International Journal on New Trends in Education and Their Implications
January 2014 Volume: 5 Issue: 1 Article: 12 ISSN 1309-6249

AUGMENTED REALITY APPLIED TO NATURAL SCIENCES

Prof. Bárbara Maria Lemos FERREIRA
Instituto Federal Fluminense
BRAZIL

Prof. Thaís Nogueira FERNANDES
Instituto Federal Fluminense
BRAZIL

Prof. Dr. Suzana da Hora MACEDO
Instituto Federal Fluminense
BRAZIL

ABSTRACT

This research presents Augmented Reality applied to Natural Sciences, specifically wind energy. A Learning Object showing the generation of wind energy was used in an experiment with high school students. In this Learning Object, the student can see the energy generation in an Augmented Reality environment. In the environment created in Augmented Reality there is the simultaneous presence of real and virtual objects. In this environment, the students could interact with the Learning Object. This work was based on the theory of Meaningful Learning, which, according to Ausubel, occurs when a concept is related in a substantive way and not arbitrary concepts with pre-existing in the cognitive structure of the individual. Reviews and evaluations were done to complete the work, highlighting its advantages in the learning process.

Key Words: Augmented Reality, Meaningful Learning, Natural Sciences.

INTRODUCTION

Several studies have shown the importance of content integration in the school environment. The unification of related content leads to an increase of interest in addition to lead students to a greater understanding of the content covered.

In different segments of education, broad themes such as the environment can be identified in the curriculum of various disciplines, being, however, more common in areas of Natural Sciences and Geography.

Thus, when it is about environment, interdisciplinarity emerges as an appropriate pedagogical propose (Fazenda, 2011), but lacks practical measures that can articulate the actions of teachers and students.

This paper aims to present results regarding the use of a Learning Object constructed on an Augmented Reality environment. In this experiment, it was observed that, through a common point of view, knowledge can be increased leading to production of a new collective knowledge with a critical understanding of the whole, with a transforming perspective (Barbosa, 2011).

It is a work facing educators from disciplines in question, which are mainly in search of new strategies for teaching and learning, making use of a methodology that will arouse the interest of students in the light of the theory of Meaningful Learning. Aims to:

Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org

- Present the software Windows Movie Maker as a resource to facilitate in the learning process of the Natural Sciences and Geography;
- Exposing the methodology used as a proposal to raise the interest of high school students in science and geography;
- Demonstrate the ability to go beyond the traditional boundaries of the classroom from technological resources.

  Thus, during the implementation of the project, we sought a real integration of disciplines, enabling the subject to be addressed in a unified way. Thus, teachers of disciplines involved alternated their placements with the purpose of bringing students to an understanding on wind energy.

WIND POWER

The conversion of kinetic energy of wind into mechanical energy has been used by mankind for over 3000 years, and the great development of the application of wind energy in Denmark began in 1980 when the first turbines were manufactured by small companies of agricultural equipment. From the 1990s the wind energy industry grew worldwide (Martins *et al*., 2008). And, according to Santos (2006) the installation of the first wind power plant in Brazil, Ceará happened in 1999 (the wind power plant of Taiba).

The energy issue is one of the most important topics of our time and the quality of life of society is closely linked to their energy consumption, and where the growth of world energy demand due to the improvement of living standards in developing countries brings concern with aspects essential for energy policy and planning of all emerging economies. Among these aspects we have the amount of energy needed for social and economic development of a country and the environmental costs to meet this increase in energy consumption (Martins et al, 2008). According to Ortiz and Kampel (2011) since the early twentieth century, some scientists have suggested the power supply, to society, from renewable sources.

To Inatomi and Udaeta (2005) concern with the sustainability issue, widely discussed in academic circles, aiming the inclusion of new sources of energy that are renewable and impact the environment as little as possible, comes to the need for global that future generations are able to survive.

AUGMENTED REALITY (AR)

Augmented Reality is a type of unconventional interface that allows users to mix images of a real environment, obtained by video camera or other processes with virtual three-dimensional objects, enriching the user's view. In this environment, the user has the feeling that the real and virtual objects coexist in space, to the extent that the virtual objects are amenable to visualization and interaction as they exist in the real world (Akagui, Kirner, 2004).

