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The Potential of Kinect as Interactive Educational Technology

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Abstract. This paper explores the idea of Kinect as interactive technology and discusses how it can facilitate and enhance teaching and learning. Kinect is examined in terms of its affordances of technical interactivity, which is an important aspect of pedagogical interactivity. Though it has facilities to fabricate meaningful classroom interactions, Kinect technology can not stand alone in the classroom setting but needs to be integrated with a computer, projector and compatible software. As far as a teaching tool is concerned, due to the multiple interaction types it supports, Kinect has the potential to enhance classroom interactions and to increase the opportunities for student participation. As a learning tool, Kinect has the affordances to create enjoyable and interesting interactions types to boost student motivation. In addition, students can utilize the information gathered by Kinect with software programs to create highly interactive multimedia works. However, the implementation of Kinect in the classroom has constraints such as large classroom space, lack of standard development tools, and long calibration time.

Keywords: Kinect, interactivity, educational technology.

1. Introduction

Kinect is described as a revolution in the making as it provides a brand new type of interaction with computers (New Scientist, 2011). Kinect is a software enabled device which can capture, track and decipher body movements, gestures and voice. The audio and video information serves as commands to interact with digital contents presented in games or software programs. In other words, users do not need to be bound by keyboards, mice or joysticks and thus have intuitive and virtual experiences.

Over one million Kinect controllers were sold in 10 days after its US launch on 4 November, 2011. Its original intention is to be used in combination with Microsoft Xbox 360 for the purpose of enhancing entertainment experiences. Thanks to hacker's success and the release of open source drivers (Giles, 2010), Kinect is able to be connected to personal computers and to be used with software programs other than Microsoft Xbox. In addition, Microsoft has announced the release of a non-commercial Kinect software development kit (SDK) for Windows in the spring of 2011 and a commercial version in a later date. With these preliminary applications and future possibilities, the development of Kinect attracts many people's attention.

The appearance of Kinect also encourages educators to evaluate its feasibility in education. For example, Kissco (2011) expresses his excitement by predicating that Kinect will become a focal classroom technology in the next few years. As Kinect can actively track users, teachers and students can control learning materials by their body and voice without being bothered by wired or wireless devices. Consequently, Kinect seems to provide natural and diverse interactive experiences for teachers and students.

This paper, therefore, would like to explore the idea of Kinect as interactive technology and to discuss how it can facilitate and enhance teaching and learning. The analysis provides an examination of its affordances and emerging pedagogic opportunities.

2. Affordance and Interactivity

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In spite of the strong optimism for Kinect, the literature of educational technology (eg, Cuban, 1986) cautions us to take a critical perspective for fear that technological promise should be more than its reality. Lacina (2009) summarizes the benefits of integrating technology into the classroom including meeting the needs of visual learners, more interactively teaching whole-class lessons, and better engaging students. But the introduction of ICT resources to schools seems to have relatively little impact on the ways that teachers teach (Watson, 2001). Consequently, it is important to evaluate an educational technology not only in the terms of its functions but also in terms of its affordances. In other words, the potential of technology should not be addressed independently of the classroom activities it supports. John and Sutherland (2005) argue that 'it is the relationship between the pedagogy within a subject area (the practice in the setting), the subject domain and its culture (the ecology of the setting) and the technology (the tool within the setting) that is crucial to engendering quality learning' (p. 405).

Interactivity has long been identified to contribute to successful teaching and learning. The degree of interactivity is judged by how much teachers control classroom interactions. Characterized by long teacher talk, brief student response and quick feedback, the traditional, triadic recitation script of initiation-response-feedback (IRF) is deemed to have little deep participation from students. Without sufficient student participation and engagement, classroom activities can not create proper pedagogical opportunities for students to interact with content knowledge. As identified by Burns and Myhill (2004), interactive lessons need to have four important characteristics including reciprocal opportunities for talk, appropriate guidance and modeling, environments for participation and an increase in the level of student autonomy.

Interactivity is the most perceived advantage of ICT in terms of its support for teaching. Beauchamp and Kennewell (2010) argue that interactivity is defined as the ability to respond contingently to learner's actions. In the case of interactive whiteboards (IWBs), they serve as a fortified version of chalkboards, allowing users to manipulate physically with text and image. In addition, when writing on IWBs, users can easily write in different colors with finger touch, erase contents, move and resize objects, and utilize the library of images provided by the IWB software. Furthermore, an IWB is actually an extension of a computer. Users can control the classroom computer via the connected IWB. As IWB technology contains a variety of interactive features, they have great potential for pedagogical interactivity.

