Utilizing Touch Technologies for Teaching and Feedback Processes in Open and Distance Learning

by
Adewale Adesina, Loughborough University UK
Email: a.o.adesina@lboro.ac.uk

ABSTRACT

It has been common practice for years to view the use of learning resources as an essential part of teaching and learning processes .The entrance of touch based devices into the consumer market is bringing about new opportunities for utilizing the highly interactive and mobile digital resources in education. Open and Distance Learning often require learners to be actively engaged with learning resources, however, not many studies have focused on single-touch and multi-touch devices as tools for engaging learners. This paper explores new innovative approaches of using tablet type devices to support assessment and feedback processes. It also discusses the potentials benefits of using the tools for collaborative learning interactions. Touch computing provides an intuitive and liberating way of interacting with digital content in a way that breaks down traditional barriers to technology so that students can work in a more intuitive, engaging and efficient manner.

INTRODUCTION

Education is a major catalyst for human development. Several studies have suggested that when learners are engaged they show sustained involvement in learning activities (Skinner & Belmont, 1993), consequently they are more likely to remain in the educational system. The role of Open and Distance Learning (ODL) in the attainment of the Millennium Development Goals and Education for All by the United Nations (United Nations, 2011) has been acknowledged in many studies.

Open learning and distance education refer to approaches to learning that focus on freeing learners from constraints of time and place while offering flexible learning opportunities (COL, 2000; Keegan, 1980). Distance education is characterized by: the separation of teacher and learner, the use of media usually print and electronic, to unite teacher and learner and to deliver content, the provision of two-way communication for dialogue and the possibility occasional meetings for both didactic and socialisation purposes (Keegan, 1980). ODL aims at bridging the time, geographical, economic, social, educational and communication distance between learner and institution, learner and academics, learner and courseware and leaner and peers (Bates, A. W., 1996) . For many learners, ODL provides opportunity for combining work and family responsibilities with educational goals.

In recent times, multi-touch technologies are becoming popular with tablet PCs and other multi-touch surfaces increasingly used in different teaching and learning scenarios. Several studies have argued that hand held tablet devices and smart phones have significant and very positive impact on learning and motivation of learners; leading to increased capacities to research, communication and collaboration (Banister, 2010; Gasparini, 2012; Heinrich, 2011). Analysts have predicted that the market for tablet computing will soon eclipse the market for desktop computing including laptops (UPI.com, 2012). As the digital landscape advances, it would seem that ODL should be poised to take advantage of the new innovations for rich educational experiences for teachers and learners. Multi-touch enabled devices like Tablets and iPads feature large-size touch screens for convenient operation, multimedia functions for sound and video playbacks, Wi-Fi/3G enabled network for easy connectivity, long battery life as well as small size for easy portability. They also provide a new way of user interaction through multi-finger/multi-touch gestures. However, because of their relative newness and uncertainties about potentials, the benefits to ODL, is yet to be widely explored and exploited.

This paper discusses affordances offered by touch based devices and explores innovative approaches of using tablet type devices to enhance learners' educational experiences. It then investigates using multi-touch gestures for problem-solving.

THE EMERGENCE OF TOUCH AND MULTI-TOUCH TECHNOLOGIES

Multi-touch refers to the ability to simultaneously register two or more distinct positions of input touches on a touch screen or surface. Multi-touch technologies present a novel opportunity to increase the input bandwidth between humans and the computer. Advances in computing hardware technology have led to higher processing speed, memory capacities, sensors and the number and size of pixels in digital cameras. As a result computers are getting smaller, cheaper and more capable of advanced functions. These developments have led to changes in the way humans interact with computers over the years. The command line interface (CLI), was the primary way of interacting with the PC in the 1970s. The arrival of the graphical user interfaces (GUI) of the 1980s brought about the WIMP interfaces (windows, icons, menus and pointing devices) as an improved method of interaction. In recent times the landscape is changing to natural user interfaces (NUI) i.e. multi-touch devices, voice control, gesture input and augmented reality (Wigdor & Wixon, 2011). VanDam (1997) described a Post-WIMP interface, as one containing at least one interaction technique not dependent on classical 2D widgets such as menus and icons which ultimately will involve all senses in parallel, natural language communication and multiple users. The multi-touch technologies are at the forefront of this revolution.