In AR there is an emphasis on visualization together with the interaction. With the use of glasses or helmet virtual reality (VR), one can visualize virtual objects mixed with the real world, in a highly realistic, increasing the perception of the user in the use the computer interface. Still, when the RA interface uses hands as interaction elements, allows the overlay virtual objects in the real world, it enables the manipulation of these objects with their hands, making feasible the development of numerous applications that benefit human training, motivating more to the user tasks to be accomplished (Utiyama, Kirner, 2004) (Figure 1).

Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org

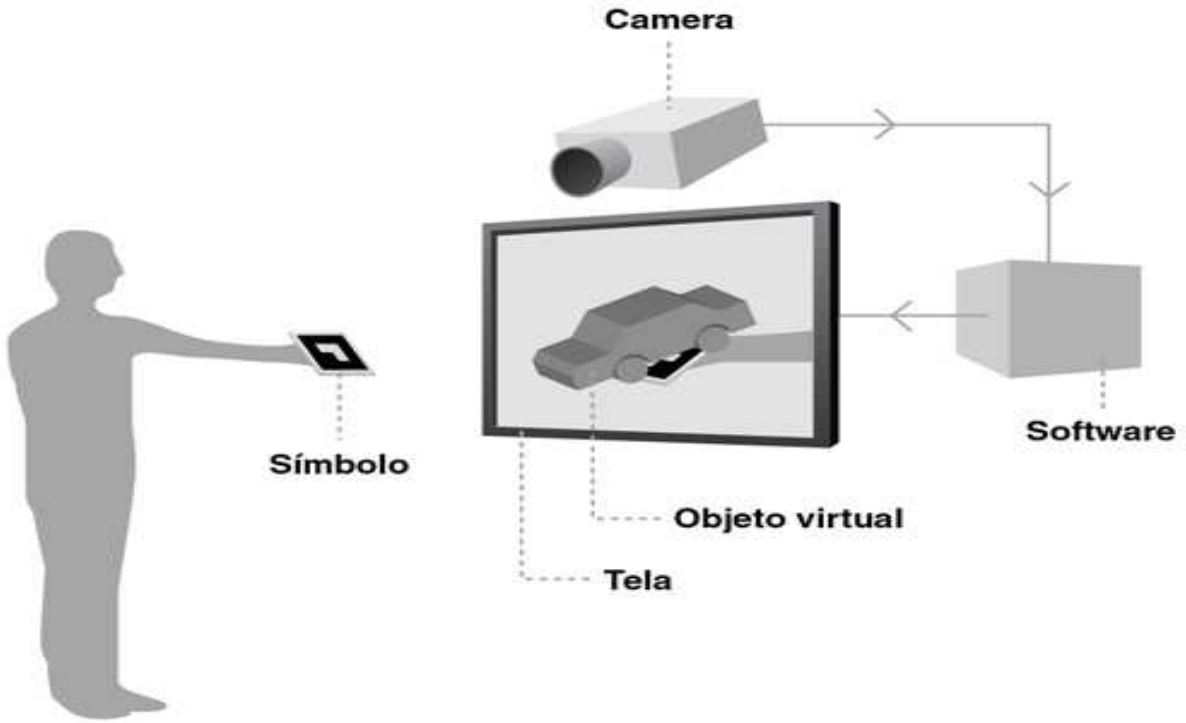


Figure 1: Functioning of Augmented Reality (http://www.agenciadda.com.br/realidade-aumentada-ra)

In building an environment of RA, it is necessary the use of sensory devices that allow the user to make the integration of virtual objects in the real environment. So, the technological breakthrough of peripherals for Virtual Reality (RV) contributes greatly to the development of Augmented Reality and basically uses the same devices, such as helmets or Head Mounted Display (HMD) optical or videos, stereoscopic or stereo glasses and monitors (visual devices); headphones and external microphones (hearing aids).

Besides allowing virtual objects to be placed in real environments, Augmented Reality also provides the user to manage those objects with their own hands without the need for special equipment, ensuring then a process of interaction with the natural environment mentioned (Zorzal et al., 2006), allowing him an attractive interaction with the environment and motivating.