The term 'interactivity', therefore, can be used to describe technical interactivity as technology serves as an interface between the user and the material, and pedagogical interactivity, which is itself a teaching strategy (Kennewell, Tanner, Jones & Beauchamp, 2008). In order to enhance the interactivity of classroom activities, technology needs to provide interactive affordances, which can be implemented to support interactive teaching strategies and to create pedagogical opportunities.

3. Affordances of Kinect in the Classroom

Though it has potential to facilitate natural interaction, Kinect needs to be situated in combination with software and other hardware in order to fabricate meaningful classroom interactions. Compared with IWBs (price ranges from about $800 to $2,500), Kinect is relatively cheap as it costs around $149. If the classroom is equipped with a projector and a computer, Kinect can be regarded as an inexpensive add-on. So far the applications for Kinect in education are still in the development stage. Recently, a German company, Evoluce, utilizes Kinect depth sensor and develops a software program, Win&I, to enable gesture control over Windows 7 desktop, browsers, Microsoft Office and other applications. Teachers are flexible in terms of their positions because Kinect can actively track their movements and gestures within four meters to the screen. If Win&I or similar software programs can be made easily accessible, most things that can be done with IWBs can essentially be done with Kinect. However, similar to the case of IWBs, the facilities of Kinect are largely dependent upon the software used. So far there have been few handy software programs for teachers to create Kinect-enabled contents. If Kinect comes with software for teachers to design the control over computers, it would surely become a powerful interactive technology. Based upon its facilities and preliminary applications, the following analysis intends to depict Kinect's potential in two broad categories: a tool to enhance teaching and a tool to support learning

3.1. A Tool for Teaching

Kinect and IWBs share some similarities as both intend to enhance the level of interactivity of the current technology-enabled classroom. Smith, Higgins and Miller (2005) review the potential benefits of IWBs for teaching and find that the benefits derive from six major themes: flexibility and versatility, multimedia/multimodal presentation, efficiency, supporting planning and the development of resources, modelling ICT skills, and interactivity and participation in lessons. In terms of interactivity and participation, they (2005) suggest that students seem eager to come up to the board and enjoy interacting physically with IWBs. Though the idea of finger touch as a controller may sound ordinary, the IWB-enabled activities make students feel like a magician and thus boost their willingness of participation. Connected to computers and projectors, Kinect can provide natural and intuitive interaction patterns via body, gesture and voice control over digital contents; thus, student participation can surely be promoted.

Another potential benefit is the increase of opportunities for interaction and discussion. In order to exploit Kinect's technical affordances, classroom activities should be designed to use the information gathered by Kinect. It follows that the pedagogical strategies should encourage student participation by body movements, gesture and voice. In the context of IWBs, Lancia (2009) observes that ESL teachers ask students to walk to the whiteboard and place words in the correct column by dragging the cursor. Such pedagogical strategy is reported to be useful as it allows students time to engage in the mental representation of the target words and provides a space for discussion. Kinect can present similar or even better pedagogical opportunities and can be viewed as a viable alternative for IWBs.

In terms of a tool for teaching, Kinect has the following characteristics. First, Kinect is a flexible teaching tool. Teachers can interact with contents via body movements, gesture and voice without using keyboards or mice. Second, Kinect can accommodate multiple users; therefore, students can have a fare share of control over interactions. A Kinect-enabled classroom can support whole-class instruction, group work and teacher-student one-to-one interaction. Third, it is a versatile tool. As it collects 3D information, Kinect can support various teaching activities such as dance and martial arts. Special instructional design can be implemented to reinforce the connection between teaching contents and student physical responses. For example, when students see a clue, they need to act out in order to proceed. If designed properly, the interactive contents can enable students' vicarious participation in physical activities. Fourth, Kinect engages students. Compared with those enabled by IWBs, the interactions enabled by Kinect support multiple physical engagement patterns, involve more time on task from students, and imply better utilization of multiple intelligences.

3.2. A Tool for Learning

As a tool to support learning, the affordances of Kinect can be analyzed in two major aspects. First, it is a stimulating tool. One major advantage claimed in the IWB literature concerning the benefits of learning is motivation and affect (Smith, Higgins & Miller, 2005). If lesson plans and interactions are carefully designed, the Kinect-enabled classroom should have the affordances to create enjoyable and interesting interaction types to boost student motivation.

