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TEACHING THE MAGNETIC FIELD OF A BAR-SHAPED MAGNET USING AUGMENTED REALITY

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ABSTRACT

It is proposed in this paper the use of an Augmented Reality environment developed to support the teaching of the magnetic field of a bar-shaped magnet. It was created a prototype with software based on Augmented Reality that has been tested with students of engineering. In this environment the student can see in 3D and interact with the magnetic field of a bar-shaped magnet. In a screen of Augmented Reality there is the simultaneous presence of real and virtual objects. In this work the magnetic fields are displayed, in the virtual world, which will be around a magnet, in the real world. From the results, analysis and evaluations were done to complete the work.

Key Words: Augmented Reality, Magnetic field, Teaching.

INTRODUCTION

With the advent of computer, new learning spaces begin to be planned and built, no longer restricted to the perimeter where there is a closed and traditional relationship between teachers and students. From the indications of the National Curriculum to High school in the area of Information Technology (Brazil, 1999), some schools already have the integration of information technology in their daily lives, beginning the shift to value learning activities for virtual experiments and experiences in places, spaces and times where and when things happen, as a way to enrich teaching. In other words, they show their concern by offering a better quality teaching, encouraging the involvement of teachers and students to build individual and colective knowledge (Kenski, 2003). The computer allows the creation of new forms of learning and communication, providing the student to know the world more critically.

In this context, the computer can be expected to contribute positively to the acceleration of cognitive and intellectual development of the student, especially as this relates to the development and formal logical reasoning, the ability to think with rigor and systematicity, the ability to invent or find solutions to problems (Costa, 1998). You can also enable the student to develop their ability to learn to learn, stimulating autonomy - which is based on learning by doing - experimenting and creating. This is now a priority of the school, using this new technology, this process can become richer and more enjoyable (Coll, 2000).

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According to Lemos and Carvalho (2010), educational software can be the interface between teachers and students as an auxiliary tool to improve the processes of teaching and learning content or educational issue. For this process to happen in our study, Augmented Reality was used to support the teaching of the magnetic field of a bar-shaped magnet.

Milgran and Kishino (1994) argue that Augmented Reality is the combination of real and virtual objects. In the study of the magnetic field of a magnet bar shaped the actual object used was the magnet and the virtual object is its magnetic field. Supported by Augmented Reality the student can see in three dimensions the magnetic field of a bar-shaped magnet. This phenomenon can not be seen with the naked eye because the magnetic fields are not visible to the human eye. For teaching purposes, teachers use spray iron filings around a magnet, as shown in Figure 1. A magnet is placed on a flat surface and gently pulverized iron powder thinly thereby forming a figure would be a representation of the magnetic field. However, even if using real elements, this representation is two-dimensional, bringing great difficulties to students in the sense that they have to imagine a three-dimensional (3D) magnetic field from a two-dimensional figure (2D).