WINDOWS MOVIE MAKER

Windows Movie Maker (WMM), is a simple tool to edit videos created in 2004 and is constantly updating. In Figure 2 we can see the home screen of Windows Movie Maker.

Among its capabilities, the program allows the user to import files (images, video segments, audio, photos) on your computer or through Webcam. Also, allows ordering scenes, create titles, captions, transitions and special effects to the recording of the final work in different formats. Given the functionality of this feature, its implementation is given in order to provide dynamism to the process of teaching and learning, overcoming some limitations of the classroom, making the student, the builder of his own knowledge.

Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org

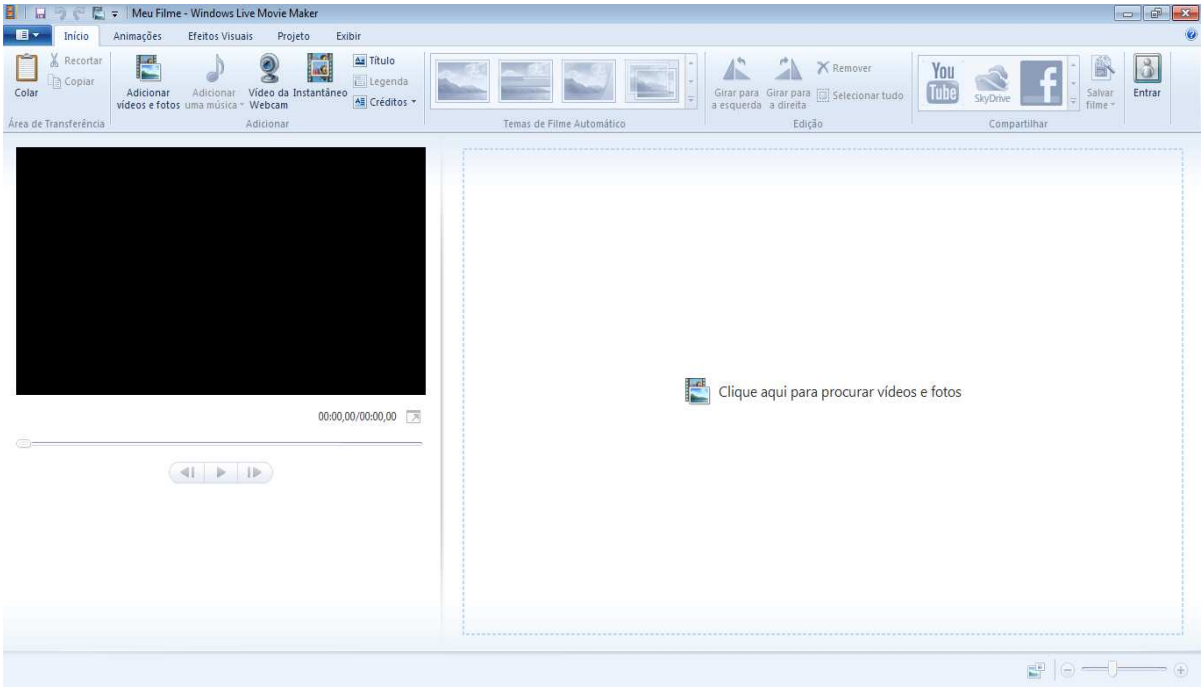


Figure 2: Windows Movie Maker's home screen

CONSTRUCTIVISM

Constructivism gives a higher value to the storage of information by students, emphasizes the act of knowing, it is concerned with how the individual constructs his cognitive structure, where the goal of learning is the construction of meaning by the student to he gives his own things, without requiring the memorization of "right" answers with the intention of replicating the direction of another person. So, to Moreira (1999) the human being has the creative ability to interpret the world, not only to respond to it.

Objectively, the cognitivist philosophy studies mostly mental processes, aiming the assignment of meaning, understanding, processing, storage and use of the information involved in cognition. Thus, the student is no longer seen as a mere receiver of information, no matter how it stores and organizes your mind, and is regarded agent of a building that is their cognitive structure, where he also will be able to new mental models to include and organize new experiences.