Affordances

The unique features and characteristics of multi-touch technologies present several advantages over traditional computers with mouse and keyboard. Some of these as highlighted by several studies are outlined below:

- *Abstraction*: Multi-touch removes abstraction form the interaction process. The direct manipulation of digital objects on the surface allows for working with virtual manipulatives directly instead of being mediated through another input device such as a mouse. A growing body of research based on embodied cognition theory suggests that physical manipulation of objects supports thinking and learning (Glenberg, et al, 2004; Moscovich, 2007; Segal, 2011)
- *Engaging*: The multi-touch environment provides a playful environment that engages users. Their interactive nature is engaging and appeals to a wide variety of learning styles (Heinrich, 2011). Skinner Belmont and (1993) argued that students who are engaged show sustained behavioural involvement in learning activities.
- *Collaboration:* The split of concurrent touch points between multiple users make it possible to create learning environments using large screens (for example multi-touch tables), which encourages collaborative learning and communication.(Don & Smith, 2010; Mercier & Higgins, 2013).
- *Bi-manual interactions*: The multi-touch favours two handed interaction which is common in the physical world (Bailly, Müller, & Lecolinet, 2012). Don and Smith (2010) showed that it allows for bimanual asymmetric text entry.

Devices, Platform, Vendors and Ecosystem

The multi-touch technologies include handhelds, tablets, tabletops and whiteboards. Smartphones are now used for browsing, navigation and running smaller computer programs called applications. Tablets or “tablet PCs” are fully functioning standalone computers the size of a thin LCD monitor, which use the screen itself for control and data input. These devices may be categorized based on the operating system that they run. So far, there are four main mobile operating systems: iOS , Android , Blackberry OS, and Windows Phone OS.

The iOS, which is a product of Apple, is run by the iPhone, iPod Touch and the iPad (tablet) exclusively. The system is closed and highly controlled; all applications must conform to the rules set by Apple. Android, a brainchild of Google, is a Linux-based, open source operating system that is run by a growing number of mobile phones, netbooks and tablets. The Android Market has been rapidly expanding. Blackberry iOS runs solely on RIM’s tablets and mobile phones, while Microsoft’s Windows Phone OS is run on Microsoft’s products and also available on Nokia devices. The Blackberry App World, and Windows Phone Marketplace only offer relatively fewer applications, but in the future their selection is expected to expand rapidly.

In 2007, when the iPhone mad it debut, a multibillion dollar market for mobile applications (apps) emerged. A native mobile app is a device-specific program designed to run on a mobile device and its associated OS. By most estimates, there are about 1.25 million native applications used in production today. This total is largely made up of iOS, Android and Microsoft applications deployed through their respective application stores (Charland & Leroux, 2011).

Native and Web Apps

The desktop and mobile software have evolved in different directions. On desktop computers, the most popular application for accessing content and applications on the Web is the web browser. In the mobile devices, the majority of web content is consumed via custom-built native apps.(Mikkonen, T & Taivalsaari, A, 2011). Native applications have the advantage of smooth user experience, good security for data and give room for innovation and profit within the ecosystem. However, users are restricted by third party vendor controls. The apps are not cross platform or based on open standards. Also native applications require different programming skill set. For instance, iOS apps require knowledge of C, Objective C; Google Android and RIM BlackBerry require skill sets in Java (Harmony flavoured, Dalvik VM, J2ME flavoured) while Windows Mobile require .NET skills (Charland & Leroux, 2011). In contrast traditional web sites and applications are not dependent on an app store, are not plagued by cross platform deployment costs, and have available programming expertise as web applications require only skills in HTML/CSS/JavaScript.

