**Tablet Gestures as a Motivating Factor for Learning**

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**ABSTRACT**

The literature reports about using computer to support learning activities from as early as they become commercially available. It also shows that educational technologists are eager to try the latest computer technology released for corporative or household usage in the educational area. The last example of this tendency has been the tablet, and among the many available models today the iPad seems to be the most preferred.

**Categories and Subject Descriptors**

D.3.3 [**Programming Languages**]: Language Constructs and Features – *abstract data types, polymorphism, control structures.* This is just an example, please use the correct category and subject descriptors for your submission*.* The ACM Computing Classification Scheme: <http://www.acm.org/class/1998/>

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# INTRODUCTION

It has been said that “education has a well-established history of taking devices originally not intended for educational purposes, and attempting to appropriate them for educational gain” [Melhish & Falloon, 2010]. It seems that new devices developed for corporate and/or domestic environments “continually challenge educationalists to develop educational sound applications” for them [Traxel, 2010]. In fact, computers and computing devices have been used to support educational activities since the early years when they were introduced in the market, and their usage has varied following the developments in computing and networking technologies [Baloian, 2010]. At the beginning, they were used almost exclusively to support individual learning, by implementing artificial intelligent tutoring systems, trying to replace the human tutor by a “personalized and adaptable” one. As computers got smaller and cheaper they made their way out of the specialized “computer laboratory” into the classroom, sometimes accompanied by electronic whiteboards and students’ homes [Baloian, 2005]. As networking technology matured, it was rapidly adopted by educational technologists in order to implement applications supporting collaborative learning activities [X]. In the last years we have seen a widespread availability of mobile devices which has led to an increased interest in the use of mobile computing to support formal and informal learning, as well as individual and collaborative learning [Guerrero, 2004]. Nowadays, computers are being used to support a variety of learning modes (individual, collaborative, synchronous, asynchronous) in different scenarios and settings (in-classroom, outdoors, formal and informal learning) and the use of advanced educational technology has increased dramatically in the last ten years [Hoppe, 2005].

This attitude of educational technologists to try to incorporate any new technology to support learning activities has also received criticism from some authors who argue that the successive iteration of corporate and domestic technological innovations have not shown any significant impact on the quality of student learning when transplanted to the educational context [Oppenheimer, 2003], mainly because of the prevailing premise that “technology which works outside the school will work just as well in school, and that it is up to educational practitioners and researchers to determine ways to achieve this” [Melhuish, 2010]. Although we share some of the critics regarding that sometimes technology may have been introduced to support educational activities just because it is there, we also think that technology cannot be ignored, especially that related to mobile computing and communications: “To do so would reinforce the perception already held by many younger people that their education is becoming increasingly detached and irrelevant, by failing to utilize the capabilities of technology to help them learn using other sources of information and from each other at any time, rather than simply while at school” [Melhuish, 2010].

Among the recent technologies being used by researchers to explore its benefits are the tablet computers in general and the Apple iPad in particular. In fact, a Web search for the “iPad” + “learning” terms produces a long list of interesting papers in this area. Most of these papers (if not all) mention portability as one of the most important characteristics to support learning. Other characteristics which are also frequently named are: affordable and ubiquitous access, situated, just in time learning opportunities, connection and convergence, and individual and personalized experiences.

Interestingly enough, we could not find any paper exploring how the Human-Computer interaction paradigm proposed by these devices influence their use for educational purposes. Only one paper [Henderson, 2012] mentions the advantages that multi-touch screens may have for education. It is known that HCI plays an important role in educational software: a good or bad interaction design may dramatically influence the usability of the application thus affecting the motivation the user may have (e.g. [Chalfoun, 2011]). The most common input mechanism for multi-touch screens are fingers, thus providing a natural way of interaction whith which students feel more motivated to learn, thus keeping them for longer periods of time interacting with the application [Agostini, 2010]. In our opinion, the lack of serious studies about the human-computer interaction with large interactive boards has been one of the principal causes why they are not widely used today for educational purposes, although they were introduced in the 80´s [Baloian, 2008].

Filling the gap may be a challenging task. Various educational levels and several educational approaches may need several studies to be made. One of such studies is attempted below, in which a game-oriented application is used by young students (kinder, first and second school grade) for second language learning. In this paper we present work whose goal is to conduct an introductory study about the interaction gestures which are most common to tablet computers (specifically for the iPad) and how they influence children’s motivation.