The challenge of any project that involves technological innovations in education is that they do not become ephemeral, without the possibility to change the routine involved in the learning process. Thus, constructivism appears to guide the development of computerized learning materials, especially of multimedia learning environments. Rezende (2002) says that constructivist epistemology relates fundamentally to the idea of construction, which planning of computerized instructional materials can be translated in creating learning environments that allow and give support to the construction of something or the active involvement of the student in conducting a task, which can be individual or group, and the context of this task (Rezende, 2002). And according to Carvalho et al. (2011) at the Freire's concept, curiosity is an ontological necessity and characterizes human existence in its process of creation and recreation. This curiosity, that principle can be naive by being associated with the common sense, becomes critical to be exercised, and, as soon as approaches with methodical rigor to the knowable object, becomes epistemological. Cruz-Cunha et al. (2010) think that technology has been continually changing in profound ways how people learn and live. Even as the Internet, many other tools of information technology can be useful in learning contexts and certainly there are

Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org

issues that are best suited to their use. [...] Some technologies bring advantages to institutions, since they can benefit from its use in teaching, both on campus and to reach new audiences, such as the fact that they can be seen as a mechanism for computer-assisted learning which can provide simulations, support visualization and interactive tools (Cruz-Cunha, 2010).

METHOD

The work was developed by students from the 8th grade of elementary school II from Alpha College in Campos dos Goytacazes, Rio de Janeiro state, Brazil. The production period of work, has been two weeks since the proposal was submitted on 12 August and the presentation to the whole school happened between 26 to 30 August 2013.

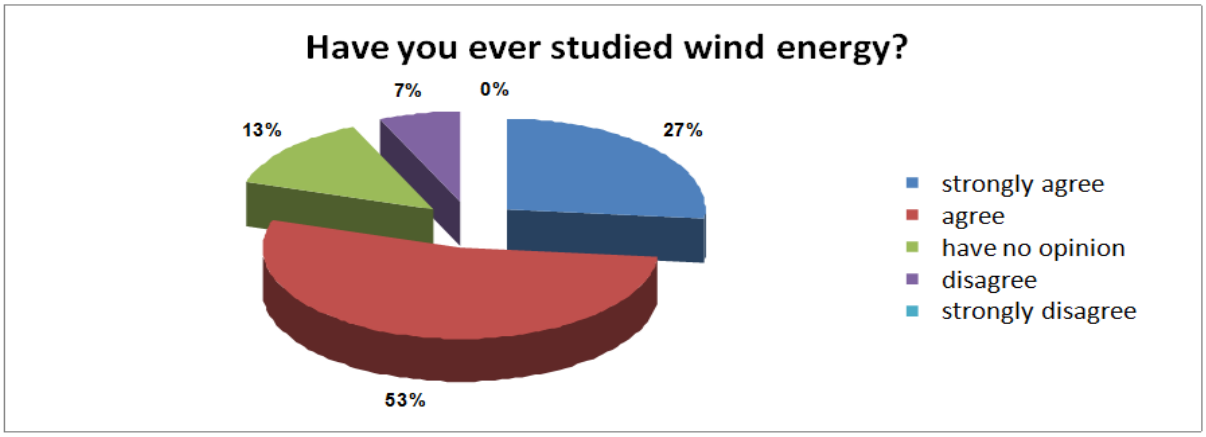
The proposal offered to students aimed to propose a discussion about the importance of wind energy, especially in the city of Campos dos Goytacazes, because it is home of the students, highlighting their benefits, costs, operating turbines, pros and cons for the production energy through this renewable source.

The experiment was done with 16 students, and these were divided into 4 groups of individuals, with the task of creating a video using Windons Movie Maker lasting between 2 and 3 minutes each. The genre of the videos could have been chosen by students, not just the documentary genre is required. However, the students had to respect the age rating of 10 years to avoid inappropriate images to school environment. In the video, still was required an explanation of the operation of a wind turbine at Augmented Reality environment. Taking into account the objectives and the questions asked, the research is a case study of a qualitative nature.