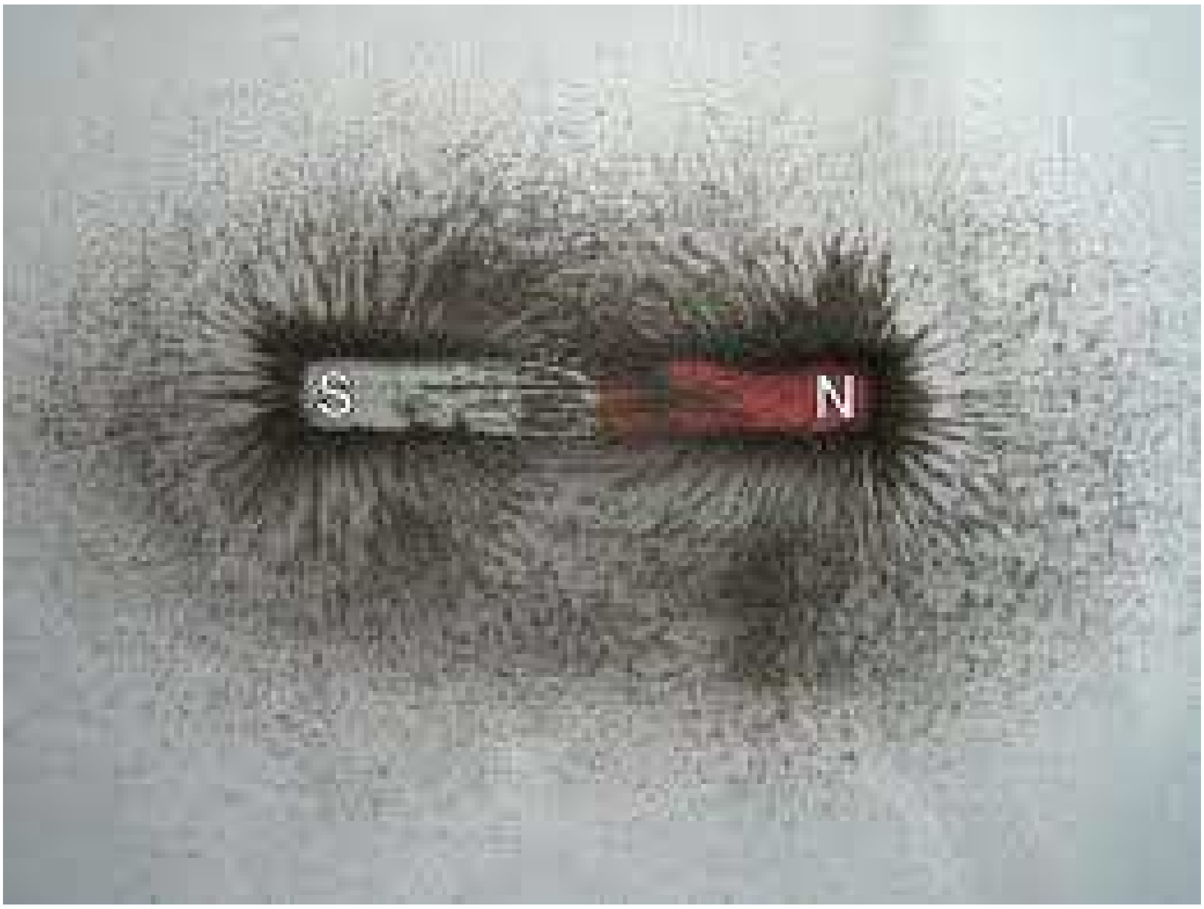

Figure 1: Magnetic field of a bar-shaped magnet (http://fuches.wordpress.com/)

However, as stated by Buchau, Rucker, Wössner and Becker (2009), the real-life problems are in 3D. Augmented Reality can help in this aspect, because with this technology it is possible to show these magnetic fields in 3D, and d and according Buchau et al., the magnetic invisible fields can be shown in an Augmented Reality environment.

According Kaufmann et al*.,* the main advantage of using Augmented Reality is that students actually can see three dimensional objects (2005). Thus, the magnetic field of a bar-shaped magnet was demonstrated in the virtual world interacting with the real world. According to Buchau et al., Augmented Reality helps students to understand the electromagnetic field's theory. In this work, the Augmented Reality enables the three-dimensional visualization and interaction with the magnetic field under study, providing the student to view objects in the virtual world that cannot be seen in the real world. This environment in Augmented Reality will act as Learning Object.

SOME PROPOSALS USING OF AUGMENTED REALITY IN EDUCATION

Although relatively new, this technology is already being used successfully in several areas. Some of the proposed use of Augmented Reality in Education will be addressed at this section.

Buchau et al. (2009) created three applications based on Augmented Reality for use in magnetic field of a magnet, the magnetic field of a solenoid and a magnetic field of an antenna. In figure 2, the magnetic field of a magnet can be seen, result of their work.