TABLETS FOR EDUCATION AND ODL

Allan Carrington (2012),recently created a Pedagogy Wheel for iPads for teaching and learning in education. It uses Bloom's Digital Taxonomy and provides suggestions for 62 iPad apps. The wheel provides ideas to learners (and staff) on the kinds of apps that can support the different kinds of thinking and learning across Blooms Taxonomy.

ODL seeks innovative ways for harnessing technology for meaningful learning. McCloskey, (2002) predicted that Tablet PC will benefit distance education after Touch technology hardware and software readily became available in the form of Tablets in 2002. Several initiatives have be explored by institutions like the iTunes U development, the OU Anywhere app of the Open University UK, and Tablet PC trials by the University of Southern Queensland (USQ) amongst others (Bird, Terese, 2011; Loch, Birgit & Fisher, Wendy, 2010). More recently, the University of Leicester used iPad to deliver a distance learning course. Every student on the course was given iPad on which they could download an app with all course materials (Leicester University, 2013). Findings from the study suggests that the portability and feel of the tablets encouraged students to spend time on the learning materials on the app in ways the traditional send out papers and books did not encourage. This trend is likely to continue especially as the tools become more affordable.

EVALUATION WITH MOBILE FRAMEWORK

As the base of mobile touch devices grow in education they should be properly evaluated for optimum value. The Koole's Model for Framing Mobile Learning (2009) provides a practical guide to evaluating a touched based mobile learning environments (see Figure 1).

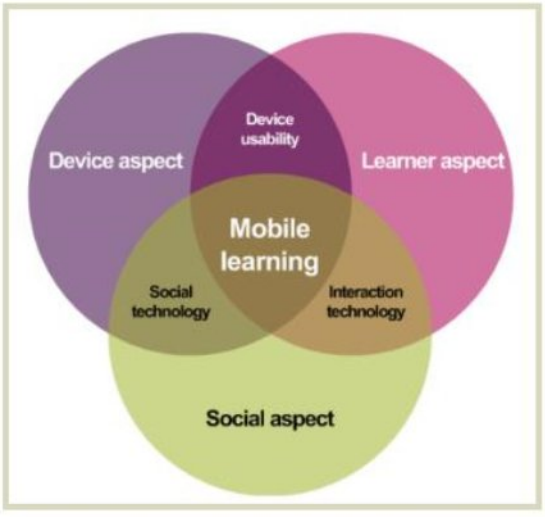

Figure1: FRAME: Framework for the Rational Analysis of Mobile Education (Source: Koole & Ally, (2006))

Of interest to this study is the device usability intersection. This intersection bridges needs and activities of learners to the hardware and software characteristics of their devices. It also relates the characteristics of the device to cognitive tasks associated with the manipulation and storage of information. Koole argues that highly portable, intuitive, and transparent devices can help to reduce cognitive load and increase task completion rates because the learner can concentrate on the tasks rather than the tools (Koole & Ally, 2006).

EMPIRICAL STUDY

Activity theorists have suggested that conscious learning and activity are completely interactive and interdependent (Jonassen, 2000). Because multi-touch provides increased opportunities of expression through direct and intuitive touch gestures, learners should be intrinsically motivated to learn from activities that are meaningful and natural to them on the devices. To test this hypothesis a problem-solving app was designed on the iPad. The environment is shown in Figure 2.

Design

The user interface has a simple design (see Figure 2). The workspace goes edge to edge on the screen with very few elements on top and it has no menus. Touch gestures are used to interact with elements on the screen and navigate to the different parts of the tool. The workspace is divided into two; the problem pane and the solution pane.

