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Natural User Interfaces to Teach Math on Higher Education

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Abstract

A common and known problem among students on higher education (in general throughout the scholar life) is the difficulty of learning math. Nowadays the teaching methods for learning math remain relatively the same. Though, with the emerging of new technologies like portable devices (smart phones and tablets) and movement interaction devices (Nintendo WiiMote, Microsoft Kinect and PlayStation Move), learners and teachers have big interest on new ways of interacting through the teaching-learning process. In this sense the Natural User Interactions (NUIs) offer a great potential to facilitate new ways of computer enhanced learning, these have the potential to enhance classroom interactions, by increasing learners participation, facilitating the teachers' presentations and creating opportunities for discussion. We present a system that combines gestural and touch interactions to support teaching math across multiple personal devices and public displays to enhance and support math education for college students. In a formative usability study, learners and teachers were positive about the interaction design and the learning possibilities for math education. Thus, this created good intentions in the users of continuing using it.

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Keywords: Learning Technnology; Math Education, Natural User Interfaces, Human Computer Interaction.

1. Introduction

Since education is closely linked to the creation of information and communication of knowledge, it is not surprising that the Information and Communication Technology (ICT) present great opportunities in education.

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Because of its huge penetration, the first idea that comes to mind when thinking about ICT is perhaps the personal computer in which the interaction occurs through devices such as the mouse, keyboard and screen.

Taking advantage of the advances that have been made in the development of interfaces tangible, gestural, auditory and the release of programming tools for the Kinect sensor and some additional libraries can facilitate the incorporation of the Natural User Interfaces (NUI) to support teaching tools, to facilitate and expedite its use by teachers and students, we can define NUI as those that allow users to interact with systems in the same way they interact with the real world (Widgor, 2011).

A common and known problem among students on higher education (in general throughout the scholar life) is the difficulty of learning math. Nowadays the teaching methods for learning math remain relatively the same. Though, with the emerging of new technologies like portable devices (smart phones and tablets) and movement interaction devices (Nintendo WiiMote, Microsoft Kinect and PlayStation Move), learners and teachers have big interest on new ways of interacting through the teaching-learning process. In this sense the NUI offer a great potential to facilitate new ways of computer enhanced learning, these have the potential to enhance classroom interactions, by increasing learners' participation, facilitating the teachers' presentations and creating opportunities for discussion.

By nature of mathematics have an area of significant opportunity for NUI.

This paper presents the development of a prototype, and its evaluation to support the teaching of mathematics for engineering that allows the use of natural user interfaces under the scheme of user-centered design.

2. Background

The 2011 Horizon Report mentions that are 6 technologies to be used in universities for teaching, learning, research and creative expression. Among them, gesture based computing with an estimate time of adoption of 4-5 years.

3. Methodology

3.1 Context of use

The context of use is determined as a result of a process of direct observation and interviewing those who could be potential users of the application: mathematics teachers working with groups of different levels.

3.2 Design

The design comes from the need felt by teachers, who for several years have taught and have experienced benefits and limitations of various tools used in the classroom. They suggest some points according to their experience (see Fig. 1).

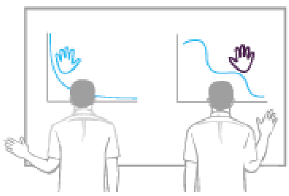

Fig. 1. Proposed interaction.

3.3 Prototype

In the first prototype raises two different scenarios: the first one covers the topic of functions, their identification and graphing, the second one covers algebra topics.

3.4 Evaluation

Once finished the first prototype, we proceeded to perform a preliminary evaluation which focused on the ease of use of the application and its user experience.

4. Preliminary evaluation

A first prototype was created to test the reaction of students when a system with natural interaction is presented to him, the way he might interact with it and see if it generates any interest in the user, we called this prototype MathNUI see it at Fig. 2.

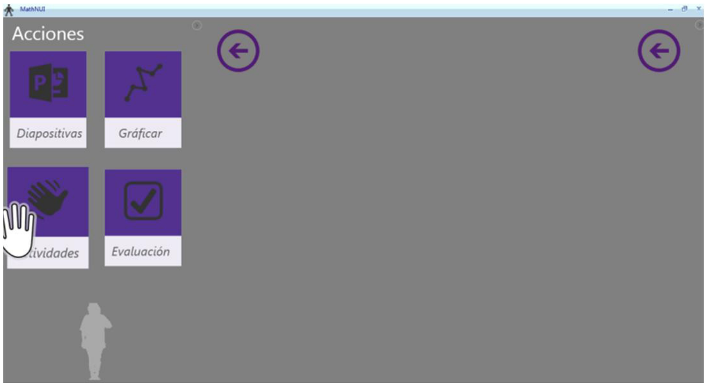

Fig. 2. First prototype: MathNUI.