FINDINGS AND DISCUSSION

According to Almeida (2011), in an increasingly globalized world, using new technologies in the pedagogical project is a way of approaching the generation who are in school. She also emphasized that "technology is not a garnish and the teacher needs to understand in which situations it effectively helps to student learning". Of the 16 students who participated in this research, one chose not to respond to questionnaires proposed, despite having effectively participated in the making of the video using Windows Movie Maker and Augmented Reality. Thus, students answered questionnaires qualitative, where responses are at the following charts.

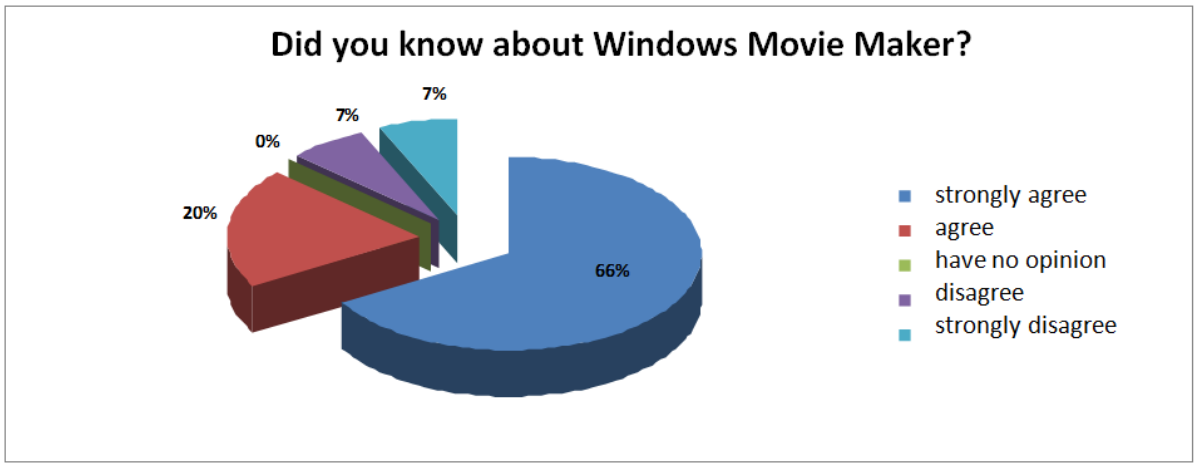
The students were asked if they had done any study on Wind Energy and the result was that eigth of them had studied, because the option marked "agree" (53 %). Four students marked the option "strongly agree" (27 %), which leads us to believe that they best remember learning. Two students marked the option " have no opinion" (13 %), which makes us think that there is no remembrance of this learning, and one marked the option “disagree” (7 %), which means they had no contact with this earlier (Graphic 1).



Graphic 1: udents who studied wind energy

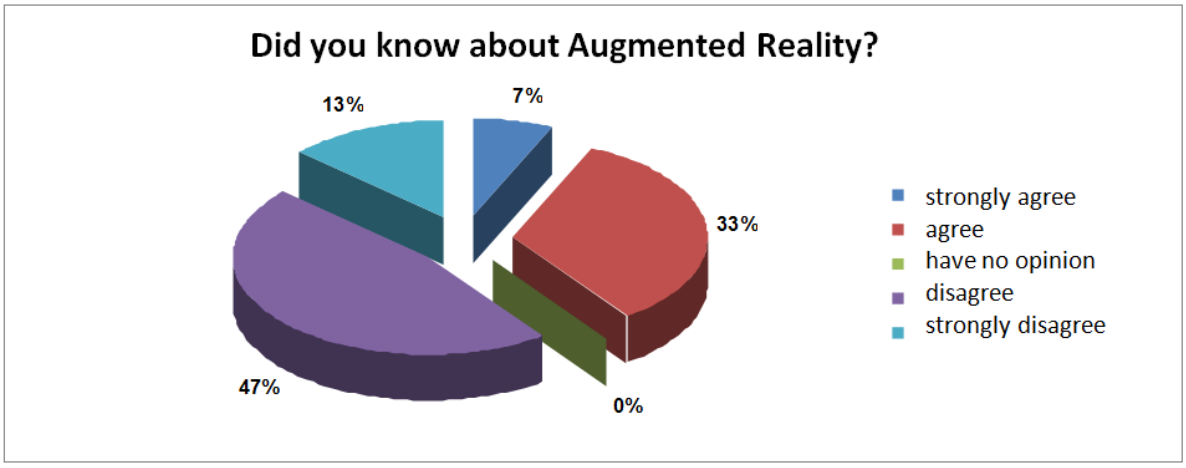
Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org