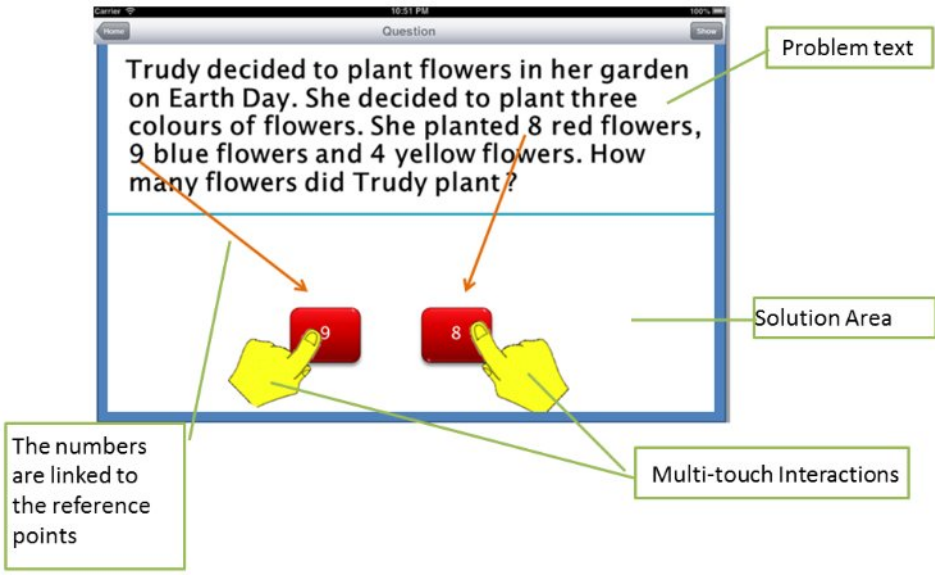

Figure 2: Multi-touch interaction for problem-solving

Experiment

The main pilot study conducted focused on problem-solving on a multi-touch environment using tap, drag and touch-and-hold gestures (Figure 2). Students were given simple mathematics problems and asked to attempt them with the gestures by manipulating draggable elements from the problem text. Nineteen participants were randomly selected for the experiment. An introduction session was given to each participant on sample question to intimate them on how to use interactive gestures to solve problems. After this, they were asked to work on three different problems. All participants receive immediate feedback on their performance.

Findings

To assess the usability of the multi-touch approach, the participants on completing the tasks were asked to respond on their being able to solve the problems. The overall response to this question was very positive. All the participants expressed that they were able to successfully carry out the tasks. Analysis of the detailed results generated on the tool showed that 98% of the participants had correct answers. Only one participant approached the problem the wrong way, this may be due to his lack of

proper understanding of the wordings of the question. To assess how comfortable the participants were with the gestural interactions, they were asked to response to a six item Likert-type question on how easy it was to use the tool. Over half (53%), responded that the found the tool moderately easy to use, 35% found it very easy while the others (15%) reported using it was sort of easy. These results show that the tool did not prevent from solving the questions and inputting answers thought to be correct. Eighty per cent of the participants responded that they enjoyed working and manipulating objects with their hands and gestures and would like to use interactive educational Apps.

The results of the small study demonstrated the feasibility of using gestures in multi-touch learning environments. The enthusiasm and positive motivation demonstrated by the participants suggests that further research into natural gesture interaction may benefit teaching and assessment processes.

CONCLUSION

The rapid advance of technology has resulted in the re-birth of the personal computer in the form of touch sensitive devices as smartphones and tablets. The high-mobility, convenient network connectivity, unique eco-system and smart application extendibility make then valuable for ubiquitous learning in formal and informal settings. In the small scale experiment on using multi-finger gestures for problem-solving tasks, participants demonstrated positive attitude and satisfaction towards the approach of interaction with digital content. This type of engagement and interaction may be valuable in motivating learners in their studies.

Recommendations

Developers and researchers should work together toward the design and delivery of effective high quality apps on mobile touch devices that can engage learners in remote locations to study and enjoy rich and natural educational experiences.

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