

# Using Augmented Reality to Enhance Education in Science and Engineering

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**Abstract**— Universities and polytechnics aim to be updated regarding industry needs, specially engineering related. One way is to link students to problem-based learning in a reality context and the trips first comes to mind. However, few details don't allow to have more frequent activities in industry, namely:

- the activity takes time and the available time is scarce;
- the deal of scheduling;
- the noise of the industry running;
- the inadequacy of taking to a group of students during industry operation;
- the costs and logistics to travel.

Making use of virtual realities, it is possible to map the industry and have a virtual visit when and where it suits best. Also, the absence of noise, the possibility to define the pace, the comfort of the own place and the possibility to have books and other material provides extra support.

The present paper reflects on the importance of augmented reality on academic visits to engage students, increase their outcomes and push further the basics. Also, the paper reflects on the possibility of extra information about the company / factory / manufacturing processes in virtual reality in the classroom that will allow students to better understand and exercise on a real plant.

This article presents the challenges and perspectives of the project involving the use of the environment Augmented reality as complementary resource for the education of Engineering in Universities. In this new context the students allow themselves to live deeply experimentation situations that would not be possible with the resources of traditional classroom. The use of this environment of three-dimensional simulation in the University scope demands a new position on the part of the professor, as well as the organization of a multidisciplinary team for modeling and supporting the activities carried through in the Augmented reality. The first question are related to the knowledge construction, identification of the necessary abilities to the responsible professor for the activities and by considering itself the Augmented reality as a possible platform to support Education activities by distance. This paper presents some reflections concerning the teach-learning process face to the new context related to the Internet and its resources.

The main contribution of the present paper is the definition of the strategy to a sustainable, true active and long term duration project.

Adding the explanations along the virtual visit and allow possibility to students write questions, more advantages emerge.

**Keywords**— Augmented reality, Virtual classroom, dynamic learning, STEM, e-Learning Courses, Implementation Strategy,

Knowledge Exchange, Augmented reality, Distance learning, Information and Communication Technologies.

## I. INTRODUCTION

The challenges to work on a knowledge based global market is a driven for take advantage of the rapid development of Information and Communication Technologies (ICT) on internet-based collaboration. In Portugal, the distance learning started in the 80s with the program «Tele-escola», where students attended lectures at home through the television, interact with teachers by phone and made exams three times a year in the nearest school. This distance learning was more passive than pro-active. Since those times, several programs tried to implement a better interaction between all parts, but there was still the problem of resources in schools and at home, limited by governmental financing and by family's availability. A program aimed the university students is still working since those times, called «Universidade Aberta». The incentive to development and get higher education in Portugal were made last year with the support to acquire personal computers and internet connection for all needed families (Project Magalhães). Nowadays, the proposed project is easier and more suitable for all parts.

In this context of cyberspace and cyberculture (The culture in the contemporary form marked for the Digital Technologies and associate to the Internet), many questions emerge to be analyzed for the professors and researchers in Education, making the construction and reconstruction of knowledge, from the exchange of experiences inside of this digital space, where the students will be being party to suit of learning. Amongst the different possibilities (use of Weblogs, video streaming, video demand, interactive digital TV and others), the professor will have to guide the study of its students, stimulating the research, the creation and the exchange of knowledge in this virtual world. The environment of the augmented reality allows the development of simulations that would be impossible in the real life, to participate of bigger and more complex projects, with other residents of the environment and even to add interactivity knowledge and behavior to objects created. Abilities and knowledge acquired and can perfectly be applied in virtual world with the situations of the real life. the augmented reality is linked to the reality: the difference between the Real Life and the Virtual Life will be the amount of control that we will have on our existence. At least, it is an environment that can open new ways to explore the construction /reconstruction of

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knowledge. The challenge is to understand and to identify the best form to use it.

TABLE I: SHOWS THE VALUES OF PROJECT AND THEIR RELEVANCE.