4.1 Testing the first prototype

The potential advantages of natural user interaction cannot be perceived until they are situated in an interaction context.

Preliminary evaluations are an ideal mechanism to go beyond current practices and allow us to get involved in the design process and visualize new schemes of application in a simple and economic way (Santana, 2005).

To explore the feasibility of the conceptual design, a preliminary evaluation was conducted, testing the scenario of use and the prototype with three students from the School of Telematics of the University of Colima (see Fig. 3). These evaluations were video recorded and photographed. The Technology Acceptance Model (TAM) was used. Developed by (Davis, 1989) and the System Usability Scale (SUS) for measuring usability (Brooke, 1996). 25% of the students were men and 75% women. 100% are Software Engineering students, 66.6% of them said that they have not used system with natural interaction.

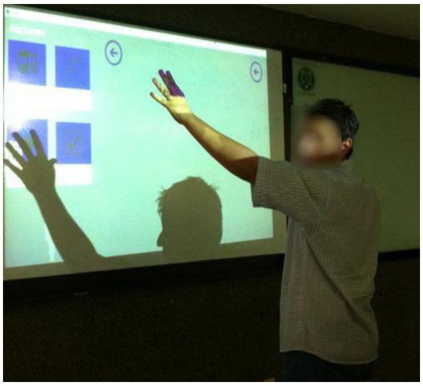

Fig. 3. Preliminary evaluation.

5. Results

5.1 TAM

The purpose of TAM is to explain the causes of the acceptation of the technology by the users. Proposes that perceptions of usefulness and ease of use by an individual in an information system are conclusive in determining their intention to use the system.

For the perception of ease of use, 80% believe that the system is easy to use, 60% agree it is easy to learn, while 40% strongly agree and 60% agree that is clear and understandable, and finally by 100% believe (agree and strongly agree) that is easy to find information on it (see Fig. 4).

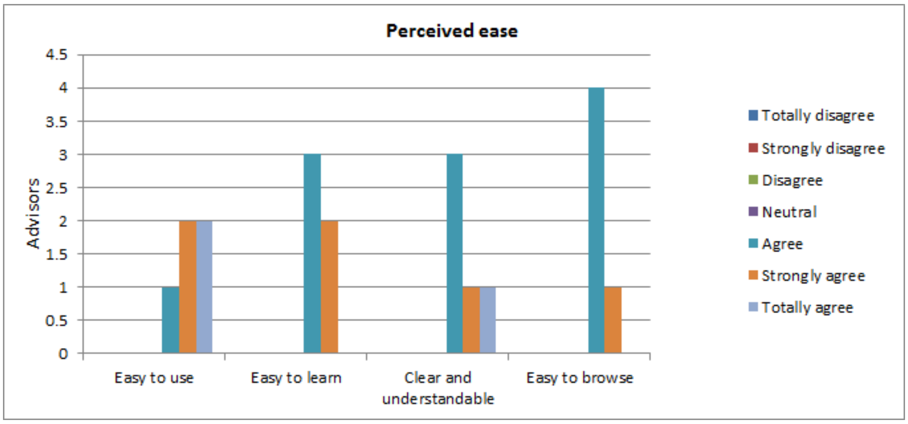

Fig. 4. Results about the perception of the easy to use of the platform.

In the area of the utility perception, of the responders, 60% believe that the system is efficient, 40% said it improved their performance, while 80% said it improved their productivity, and 80% believe that was useful (see Fig. 5).

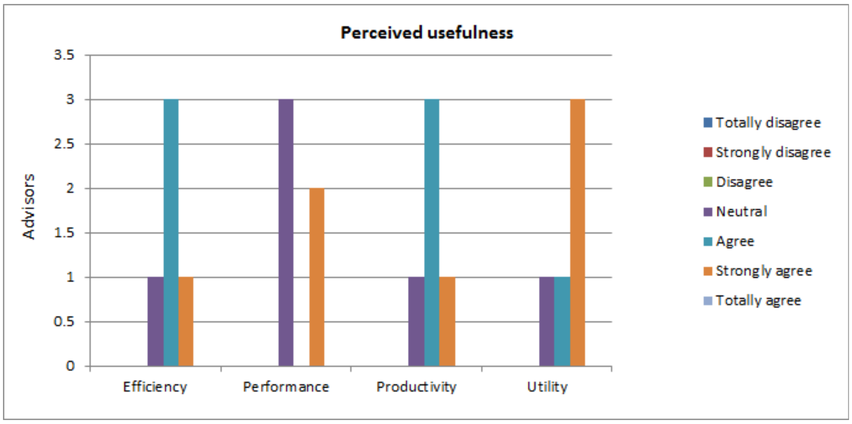

Fig. 5. Results about the perception of the utility of the platform.