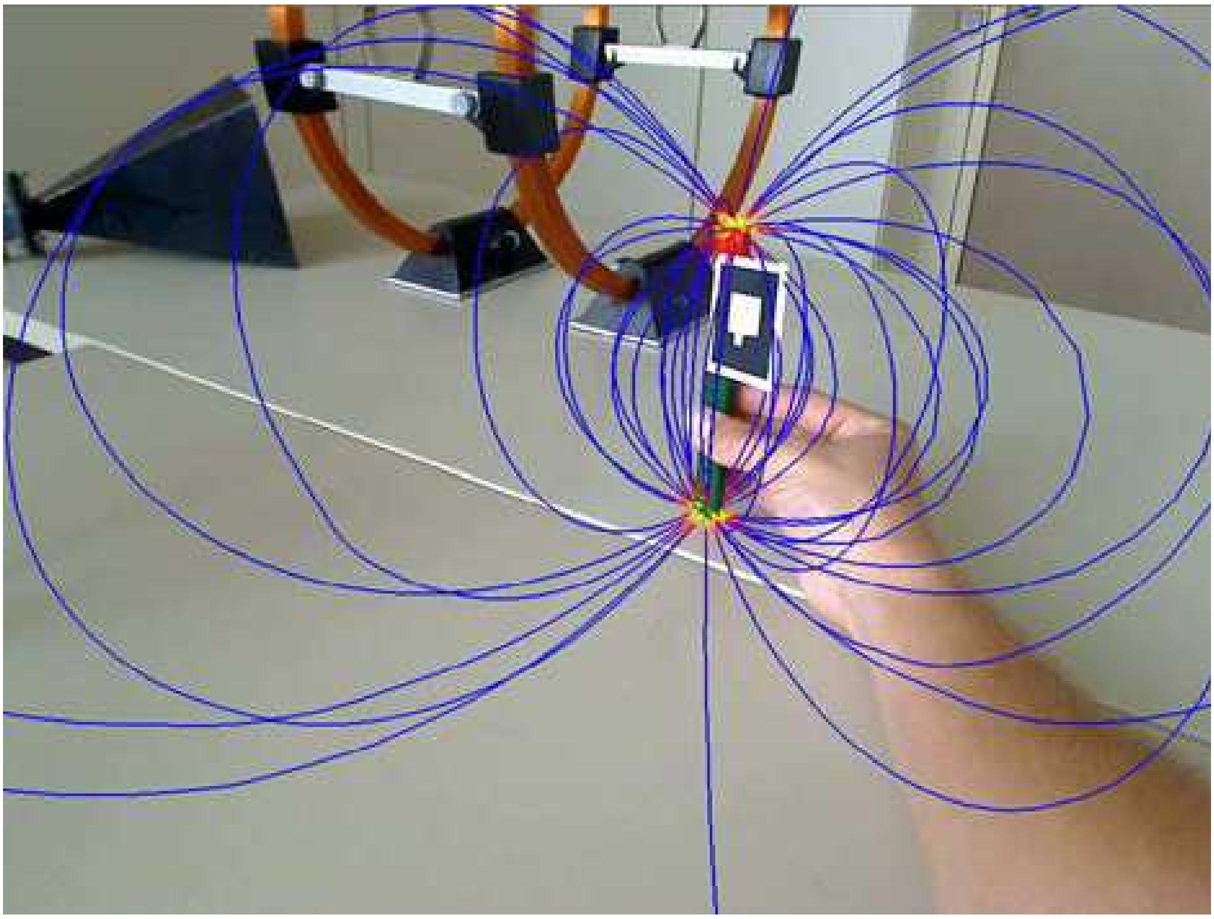

Figure 2: Magnetic field of a magnet (Buchau et al.)

These applications allow the student to view the magnetic field in three dimensions. This study does not present the results of using the student applications.

Also using Augmented Reality in teaching, Lemos and Carvalho (2010) created the SISEULER, which acts as Learning Object where the student can have a better understanding of the relationship of Euler through visualization and manipulation of objects. This experiment was tested with a positive result with basic education Mathematics teachers. Figure 3 shows a dodecahedron using SISEULER.

