Use of *Smart* Boards for Undergraduate Teaching in Computer Graphics and Interface Design

Julio Guido Oliveira Militão
University of Fortaleza – UNIFOR
1321, Washington Soares Ave, Fortaleza, CE,
60.811-905, BRAZIL, +55 85 3477 3079
militao@unifor.br

ABSTRACT
This work is the result of applying new technologies for teaching in the disciplines of Interface Design (IHC) and Computer Graphics in Computer Science Course at Fortaleza University – Brazil. We realize that the use of interactive Smart Boards makes the classes more interesting, allowing a better learning for the student. The differences in the classroom are now the inclusion of new media, interactive tasks and greater student participation in class. The results show an increase in student interest and also a lower dropout rate.

Keywords
IHC, Teaching, Smart Board, Computer Graphics, IHC

INTRODUCTION
The use of technological resources to improve the teaching-learning process is a constant concern today. The idea that classrooms are places whose features interact to promote learning is investigated in this research, which specifically examines new instruments for improving the learning process. Our goals are: (1) motivate students and (2) improve the teaching methods with the use of Smart Boards.

The Smart Board is a computerized whiteboard through which new ideas can be recorded, saved, recalled and integrated with other information. These features would facilitate interactive learning and the effects would be evident in improved test scores [4], generation of ideas, satisfaction with group learning processes and user satisfaction with the Smart Board. Smart Board uses special software and it allows better methods of learning than a common classroom board. Among them:

- To show and go to any application or program into a computer and also write over them to draw attention to important issues;
- To show any material in all kinds of media (video, models, bi and tri-dimensional images and vector objects) to classes and control everything from the frame;
- To record all training material and notes produced in the frame to a file that can be printed and distributed to the students of the class.

The undergraduate classes of Computer Science at University have computer labs for students to perform practical activities. The use of a computer lab allows students to exercise the content through the use of adequate computer tools. However, the University also has rooms with Interactive Smart Boards. In this research we used this infrastructure to replace the regular classroom.

The disciplines of Interface Design and Computer Graphics need special attention because they work with students' abstractions. The use of conceptual models to produce concrete images part of the theory involved in such disciplines.

The Educational Planning of Interface Design is structured in five Units. In each Unit, special activities are developed using the Smart Board. The Computer Graphics disciplines also use the Smart Board, but only for a few units. This will be detailed in a further section.

Since most of the students have laptops with wi-fi, they stay connected to the Internet during the class; the use of laptops becomes an element of distraction in the regular classroom.

These two factors motivated us to experiment the use of a different environment that increases students' interest and consequently increases the learning rate.

Then, we start to use the new lab at the disciplines of Interface Design and Computer Graphics Course in Computer Science. The experience started in the second semester of 2009.

The teacher began to conduct his lectures in the Smart Board lab (Figure 1). The room is equipped with a Interactive Board – Smart Board, a whiteboard, two tables and 16 computers. The time necessary to the teacher to get used with the technology so that the students would take full benefit of it in classes was a week. The students,

otherwise, got in touch with the activities once a month. We realized that they need more time to manipulate all the learning technology.

Figure 1. Room with Smart Board.

This device is of the most intuitive use. No special training is necessary. Even though, activities such as opening a class, creating objects and manipulating videos were able to happen easily. Since then, the improvement in using the Smart Board has increased from then and after the first semester the teacher was able to realize it.

METHOD

The adopted methodology consists of using Smart Board in classes of Design Interface and Computer Graphics, replacing the whiteboard in theoretical classes. This replacement process was structured in four phases.

The first step is designing and authoring the course, the lessons and activities, regardless of the technology being used. The teacher may reuse the classes already prepared.

The second and most important phase should be to investigate and define alternative approaches of the content to stimulate interactivity allowed by the technology of the Smart Boards. They must include multimedia, interactive software, some tasks to allow students to use - in the classroom - the Smart Board and last but not least practical exercises.

The next stage is to transform the classes to a Smart Board software [3], which depends on the developer. After the transformation, the class must be tested without the students. In some cases, it is necessary to make an adaptation of the content or replacement of media for compatibility reasons.

Once prepared and tested, the lesson may be applied. The teacher must be aware of an initial extra time necessary to load the lesson on the Smart Board software before the class starts.

