world, as seen in Figure 19.



Figure 19. A Child Showing Her Business to Her Mother.

Children worked remarkably well together both in the classroom and at the computers, discussing ideas, negotiating the direction of the activity, and solving certain design and technical problems. They developed ways of working together, helping each other build or help less experienced users navigate and use the controls.

Results

From the field work carried out with the NR assistants, the teacher of the primary school of Macieira de Sarnes, and sixteen children, 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, in accordance with the evolution of the activities:

- 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
- Third phase – Connection with the community.

First phase – Preparation of the educational activities

Since the educational activities involve collaborative work, we needed to organize the virtual space because the class was divided in groups; for each group we wanted to assign a piece of land for them to develop their business. To solve this, we divided the world manually by changing the texture of the land to simulate roads and separate the world into several “lots.”

In some virtual worlds, land is a continuous space, as in AWEDU and Second Life; often, the logical organization is supplemented with virtual objects to visually organize the space. Other virtual worlds like Moove are not based on a continuous space, but rather divided on rooms “by design,” with each room managed separately. While this “isolated room” approach simplifies group management, it prevents a visitor from grasping the overall perspective of the several areas where the various groups are developing their activities.

Another problem that we realized would surface later, but was not initially identified in this activity because we worked with just one class, was that of management of all the information about schools, classes, teachers, groups, learners, and allocation of avatars to a group. This problem will surface if we enlarge activities to encompass multiple classes and/or schools.

Second phase – Development of the activities

One of the problems shown above was the presentation in AWEDU of text panels to present the idea and business name by children and the organization of those panels in the AWEDU space. To insert text inside the 3-D virtual world, users have to use objects for that purpose from the lists of downloadable building objects and replace the text in the field “description” of the objects properties. In fulfilling this task, the students indicated some confusion about how they could replace the text of the idea and name of business, and in some cases, learners overlapped the panels. For comparison purposes, if we were using the Second Life virtual world, to insert text panels the user must create an image in an external application and then upload that image as a texture and apply it to a surface.

The insertion of images like the logos and the products was another difficulty detected because in AWEDU, to insert an image the user has to make a series of steps that revealed to be complicated for a child. In order to present the logo of each business in the EEB1 world, the NR assistants uploaded each image to a web server and inserted in the EEB1 world an object of the type “signpost” that allows one to link its appearance to a server where an image is hosted.

While developing the buildings, children found some problems, too, including not realizing which object was selected; forgetting which key should be pressed to duplicate an object; and trying to insert objects that do not exist, due to typing errors or not including the object extension “.rwx” in the filename. This was very confusing and not practical because children had to know the exact filename of the object models. Children took some time building because they spent a lot of time searching for object files.

Third phase – Connection with the community

An activity that was not possible to develop but is very important in a subject like entrepreneurship is the interaction between the entrepreneurs (children) and the potential targets (the community at large), whether for the sale of products (targets are potential clients), or for awareness campaigns (targets are citizens in general). This interaction was not possible in the virtual world “as is” because our entrepreneurs are children 9- and 10-years-old and other virtual world users could be anyone, children or adults, with good or bad intentions. In a virtual world, children can be exposed in many ways: harmful illegal content, such as pornography and gambling; undesirable contacts, such as from adult impostors posing as children; disclosure of personal information leading to risk of physical harm or harassment; identity theft; and physical harm through real life encounters with online acquaintances, among others (ENISA, 2008).

In an entrepreneurship activity such as a business or awareness campaign, however, there must be contact with potential customers or the community at large – including adults. In the activity that was developed, the bags being sold in the “Little Bags” store were not available for sale directly in the EEB1 world: there was no ordering system, so the store was just a virtual display and purchases had to be done physically at the school.

We need to make children’s entrepreneurial activities available to society in general, but in doing, so children could be at risk. Therefore, for using virtual worlds for EE of children, not just as a “sandbox” of make-believe entrepreneurship, a solution is needed to protect our children entrepreneurs online. We discuss a possible approach in the following section.

Conclusions

Based on the problems presented in the results section, we identified a number of specific requirements to promote the learning activities and the entrepreneurial education in virtual worlds.

At the beginning of a new project with a school or class, it is necessary to prepare the virtual world space, gathering information about the schools, classes, teachers, learners, groups, and assigned avatars. We need all this information to know who is who in the virtual world and who develops what. In this specific case with the class of Macieira de Sarnes, it was not difficult to identify this because we worked with a single class of eight groups, in a single school; in the future this could be an issue, if we have in the same world several schools, several classes, teachers, learners, and groups with avatars defined or assigned by different people. It is our intention, in a following stage, to work with other schools or classes, but we need to organize all of this information in a management system. Although this is not a specific requirement of the teaching of entrepreneurship, it is important to organize the educational activity.