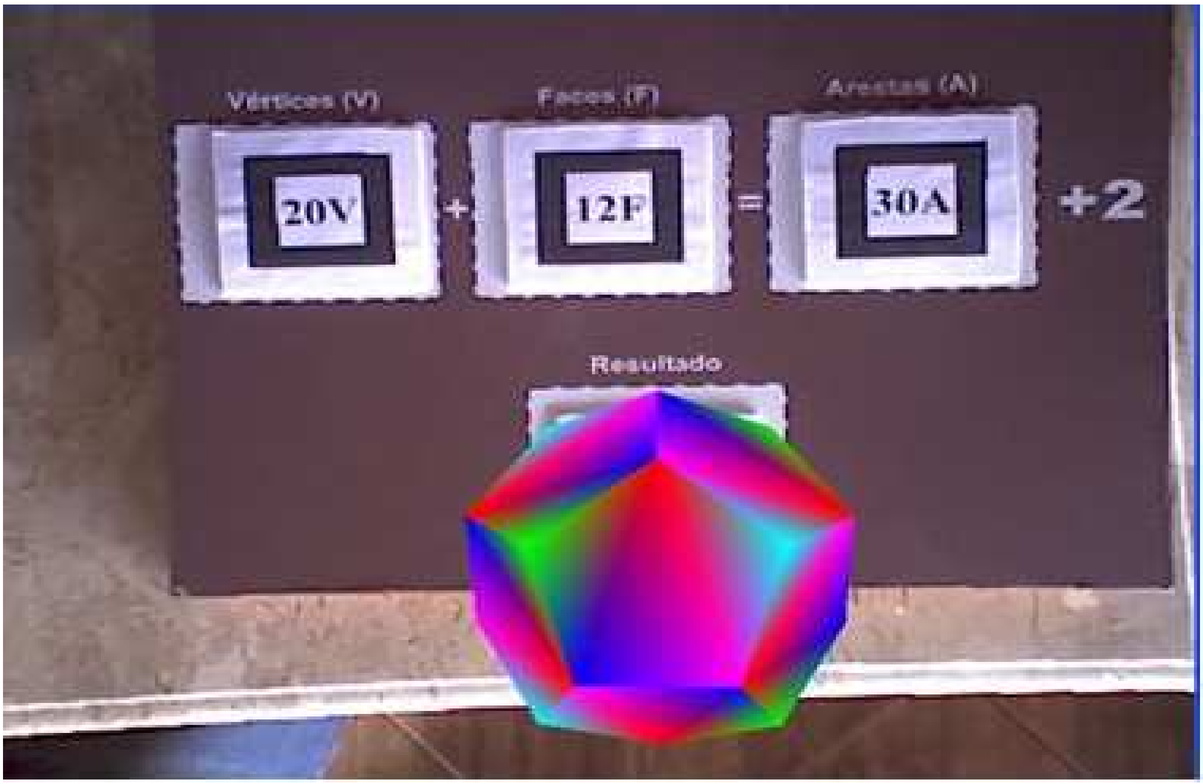

Figure 3: Dodecahedron using SISEULER(Lemos and Carvalho)

Macedo et al. (2010) presented one method to teach Solids using Augmented Reality, providing the student interaction and visualization of solids. Figure 4 shows the user in an Augmented Reality environment manipulating a pyramid.

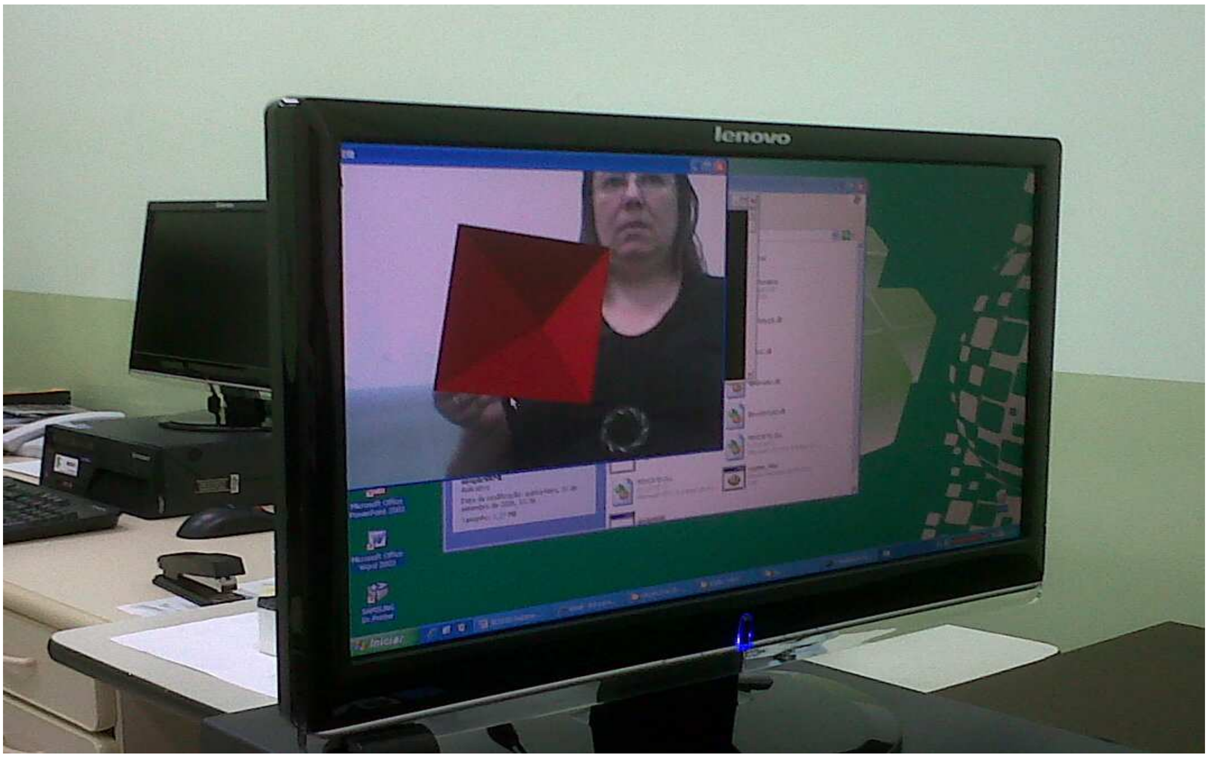

Figure 4: User in an Augmented Reality environment manipulating a pyramid (Macedo et al.)

Lima et al. (2008) developed the VSTARGD (Viewer of Torus Surfaces of Descriptive Geometry Through Reality). With this viewer the user can see torus surfaces, which three are animated. Figure 5 shows the VSTARGD.

Figure 5: VSTARGD (Lima et al.)

HOW AUGMENTED REALITY WORKS

Augmented Reality from d and shoot a scene in real time and from a marker at the scene, brings to the computer screen a scene in a virtual world mixed with a real world, which is the world Augmented Reality. The formation of the Augmented Reality environment is the exemplified in figure 6.