The teacher has the option to install the software on his personal computer and loads the class. In this case, the teacher just needs to connect his computer to the Smart Board and the whole class is ready. The main advantage of this initiative is that the teacher tests the class at home, eliminating the need to test it in the laboratory.

In this experiment, the lessons of the two disciplines were already edited in *Br Office Impress*. They were converted to *NOTEBOOK* Smart Board software [3] (Figure 2). Some of the classes were imported with no problems, but others needed to be redone.

When the conversion to Smart Board software fails, the teachers converts the file into a PDF Format and shows it without **NOTEBOOK** Smart Board Software. In this case, the teacher cannot register the notes directly on the slide, but can capture the screen and save in a file.

Sometimes is necessary to show more examples or to explain with other approach, in these cases we can access internet to got new materials. This experience can be enriched by copying a video or an image to the NOTEBOOK Software and realize making some annotations.

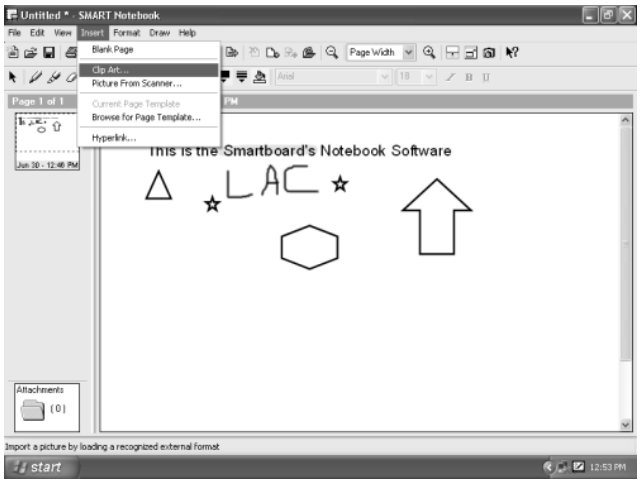

Figure 2. *NOTEBOOK* Smart Software [3]

Interface Design

The goal of the "Designing Interfaces" class is to teach the essential concepts of building Graphical User Interfaces for Interactive Information Systems (IS). It is taught in the second half of the course and it provides greater tools for a good survey of IS requirements and strategies for building the concrete interface.

Table 1 shows the major initiatives undertaken in three semesters we used the Smart Board. Activities were planned and took place to complement the content or to fix it.

To complete the class, the teacher included practical exercises for the students at the end of each lesson. On these occasions some students went up to the equipment

and performed the task. The exercises were expected since the students wanted to manipulate the brushes and objects on the screen.

Table 1. Initiatives implemented at the discipline of Design Interface using Smart Board.

CONTENT	Smart Board Activities
Unit I Fundamentals of Human - Computer Interaction	• Analysis of the technology involved to perform interaction using Smart Board device • Presentation of Video of Accessibility, pausing and writing in some frames • Analysis of Br Office Interface versus Microsoft Office Suite • Investigation on how we can use the Smart Board to teach and to learn Design Interface • Discussion of the differences on Smart Board approach • Use of Smart Board to draw and manipulate tri-dimensional models
Unit II Elements and Interaction ways of Interfaces	• Use of Virtual Keyboard to input text • Identification of special features of *NOTEBOOK* Smart Board software [3] such as a magic pen that zoom in/out the subject.
Unit III Principles of Use Interfaces.	• Analysis of Smart Board and Whiteboard: advantages and disadvantages • Enumeration of Limitations and difficulties to realize some defined tasks such as writing long texts
Unit IV Interface Design	• Use of tools to draw conceptual models of Interactive Systems (UsiXML[8], MoLIC[7]) • Use of tools (Pencil[5], Axure[1]) to draw a wireframe prototype
Unit V Interface Test and Evaluation.	• Presentation and analysis of the videos made by students during of test sessions

Computer Graphics

It is required a more intense use of the computer lab for the discipline of Computer Graphics. For the contents that are related to programming we use the computers in the room that overlooks the Smart Board. This is the reason that not all units include activities in Smart Board.

We observed that the direct manipulation of the objects brought a fundamental difference when the teacher explains some subjects such a Geometric Transformations and Geometric Modeling.