TABLE I: PROJECT VALUES

Value	Description	Relevance
Focus on students	Continuouaugmented reality approach to the students needs, expertise and interests	The students are the main focus: they are the input and the output of the project
Flexibility	Know the government aims and supports and quick adapt to it	Efficiency and effectiveness can only be reached with strength global implementation
Dedication	Really know the importance of better education	Education is a path to self esteem, finance improvement, stability, competitiveness, among others
Education of Excellency	Aim the best level of recognition and reputation	Treat this as the dogma, believing that there are sacrosanct and non-negotiation issues

The education politics have been a national Portuguese priority in recent years, given its strategically interest in the world-wide context. It matters to rethink the strategy of qualification, of mobility and certification of the pupils, of the human resources in a optics of continuous formation throughout the life, of a formation with a bigger degree of innovation, severity and requirement, a time that the technological mutations and the rapidity with that if they succeed, imply that the qualification of the people is today the main critical factor of success for the competitiveness and the development sustainable and supported of any region and/or country. It increases, still, that in a world each more complex, changeable and uncertain time, where all the economies compete between itself of a globalized form, the areas of the knowledge, in general, and of the educational formation, in particular, is crucial and decisive factors for the affirmation of the economies and developed regions. In this way, the increase of the severity and the requirement will lead unequivocally to a bigger efficiency of the educative processes and to a bigger effectiveness of the formation.

The mission of the project is to promote the formation of pupils of high schools education, narrowing relations between these and the Universities and developing activities of Research and Development (R&D) essential for one better adaptation in the transition for the academic life. The vision of the project is to have been the pioneer, to be a reference in

engineering the University level in the country and to affirm itself in Portugal and in the foreigner countries.

## II. CASE STUDY

The Augmented reality is a online digital reality in 3D where one could be what he wants, can make what he desires, be able to never live deeply imagined experiences and can changed themselves into what always had dream, changing the form as we communicate and live. Also, in the augmented reality it is possible to assimilate new paradigms and to share these new experiences with others avatars. It is in constant update and growth, due to hundreds of new residents that each day enters and creates their Avatars (a computer user's representation of himself/herself or alter ego. It is an "object" representing the embodiment of the user) being able to explore the world and to know people. It is a world imagined, created and kept by its residents. The main goal of the environment is to stimulate each person to find a way to survive, learn and develop trades that will reflect in its purchasing power. The user will be able to create objects, to construct property, to develop accessories and others, through links to insert objects inside the Augmented reality, such as banners, building walls, figures, 3D objects, posters and so on. In the same way, it is possible to add a Augmented realityur (an Internet address that transports the avatar inside an indicated virtual place). This possibility to create links between the Internet and the game Augmented reality and these new tools of cooperation and coordination in real time, allows to a leverage of sensitivity, perception, thought, imagination, for instance. The interaction possibilities of this new modality of human activity and with this new technology are the engine for the university to explore not far beyond the game Augmented reality.

## III. IMPLEMENTATION

To implement this project, it exists the necessity of establishing a team of interdisciplinary knowledge and competences to lead the project. The necessity of investment in the hardware is low and investment in the software for construction is free but time consuming. The prerequisite for use of this project proposal do not imply that professor must have knowledge of computer science to be the producer of activities in the SL but to be the pedagogical designer of the activity. The activities in the project potentialities offered in the SL brings the next challenge that is to give continuity in the use of the tool in an ampler and complete situation of classroom, where the students will be able to live deeply the practical situations, allowing a ampler analysis concerning possibilities of the environment. The biggest challenges to the organization that validate the proposal will be: the organization of the team, acquisition of knowledge on functioning of the SL and understand that type of activities to extend the work carried through in the actual classroom. The team to interdisciplinary account with professionals of the area of the Education, Pedagogy, specialist in SL, deriving programmers of the part of Systems of Information and

professors of engineer. This complementary conjunction of abilities work will be decisive to reach the objective. Several profiles must be considered for elaboration of educational applications since the challenges are of technological and pedagogical order.

Many aspects related to the use of environment Augmented reality as additional resource to the process of teach-learning of contents, specifically in those subjects of more traditional form of presentation can be incorporated. In this environment appears some perspectives and ideas that can assist in the construction of knowledge in the scope of the education of engineering. The organization of the activities, the process of formation of the professor for use of Augmented reality, the consolidation and integration of the team will consume most of the destined time to the project. In the implementation and exploitation, some experiments can be carried through to test questions related to the accessibility, usability, relevance of the activities proposals and adequacy of the work. The major improvement is the possibility to build activities to be constructed in the augmented reality to allow the experimentation of situations that would not be possible in the classroom traditional, such as: machine overrunning, faults simulation and long term fatigue.

#### IV. CONCLUSIONS

There is a great opportunity to implement an e-learning project in Portugal in several areas. The Universities have the potential to begin a real knowledge global market with the internet-based technologies.

The project proposed is a driven and a motivation for future projects within the communities.

The limitations and drawbacks are only in the financing, but since this project is aligning with the Government strategy there is strength to avoid that.

The applications are not only for high schools and Universities but also for ECTS lectures and professional formation, for instance.

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