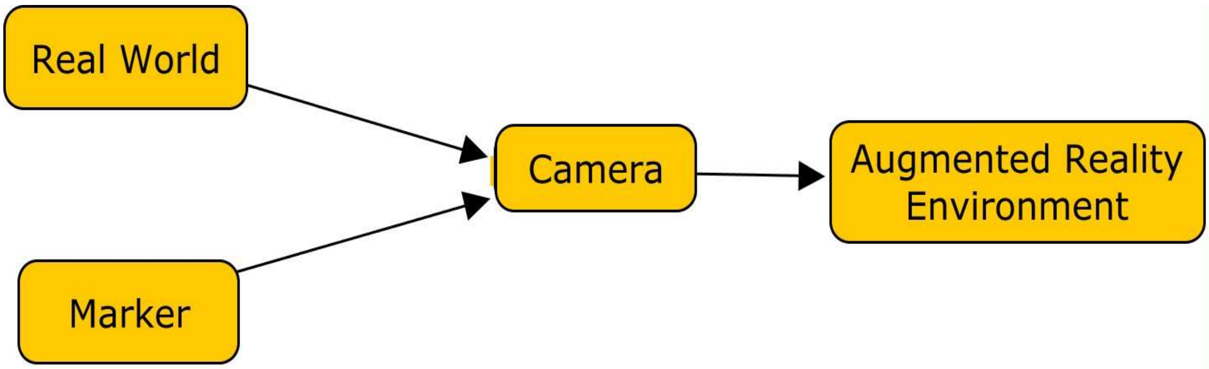

Figure 6 : Formation of the Augmented Reality environment

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To create Augmented Reality environment it was used the ARToolKit (Augmented Reality Toolkit), which is a library with open source and free, suitable for developing applications of Augmented Reality (Zorzal et al., 2008). According to Coelho and Bähr:
Through Augmented Reality scenes are formed in a certain place, in real time, from real world scenes and scenes of a virtual world, corresponding to this location. The scenes are formed to give the impression that virtual objects exist in real world (2005).
Augmented Reality works as follows:

1. Puts up a marker on an object where you want the interaction to occur;
2. This marker will be displayed by the camera's microcomputer;
3. If it is recognized, will lead to a pre-established library;
4. Will appear on the computer screen, the first object where was the marker mixed with the object that was at the library.
5. The two objects will be merged into a world that mixes the real world with the virtual world.

In Figure 7, an example of Augmented Reality where the user and the bar-shaped magnet are mixed in the real world with a magnetic field of the virtual world in the same screen.