Another requirement is the division of the virtual world space. This is necessary because this kind of activity is based on a model of learning that organizes learning around projects (called Project-Based Learning or PBL for short). PBL involves groups of students in design, problem-solving, decision making, or investigative activities and gives students the opportunity to work relatively autonomously and culminate in realistic products or presentations which are features that fit well within the overall goals of entrepreneurship education (Jones, Rasmussen, & Moffit, 1997; and Thomas, Mergendoller, & Michaelson, 1999). Therefore, each group needs to

develop their project (creation of a business) in their own space and also organize the world to avoid the overlap of the businesses created. This requirement is not specific to entrepreneurship education but is necessary to support the educational activities.

Other management-oriented requirements of the same kind were found: backing up and restoring of classes in the virtual world and cleaning up objects from previous virtual world activities, for instance. Another challenge came through providing monitoring information to the teacher, so that he/she can more easily follow the development of the learners' efforts.

Regarding the development of the activities, as mentioned in results section, the learners had some difficulties in dealing with some tools of the virtual world and required the intervention of the NR assistants to solve some problems. Thus, we identified some requirements that must be implemented to support learners in the course of their learning activities to better orient and improve their learning.

One requirement is the presentation of business information including the business name, business idea, and others. This information will be sent automatically to the common area of the world and presented on a panel that is updated as children enter information. This will allow children to be more readily aware of one another's businesses and respond accordingly.

Another requirement is related to the necessity of uploading images into the virtual world easily. Again, this is not a specific requisite of entrepreneurship education, but it is necessary to insert relevant images for the business activity like the logo or product pictures.

As mentioned above, the children experienced some difficulties creating objects in the virtual world. Thus, we identified the improvement of the methods for creating and developing objects as essential. Some requirements to this regard are the classification of objects into categories, being able to search objects, place objects through the position (coordinates) of the avatar, preview objects, and their actual creation. These must be seen for the moment as requirements specific to Active Worlds and thus to the particular platform being used, since they are closely linked to the interface methods and features of the virtual world software. All these requisites will be incorporated in a system to assist children in the development of their businesses.

Yet another significant requirement is allowing learners to provide information in the virtual world about the products that are available for sale including quantities, price, and so forth when they finish their physical products. This requirement may at first sight seem to be associated with entrepreneurship education, but one must realize that plenty of other educational activities using virtual worlds may require similar information-posting actions. For instance, the requirement in a biology activity to display on a virtual world the level of growth of a beanstalk.

It is our opinion that the one aspect that provides a strong requirement and one that is more important in EE than in other educational activities is that EE requires a strong connection with the overall community. That requirement is the need for interaction between children entrepreneurial activities and the targets of those activities, either other children or adults. This interaction can be useful in other subjects, like mathematics, history, or biology, but in entrepreneurship, it is more than simply "useful," as its presence significantly changes the nature and content of the educational activity from make-believe entrepreneurship into real

entrepreneurship. We deem it essential, allowing learners with businesses to conduct real business activities.

We stress that this requirement is very significant for learners: in the project developed with the class at Macieira de Sarnes, the teacher stated that *“they are exploring the possibility of construction and development of the final product for sale, of the fact that they could be making what they will sell in their shop.”* As in the real world, in the virtual world visits to a business and purchase of products can be done by any person. Because customers can be anyone, we are concerned with the children’s security, but we are determined to find a solution that does not prevent the contact between entrepreneurs and targets. A possible path, we hypothesize, is the creation of a mediated environment, by automatically reproducing in an adult-accessible space the children’s businesses, thus allowing a teacher to analyze feedback from that adult space into the children’s space, before enabling it.

At a simpler level, another requirement is the overall monitoring of entrepreneurial activities so that children and teachers get information on customer sales, customer feedback, public feedback of awareness activities, and so forth in order to be able to respond. For instance, in commercial activities, an ordering and delivery system is necessary.

In Table 1, we present all these requirements. We plan to base future development of technological models and solutions upon them.

Table 1. Requirements Found in the Research Process.

Phase	Found requirements
Preparation and monitoring of the educational activities	<ul style="list-style-type: none"> • Management of information about schools, classes, learners, groups, and avatars • Division of the virtual learning space • Monitoring the learners activities
Development of the activities	<ul style="list-style-type: none"> • Presentation of business information • Inserting images (logos and products) • Supporting the creation of objects • Providing products/element information
Connection with the community	<ul style="list-style-type: none"> • Secure interaction between entrepreneurs and targets • Monitoring entrepreneurial activities

Final Thoughts and Future Work

The identification of the presented requirements supports researchers in the development of technological and educational models as well as solutions for the development of entrepreneurship education activities with primary school children.

We believe that most of these requirements are useful not just for entrepreneurship education but also for other educational activities that involve children actively creating and developing projects in virtual worlds.

Entrepreneurship education brings to front the need to find a solution that allows virtual world interaction between children and the community at large. We hypothesize that this may be possible through a mediated system which replicates information between a virtual spaces accessible only to children and authenticated adults and a public virtual space, with teachers or other education professionals mediating the replication.

From a wider perspective, such a solution, while critical for EE but not for other subject matters, may end up expanding the richness of virtual world educational activities in general. In the real world, children are not imprisoned inside schools: they live within the world of adults, accompanied by their parents, and their educators. We believe that the research and education communities should strive to achieve such a balance between children and adults in the use of virtual worlds for education.

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