Still, considering constructivism, students were asked if they were familiar with the interface Augmented Reality (AR), and 9 students did not know, because the options marked "disagree" (7%) and "strongly disagree" (2%) while 6 knew, perceived by dialing options "agree" (5%) and "strongly agree" (1%) (Graphic 3).
Since constructivism pedagogy was employed in this work, was asked if they already knew the Windons Movie Maker (WMM), and the responses were tabulated and organized in Graphic 2, where it is seen that 13 students already knew, because options marked "strongly agree" (66%) and “agree” (20%), and only two did not know, that realized the options "disagree" (7%) and "strongly disagree" (7%).



Graphic 2: udents who knew about Windows Movie Maker

Still, considering constructivism, students were asked if they were familiar with the interface Augmented Reality (AR), and 9 students did not know, because the options marked "disagree" (7%) and "strongly disagree" (2%) while 6 knew, perceived by dialing options "agree" (5%) and "strongly agree" (1%) (Graphic 3).



Graphic 3: Students who knew about Augmented Reality

Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org

CONCLUSION

The methodology and strategies used in the development of this project show that the use of technological materials always arouses great enthusiasm in our young people. But the fact of the use of the video camera, the operation of turbines for wind energy production through Augmented Reality interface, is shown as a novelty well accepted by the students, and constituted as a motivational factor in increasing order.

Still, it is possible to observe that the technological resources are already part of learning moments and increases the interests of the students, given that his world includes technology.

IJONTE's Note: This article was presented at World Conference on Educational and Instructional Studies – WCEIS 07- 09 November, 2013, Antalya-Turkey and was selected for publication for Volume 5 Number 1 of IJONTE 2014 by IJONTE Scientific Committee.

BIODATA AND CONTACT ADDRESSES OF THE AUTHORS

Barbara Maria L. FERREIRA is a teacher at Colégio e PréVestibular Alpha and Conselheiro Josino Municipal School, Brazil. In 2010, Ferreira was graduated in Natural Sciences - Specialization in Biology at Instituto Federal Fluminense de Campos. She is finishing her specialization in Teaching in the XXI century, at Instituto Federal Fluminense de Campos. Her research interest is the pedagogical use of Augmented Reality (AR) and digital technologies applied to Science and Biology.

Barbara Maria L. FERREIRA
Rua Dr. Smith, 273,
Parque Dom Bosco - 28030-130.
Campos dos Goytacazes, Rio de Janeiro, BRAZIL
E. Mail: babimlf@gmail.com

Thaís Nogueira FERNANDES is Geography teacher at private and municipal schools in Campos dos Goytacazes, Brazil. She is finishing her specialization in Teaching in the XXI century, at Instituto Federal Fluminense de Campos. Her research interest is the pedagogical use of digital technologies.

Thaís Nogueira FERNANDES
Rua Dr. Siqueira, 273
Parque Dom Bosco – 28030-130
Campos dos Goytacazes, RJ, BRAZIL
E. Mail: thais.nogfernandes@gmail.com

Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org

Suzana da Hora MACEDO is professor at Instituto Federal Fluminense, Brazil, since 1987. In 1986, Macedo has graduated in Electrical Engineering, at the Universidade Santa Úrsula. She received her Master's Degree in Tecnology, with focus on Electrical Engineering, in 1998, at Centro Federal de Educação Tecnológica Celso Sukov da Fonseca (CEFET/Rio), Rio de Janeiro. She received her Ph.D. in Information Technology on Education from the Universidade Federal do Rio Grande do Sul (UFRGS), Brazil, in 2011. Her research interest is Augmented Reality and Digital Technologies applied to Education.