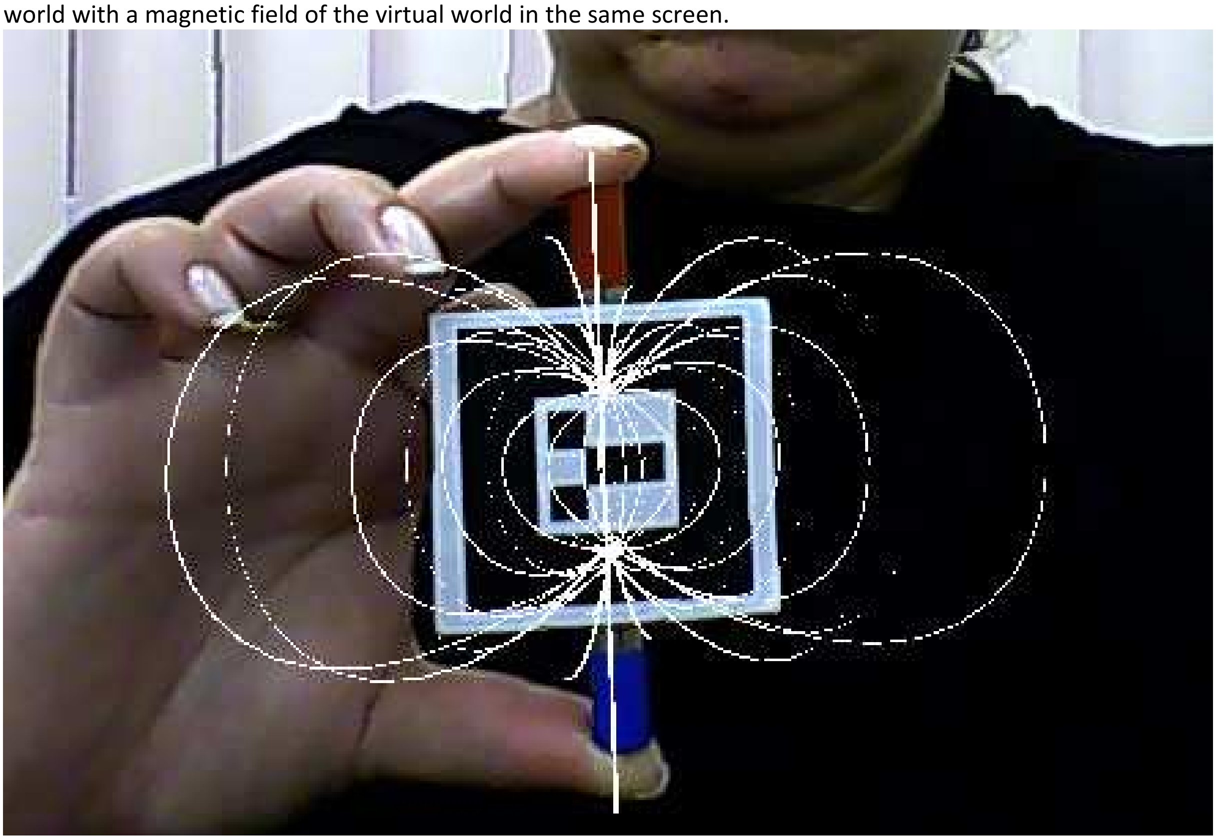

Figure 7: The user and the bar-shaped magnet mixed

The magnet used at this experiment can be seen in Figure 8.

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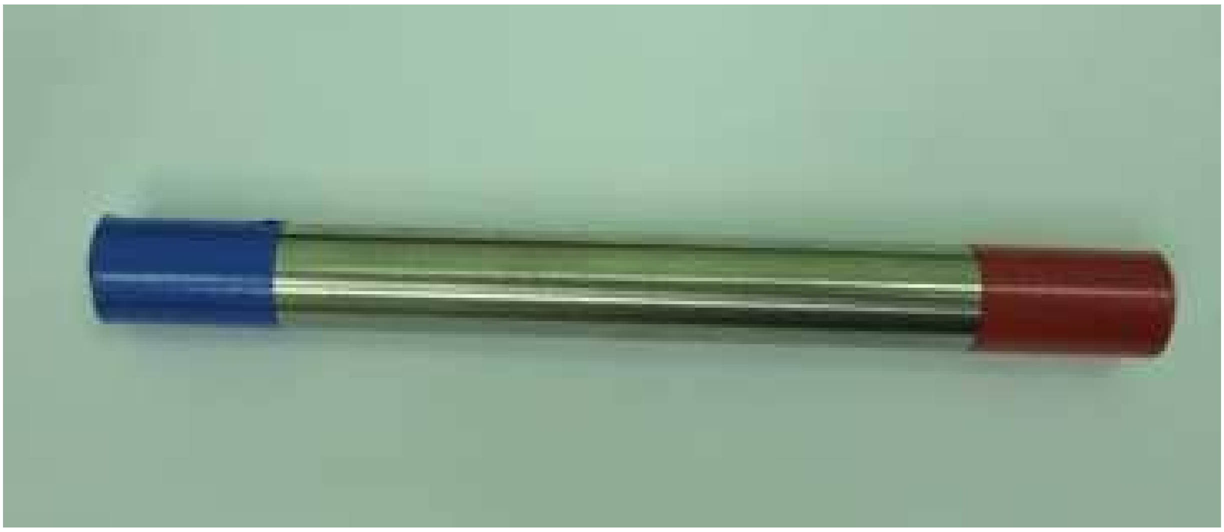

Figure 8: Magnet bar-shaped

A marker (figure 9) is placed in front of the camera. Then the link has been established and the virtual image emerged, which is the magnetic field.

Figure 9: Marker

Figure 10, shows that there is no presence of the magnet.