Second, Kinect can be used with software programs to enhance its role as a learning tool. The idea of a learning tool aligns with constructivism, which emphasizes building external, sharable artifacts and personal relationship with knowledge in the process of learning (Papert, 1980 & 1996). Educational software is designed to facilitate the construction of personal representations of knowledge. Due to the fact that Kinect can gather information from users, students can add creativity to their multimedia works by feeding the information into the programs. In this way, Kinect can extend the varieties of interaction types supported by the software programs and bring new features to the multimedia works created by students. Two creativity tools, Scratch and Mikumikudance, are demonstrated in regard to their application of Kinect.

Scratch（http://scratch.mit.edu/）is an educational programming language developed at MIT media lab. It is a learning tool as well as a cognitive tool for kids to explore different subjects of interest. Scratch can connect to sensors such as Picobard and LEGO WeDO for different types of interaction with the real world. With the effort of Stephen Howell (http://stephen-howell.tumblr.com/), the body information containing the x-, y- and z- axis values captured by Kinect can be fed into Scratch via OpenNI2Scratch program. For example, KinectSkeleton (shown in Fig. 1) is a game created by Stephen Howell, in which Scratch, the main character, can map the positions of the user's skeleton. With Kinect sensors, children can create their stories or games with fun and good interactions.

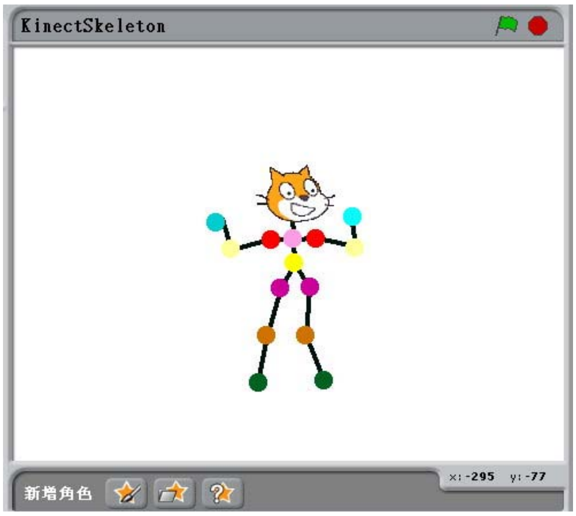

Fig. 1: KinectSeletion Program

Mikumikudance, commonly abbreviated to MMD, is a free animation program for novice animators to create 3D animations. This program has been popular among young people for its easy and quick implementation. With the advent of Kinect, a plug-in is made and expanded by Mr. Mogg to get the motion of neck, wrist, upper body, lower body, and ankle in MMD Kinect motion capture. Instead of manually manipulating joints, animators can make use of Kinect plug-in to do a quick 3D animation by acting out. Figure 2 is a screen capture of a 3D model mapping the movements of the user (the red man).

Fig. 2: MMD program with Kinect plug-in

4. Constraints

Implementation of Kinect is not without technical constraints. First, the implementation of Kinect requires enough empty space to the screen, which might be difficult to find in a regular classroom. Second, calibration takes time, which may result in the waste of instruction time. To begin with, it may take up to a few minutes for Kinect to track a new user. In addition, sometimes situations arise for re-calibration when students walk out of the range that Kinect can reach or when calibration is not done correctly. Third, there are very few software programs and teaching materials available that utilize the capabilities of Kinect. Fourth, in order to make good use of a multitude of information gathered by Kinect, including the information generated from multi-user scenarios, a standard SDK is needed for future software development.

5. Summary and Implications

The above analysis suggests that Kinect has great potential to enhance classroom interactions and to ignite student creativity. Kinect technology, however, can not stand alone in the classroom setting but needs to be integrated with a computer, projector and software. Customized software to facilitate classroom interactions and to create Kinect-enabled contents seems to be missing in the picture of integration. Therefore, the evaluation of Kinect as the focal classroom technology largely depends on the future development of Kinect software. Software design needs to incorporate the design of interactive pedagogy in order to exploit its technical interactivity.

Judging from the preliminary applications, Kinect is capable of being a tool to enhance teaching and a tool to support learning. This paper draws the connections between Kinect and IWBs and believes that Kinect can provide better interaction types and fulfil most of the facilities offered by IWBs. One advantage that is absent in IWB literature is that Kinect has the facility to gather information which can later be fed into student creativity tools. Its application in Scratch and MMD serves to diversify student representations of knowledge. Future studies are needed to address student creativity enabled by Kinect.

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