# PREVIOUS WORK

Game-based learning (GBL) has been proposed as an effective tool for learning [1]. This may be applicable at all levels of education [10]. For the particular case of first-graders, a playful approach to learning is a natural one [X]. The toddlers explore their world with toys and they concentrate on things that amuse them [X]. Van Ments calls *surface structure* of a game the observable mechanics of the activity [2]. On the other hand, Gredler defines *deep structure* as the psychological mechanisms operating in the exercise [3].

A theoretical basis for educational games [4] may be the Cognitive Theory of Multimedia Learning (CTML) [5], which in turn it is based on Paivio’s Dual Coding Theory (DCT) [8]. DCT specifies that a learner´s cognitive system (memory) operates on two distinct channels: verbal and pictorial. Occupying both channels to provide information to the learner allows him/her to build better understanding of the educational material [5]. Taking this into account, Papastergiou [6] claims that games can enhance student performance by presenting well-designed instructional messages that support cognitive development. This is supported with experimental results [7]. Recent data indicates that adoption of games for classrooms are increasing in a positive direction consistent with the Rogers Technology Adoption Curve: K-5 seems to be in the Late Majority stage where the 6-12 category are still in the beginning of the Early Majority stage [Proctor].

Natural User Interfaces (NUI) are the evolution of Graphical User Interfaces (GUI), which in turn are the evolution of Command Line User Interfaces (CLI) [20]. While CLI required a keyboard to interact, a GUI needed a mouse, and NUI needs the user just move some part(s) of his/her body such as the voice-producing organs, an arm or hand. Hand gestures are then a particular case of NUI. They may be done on the air or touching a device surface [X]. Suitable sensors must capture the gestures: cameras in the case of air gestures or contact sensors in the case of haptic gestures.

Apple’s iPad is an interesting device to capture touch gestures with its multi-touch technology. Its reasonably large screen (9.7 inches) leaves space for displaying items easy to see and touch. In general, children love to touch things, since it is a natural interaction that requires no learning [12].

However, Falloon [11] provides a word of caution concerning iPads. They are not panaceas and they may well follow other “technological innovations” which have come and gone. Based on a study with 5-years old kids, he argues the key is in the design of the applications, which must convert motivation for using iPads to thoughtful engagement and productive learning. In particular, the apps should: i) communicate learning objectives in ways young students can access and understand; ii) provide smooth pathways to achieve goals; iii) include accessible and understandable instructions and teaching elements; iv) incorporate formative, corrective feedback; v) combine an appropriate blend of game, practice and learning components; and vi) provide interaction parameters matched to to the learning characteristics of the target student group [11].

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As stated above, this work is aimed at getting insight about the effect of the new human-computer interaction paradigm tablets impose on educational activities supported by them. We want to especially explore how the human-computer interaction paradigm, mainly based on gestures over a multitouch screen, is perceived by the learner, particularly by children aged 4 to 6 years. The reason why we think it is interesting to start the research with kids is first, because NUI are the most convenient way for them to interact since they might have problems typing commands and because they do not have the bias of having used for long time the direct manipulation human-computer interaction paradigm.

The strategy developed for conducting experiments and obtaining relevant data was to design a game-based learning application for the iPad which would include all the gestures we would like evaluate how they are perceived by the users, which they like most and whether they influence the motivation and the outcome of the learning process.

Since we did not find concluding evidence in the literature regarding which type of learning subject is more convenient for implementing such an experiment we decided to implement a second-language learning activity. More specifically, children have to match words they listen from the computer to a specific picture shown on the tablet’s screen. This is because there are examples of successful applications supporting language learning in the literature and we had the possibility to test it in a real scenario (see evaluation section). In order to make the evaluation of the various gestures simpler to the children we associated gestures with characters. In order to match a word with its corresponding picture children have to move the character to the picture of the word they listen. Different gestures move different characters:

The age of the users puts some restrictions to the development of the application since children of this age have not their psychomotor and cognitive totally developed. This means, the gestures the application implements should not be too complicated or fine grained. Children of that age tend to focus on one item at a time [Hourcade, 2007]. This may cause unexpected situations when interacting with a touch screen application. For example, if the user touches a button inadvertently hand is not occupied, and the display changes of view, may be frustrated by not identifying the cause of the event. Therefore, it is necessary to properly distribute the items on the screen, so that such errors can be avoided in a normal scenario of use.

Table . Table captions should be placed above the table

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# SYSTEM DESIGN

The software was implemented as an iPad application with children-oriented graphics. The application contains a set of pre-designed ‘scenes’. A scene is the representation of a physical place or a concept and includes a set of related elements. For example, one of the scenes is called ‘Family’, which contains graphic representations of portraits for family members (‘mother’, ’father’, ’daughter’, ’son’, ’pet’).

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