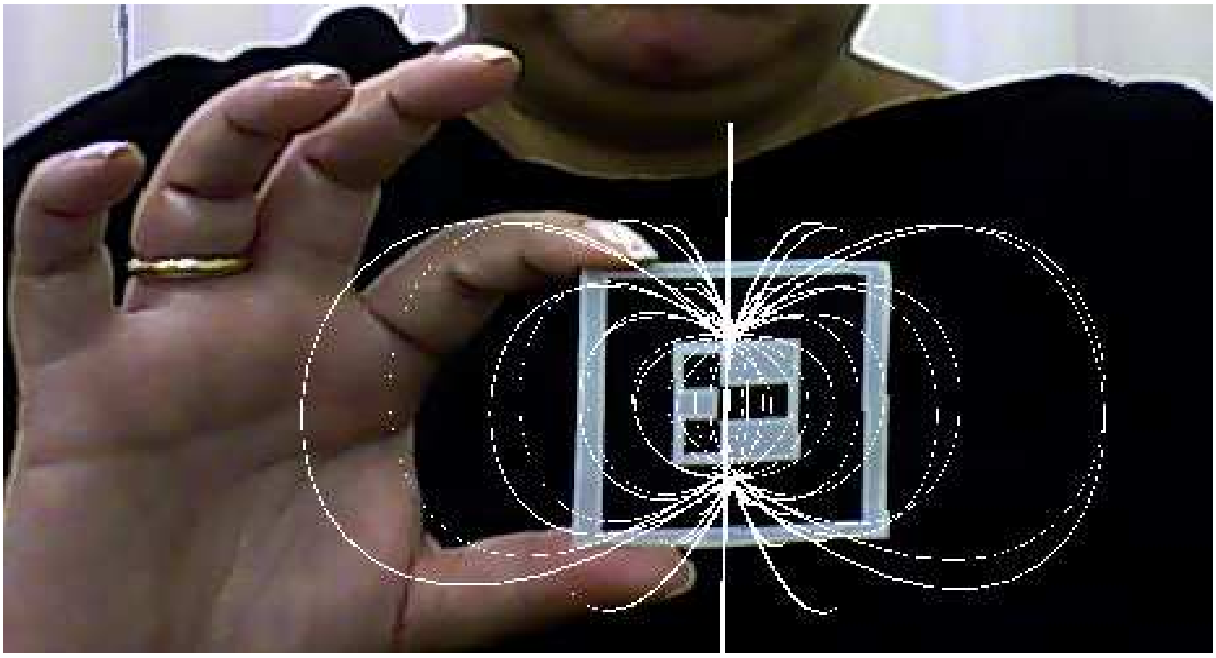

Figure 10: Marker without the magnet

Subsequently, the marker was placed just in front of the magnet and the camera captured the image. The camera recorded the marker image and made the *link* with the magnetic field that was stored in a preset library. The user, the magnet and the magnetic field are now in an environment of Augmented Reality (Figure 11).

Figure 11: The user, the magnet and the magnetic field are now in an environment of Augmented Reality

In this proposal, a research was conducted with the students, where the magnetic field of a magnet was mixed into the real world environment in Augmented Reality.

AN EXPERIENCE IN THE CLASSROOM

The intent of this experiment was to create a playful environment in the classroom, where students could interact with the Learning Object and could also visualize this object, also increasing the students motivation, aiming to learn. The students can view the magnetic field of a bar shaped magnet like never previously experienced. In this experiment, the learner has the opportunity to visualize the magnetic field in three dimensions.

Also the aspect of motivation has been taken into consideration. The students have needs that must be met, it is up to the teacher to make this happen (Mouly, 1963). With Augmented Reality the students have the opportunity to visualize the magnetic field on a ludic way. Thus, the learning process will be more attractive and, therefore, the learning is more efficient, since, according Mouly (1963), the efficiency is proportional to the motivation of the individual.

Figure 12 shows a student with the lap top's camera in class. The marker is located on the bar-shaped magnet. This marker made the link with the virtual world, bringing to the screen the magnetic field.