Prof. Dr. Suzana da Hora MACEDO
Rua Rodrigues Peixoto, 30
Parque Tamandaré – 28035-060
Campos dos Goytacazes, RJ, BRAZIL
E. Mail: shmacedo@iff.edu.br

REFERENCES

Akagui, D. & Kirner, C. (2004). *Desenvolvimento de Aplicações de Realidade Aumentada com ARTollKit*. In: http://www.lbd.dcc.ufmg.br/colecoes/wra/2004/002.pdf.

Almeida, M. E. B. (2011). *A tecnologia precisa estar presente na sala de aula*. In: http://educarparacrescer.abril.com.br/gestao-escolar/tecnologia-na-escola-618016.shtml.

Barbosa, Derly. (2011). *A competência do educador popular e a interdisciplinaridade do conhecimento*. In: Fazenda, I. C. A. (Org.) Práticas interdisciplinares na escola. São Paulo: Cortez, 2011. p.65-78.

Carvalho, J. D. S.; Ramacciotti, A. & Rocha, J. C. D. (2012). *O diálogo na Educação online inspirada na pedagogia freiriana*: algumas aproximações. In: http://revistas.pucsp.br/index.php/curriculum/article/download/6869/9673.

Cruz-Cunha, M.. M.; Reis, M. G. A. D.; Peres, E.; Varajão, João; Bessa, M.; Magalhães, L.; Barbosa, L.; Barreira, J. (2010). Realidade Aumentada e Ubiquidade na Educação. *IEEE-RITA*, v. 5, n. 4, In: http://rita.det.uvigo.es/201011/uploads/IEE-RITA.2010.V5.N4.A8.pdf.

Fazenda, I. (2011).Práticas interdisciplinares na escola. São Paulo: Cortez.

Inatomi, T. A. H. & Udaeta M. E. M. (2005). "Análise dos impactos ambientais na produção de energia dentro do planejamento integrado de recursos." *Brasil Japão3*. Trabalhos2005. Coordenadoria de Relações Institucionais e Internacionais. UNICAMP – Universidade Estadual de Campinas. Disponível em http://www.espacosustentavel.com/pdf/INATOMI_TAHI_IMPACTOS_AMBIENTAIS.pdf

Martins, F. R.; Garnieri, R. A. & Pereira, E. B. O aproveitamento de energia eólica. *Revista Brasileira de Ensino de Física.* V. 30. n. 1. 1304 (2008). In: http://www.sbfisica.org.br/rbef/pdf/301304.pdf

Moreira, M., A. (1999.)*Teorias de aprendizagem*. São Paulo: EPU.

Ortiz, Gustavo P. & Kampel, M. (2011) Potencial de energia eólica offshore na margem do Brasil. *V Simpósio Brasileiro de Oceonografia*. Oceanografia e Políticas Públicas. Santos, SP, Brasil. In: http://mtc-m19.sid.inpe.br/col/sid.inpe.br/mtc-m19/2011/07.06.17.10/doc/Ortiz_Potencial.pdf

Rezende, F. (2008) As novas tecnologias na prática pedagógica sob a perspectiva construtivista. Ensaio pesquisa em Educação em Ciências [on-line], v. 2, n. 1, In: http://www.portal.fae.ufmg.br/seer/index.php/ensaio/article/viewArticle/13

Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org

Santos, A. (2006). Projeto de geração de energia eólica. Projeto de Conclusão do Curso de Engenharia Mecânica. Universidade de Santa Cecília. Santos, SP, In:
http://cursos.unisanta.br/mecanica/polari/energiaeolica-tcc.pdf

Utiyama, F. & Kirner, C. (2004). Rastreamento de Trajetórias para treinamento com Realidade Aumentada. Disponível em: http://www.lbd.dcc.ufmg.br/colecoes/wra/2004/003.pdf

Zorzal, E. R.; Buccioli, A. A. B. & Kirner, C. (2006) "Usando Realidade Aumentada no Desenvolvimento de Quebra-cabeças Educacionais". In: http://www.lbd.dcc.ufmg.br/colecoes/svr/2006/019.pdf

Copyright © International Journal on New Trends in Education and Their Implications / www.ijonte.org