Regarding the attitude towards the use, a positive response was obtained for the system: 80% agree that it seems a good idea it software (see Figure 6).

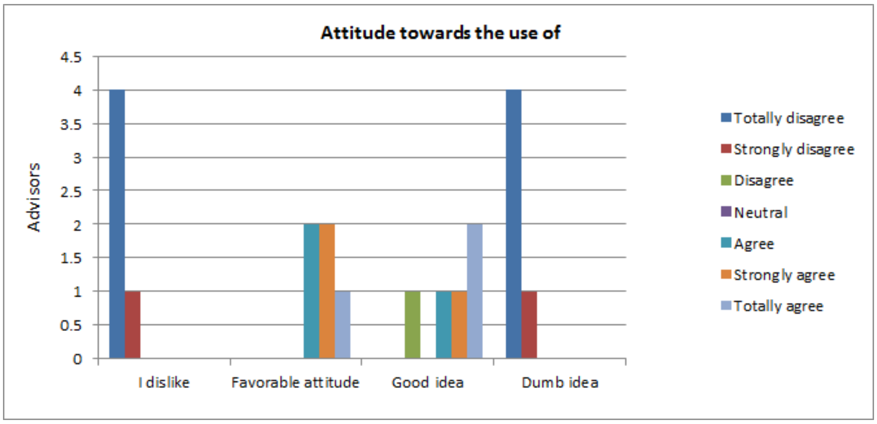

Fig. 6. Results about the attitude toward the use of the platform.

Finally the answer on the intended use, 80% of the users said they would use the system in their courses, use it again and have the intention of use it (see Figure 7).

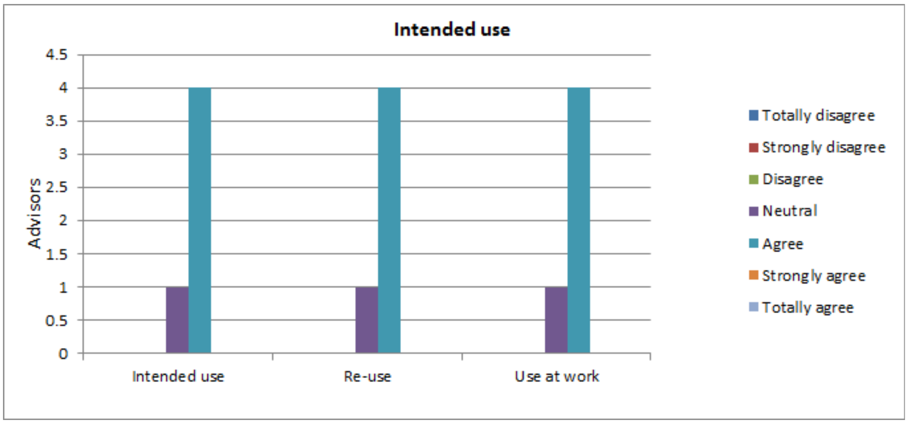

Fig. 7. Results about the intention of use of the platform.

5.1 SUS

The SUS is a simple, ten-item scale giving a global view of subjective assessments of usability, has proved to be a robust and reliable evaluation and correlates well with the usability metrics.

The results exposed a frequency of the distribution of SUS scores showed in Fig. 8 from which we can infer that the platform evaluated, at least in the System Usability Scale is going in the right way because 100% of the participants consider their needs satisfied with this platform: between 61 and 100 points of satisfaction.

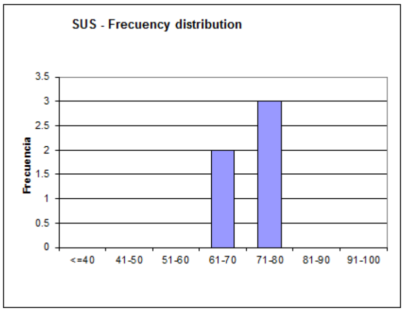

Fig. 8. SUS distribution.

6. Conclusions

This work presents the creation of a NUI math learning system called MathNUI at the University of Colima, for learning mathematical concepts through the use of natural user interactions.

The evaluation of this platform gave as a result that the platform is useful and allows a greater performance and efficiency, and it is also considered a good idea. Thus, this created good intentions in the students of using it again.

As a general conclusion we can say that the use of natural user interfaces to develop math applications for education is adequate.

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