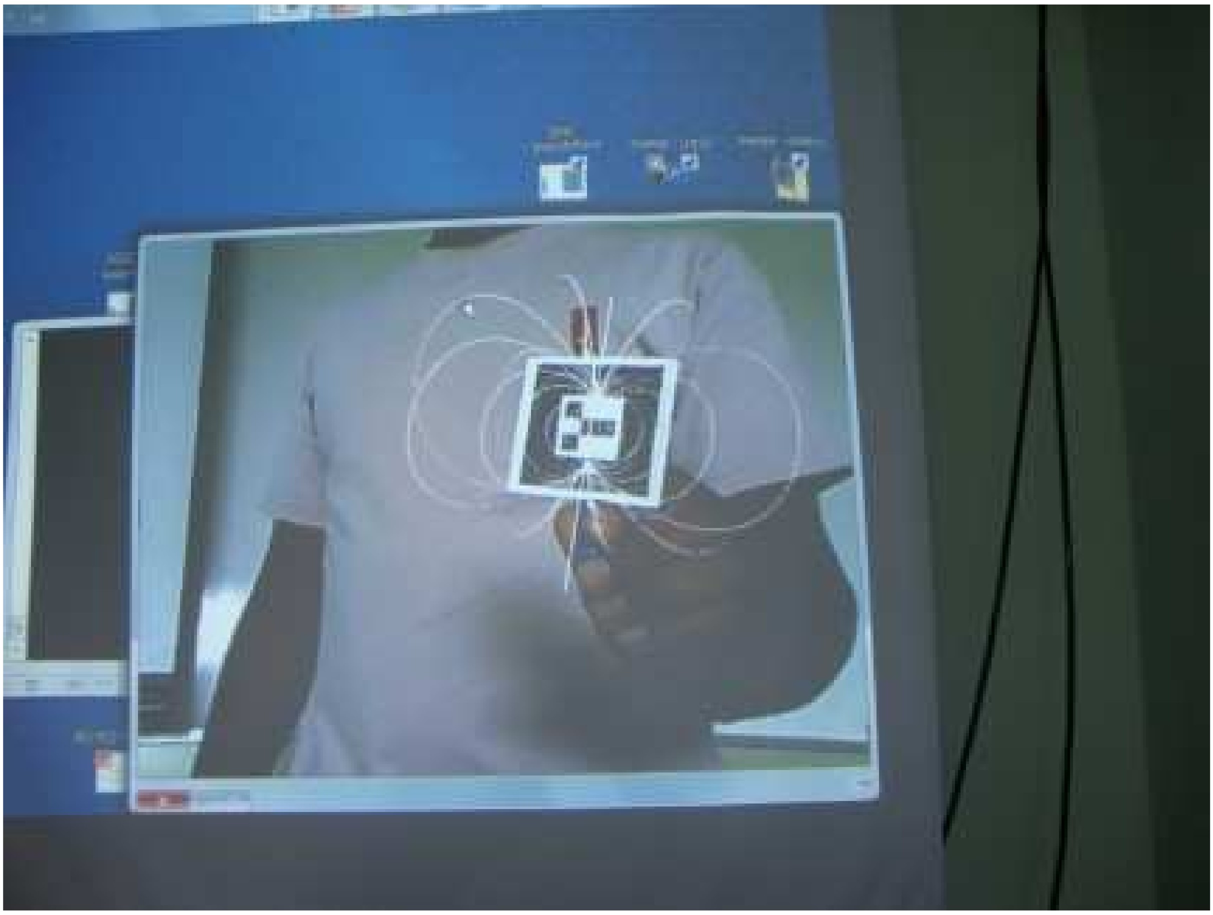

Figure 12: Student at the Augmented Reality environment

Participated in this experiment three groups of Technical Course of Electricity and One group of Technical Course of Electromechanical of the Instituto Federal Fluminense, totaling 33 students, aged between 19 and 44 years. Among students who participate at this experiment, a group of Electricity is day shift, with a total of 12 students and the other classes are night shift.

The experiment was conducted in classes in march/2011. After the experiment they answered a questionnaire and the main results are described in the next section.

FINDINGS

When asked if they found it easy to use Augmented Reality, 32 students answered yes and one said he did not know.

The 33 students responded, when asked, they could see the magnetic field of the magnet bar shaped.

To the question: "Would you like to take more classes using Augmented Reality?", also 32 students responded that they would like and just one said "I don't know".

There have also been questions in which students could respond freely to questions. The following will highlight the main responses:

A) (20 years - man) "I really liked. I think that's useful, functional and practical to help us understand the physical phenomena. "
B) (24 years - man) "I found it very useful and easy to use but best of all, what you see in practice is what is said in theory."
C) (19 years - woman) " Helps understand how it works in reality."
D) (24 years - man) "I like it because of the view of the things that we cannot see with the naked eye."
E) (21 years - man) "Becomes more practical the understanding the issues difficult to demonstrate."
F) (29 years - man) "Much interesting to observe the magnetic field in 3D."
G) (44 years - man) "Other materials could also use this technology."
H) (31 years - man) "I finally could see the 'so famous' magnetic field."

It's important to highlight that there was no negative response demonstrated by the students.

CONCLUSIONS

The Learning Object on Augmented Reality environment proposed aimed to introduce students to a way of interaction and visualization, in three-dimensional, of the bar-shaped magnetic field. This work proposes is a new way of teaching magnetic fields. With this experiment, and According to the questionnaire answered by the students, it was observed that the students were able to visualize the magnetic field of a bar-shaped magnet, and they found it's easy to use the Learning Object based Augmented Reality. Also, all the students would like to have more classes using Augmented Reality. According to the questions that could respond freely, the students commented that they found useful, practical to use and it helps to understand the physical phenomena. From what was shown, the students could actually see the magnetic field of a bar-shaped magnet in three-dimensions and were also able to interact with this field.
Augmented Reality presents the following advantages, among others:

- Allowed students to visualize the magnetic field of a bar-shaped magnet;
- Allowed student interaction with this magnetic field;
- From the moment the Learning Objects in Augmented Reality has been prepared, its use is simple and practical;
- Simplicity and economy of the equipment used: the experiment was conducted with only a webcam and a laptop. Also, a data show with big screen, only to enrich the experiment.
- The Augmented Reality environment is excellent to visualization of magnetic fields.

We conclude, therefore, that, with this technological apparatus, contributions to education will be of great value.

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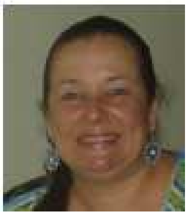

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