On table 2 we quote all the activities realized during the course.

Table 2. Initiatives implemented at the discipline Computer Graphics using Smart Board.

CONTENT	Smart Board Activities
Unit I Computer Graphics Introduction	• Analysis of Smart Board as a Input/Output Device • Analysis of the technology involved to perform interaction • Investigation on how we can use the Smart Board to teach and to learn Computer Graphics
Unit II Graphical Primitives	• Interactive visualization of the tracing of Segment lines using Bresenham and DDA Algorithms[9] • Comparison of Line Segments with and without anti-aliasing • Drawing and storing of primitives on Vectorial and matricial representations.
Unit III Geometric Transformations and Coordinate Systems	• Explanation of the geometric transformations in R^2 and R^3 using direct manipulation • Construction of two different Coordinate Systems and analysis of them
Unit VI Syntetic Camera Model	• Use of Smart Board plugged on webcam to determine the Syntetic Camera Model parameters • Rendering of Virtual Scenes using Blender
Unit VIII Geometric Modeling	• Creation of tri-dimensional models using Blender and PovRay • Direct manipulation of objects with transformations of Scale, Rotation and Translations
Unit IX Computer Animation	• Creation of color animation using Image Editor • Creation of animation using Blender[2] and Povray[6].

RESULTS

At first, the Smart Board was used as a projection screen and a data-show, with one difference: notes were made directly on the slide and recorded in a file. These notes served to improve the next semester class. Another feature used was the ability to expand or display details of a given substance through the tool "Magic Pen".

The challenge became: how to use the Smart board to improve a lesson? What would it take to bring a new

experience - nice and different – to the student? How to implement these new experiences?

In response to these questions, the inclusion of at least one interactive activity per unit was established as fundamental. The students have also collaborated, with some ideas and support to improve new ways to teach the subjects.

One of the initiatives took place in the discipline of Interface Design at the time of Unit IV - System Prototyping. The teacher gave a scenario to each team. One team, using the Smart Board, draws the respective storyboard. The analysis of the storyboard was made by others students at the time of the design. The concrete interface was designed with another team using a Wireframe tool. All the students worked together with the teacher's support. The students feedback was very positive in this example.

Another moment that made the activity rich and very fruitful was the analysis of concrete interface made by students. The teacher showed the Interface created by the team. Using Heuristic Aspects, he indicated the right things and the mistakes made by the team.

We cannot guarantee that there is a real benefit with the use of such technology for teaching of the all topics of Interface Design (HCI) or Computer Graphics. We are applying it in some specific activities as shown in Table 1 and 2 but we intend to extend them in time.

The result shows an increase in student interest in the class that use Smart board compared with computer lab class. They always praise the classes and reported that they were more interesting.

We can also observe that all the students liked going to the Smart Board, including those who were initially shy. The idea to use new technology such a Smart Boards was very receptive by the students. A student said about the new approach: "*It was amazing to get in touch with such device. Smart Boar definitely made the class more interesting*". This speech was observed in all students. Other positive remark that can be presented is the case of group work. They always present some kind of competition about who is going to the Smart Board.

Although we have not done a thorough analysis of the evolution of the notes, we observe a lower dropout rate of the students enrolled.

CONCLUSION

The use of the Smart Board - interactive digital whiteboard - in the classroom brings a new class perspective to the learner. It is innovative and cooperative, it uses new technology, it motivates the learner to come to the class. Besides enabling sharing and using all types of materials and work performed or selected by teachers and students, it is also accessible to the World Wide Web.

The Smart Board makes the teacher enthusiastic for the numerous possibilities of structural improvement in their classes, with materials available in real time, animation, multimedia, sound, internet, text, spreadsheets and all the computer resources.

For the student, the Smart Board turns a passive classroom into a dynamic experience. It was possible to detect an increased capacity for abstraction of students by the participation in practical activities. Initially, the content was verified through tests, homework and researches. Using the Smart Board the teacher could, interactively, verify the learning improvement by giving feedback to the students. Although, the increases of interest in the content reflect a better academic performance and a lower dropout rate. These rates will be statistically analyzed as soon as we apply the method more terms.

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