Gender Issues In Virtual Reality Learning Environments

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ABSTRACT: Virtual environment for education have been discussed in various ways. A virtual learning environment plays an important role in one of the main aims of education and it is designed to educate the user either in school level or at higher learning institutions. The question of how technological advances in this field will impact education is difficult to answer at present with any degree of certainty, but is one that must be considered by educational researchers, teachers, and administrators. Virtual Reality (VR) has been shown to be an effective way of teaching difficult concepts to learners. VR helps instructors motivate students to discover those essential links in a fresh, exciting educational environment which develops well-rounded thinking and real-world behaviors.This study examined gender-related issues in using new virtual reality (VR) technology as a learning tool in career and technical education. this paper reviews the effects of virtual reality learning environment explanation with particular reference toward gender differences in spatial abilities. Finally, this paper will discuss the issues of virtual reality learning environment on gender differences in spatial abilities.

ABSTRAK : Realiti maya dalam dunia pendidikan telah dibincangkan dalam pelbagai cara. Persekitaran pembelajaran realiti maya memainkan peranan penting dalam pendidikan dan direka untuk mendidik pengguna baik di peringkat sekolah mahupun di institusi pengajian tinggi. Persoalan tentang bagaimana kemajuan teknologi di dalam bidang ini mampu memberi impak dalam pendidikan agak sukar untuk dijawab dengan tepat, tetapi ia adalah salah satu bidang yang harus diberi tumpuan oleh para penyelidik pendidikan, guru, dan pentadbir. Realiti maya telah terbukti sebagai cara yang berkesan untuk mengajar konsep-konsep yang sukar untuk diajar kepada pelajar. Realiti maya membantu pengajar mendorong pelajar untuk mencari hubungan pembelajaran dengan persekitaran dan mewujudkan suasana pendidikan yang menarik untuk membina pemikiran yang sempurna dan tingkahlaku dalam dunia nyata. Kajian ini mengkaji isu-isu berkaitan jantina dalam menggunakan teknologi baru realiti maya sebagai satu alat pembelajaran dalam kerjaya dan pendidikan teknikal. kajian ini membincangkan kesan-kesan penjelasan persekitaran pembelajaran realiti maya dengan merujuk khusus ke arah perbezaaan-perbezaan jantina dalam kebolehan ruang.

1.0   INTRODUCTION

The evolution of educational system based on technology is currently under-going radical revision. Virtual Reality is a rapidly growing area and involves the immersion of the user into a 3D virtual world of computer generated objects with which the learner can interact. Virtual reality is an advanced form of human-computer interface that tries to explore the human senses in order to obtain a high quality interface. Many reason have been shown to justify the use of virtual reality in education, indicating that this techniques has great potential. For educational purposes, virtual reality has been proposed as a technological breakthrough that

holds the power to facilitate learning. The educational benefits offered by this technology include ability to take students into environments otherwise inaccessible, the high memory-retention of "experience" as opposed to passive observation, and the ability to reach out to visually oriented learners and global learner. Virtual Reality is a powerful computer based tool for education since people comprehend images much faster than they grasp lines of text or columns of numbers. Participation is critical to learning and VR offers multi-sensory immersive environments that engage students and allow them visualize information.

For a long time, science and engineering education has relied on drawings and pictures to describe a variety of systems and objects sometimes accompanied by laboratory experiments with real systems for hands-on practice. It is now possible and easy to generate virtual models of systems.   Developments in this technology provide new tools and approaches to facilitate better learning-teaching environment.   Before we can take full advantage of this new tool, we must first study its strengths, weaknesses, and capabilities, in order to determine how best to apply VR to engineering education, practical engineering, and scientific visualization.

2.0   VIRTUAL REALITY

Virtual reality is a devise used to enable people to deal with information more easily. It is provides a different way to see and experience information beside being used as a tool for model building and to enhance problem solving skills. VR is described as a cutting-edge technology that allows learners to step through the computer screen into a 3-D interactive environment. Generally, there are two major types based on the level of interaction and immersive environment (E.A.-L. Lee and K.W. Wong, 2008). The first category, known as immersive VR, is based on helmet mounted or immersive display technologies. The second category, nonimmersive VR, or, sometimes, desktop VR, presents images on a normal monitor and allows the user to interact with the computer-generated images. Although the user is not technically immersed, it is considered as a VR system because it is comparable to viewing a real world through a window. Thus, it appears the world exists, looking at it via a monitor. This type of system does not depend on complex and expensive peripherals. The use of normal computer display in a nonimmersive system means that the same display can be used to perform other computing tasks when it is not displaying a virtual model, and interaction with virtual worlds can be performed using conventional input devices, such as mouse or keyboard. Unlike many other educational tools, a virtual environment is designed without a specified sequence. Its focus shifts from prescribed interactions with the learning environment to environments that permit the learner to engage in various types of interaction that the system is capable of supporting. In this learner-centred approach, learners control what they want to explore or manipulate. They can choose to navigate through the simulated environment, or interact with the objects of their interest, for further observation. By doing so, the learner may make mistakes or wrong predictions. These experiences will provide conditions for modifying existing knowledge and thereby construct new knowledge (Dijkstra, 1990). This is also known as discovery or experiential learning where it is based on the assumption that a learner discovers principles through experimentation and practice (Alessi & Trollip, 2001). VR is basically a way of simulating or replicating a 3D environment through computer-generated and giving the user a powerful experience of "being there," taking control, and actively interacting with the environment and its contents (Ausburn & Ausburn, 2004, 2008b; Ausburn, Martens, Dotterer, & Calhoun, 2009; Beier, 2004; Brown, 2001). What is important about the recent major technical advances in VR for career and technical

education educators is that these technologies now bring the advantages of VR experiences within the technical capabilities of most schools and instructors. Because of the improvements in the technical capabilities and features of VR and its accessibility to schools, teachers, and organizations, this technology is emerging as an important new tool for career and technical education programs.

Recent literature reviews of published research (c.f., Ausburn & Ausburn, 2004, 2008a, 2008b; Ausburn, Ausburn, Cooper, Kroutter, & Sammons, 2007; Ausburn, Ausburn, Ashton, Braithwaite, Dotterer, Elliott, Fries, Hermes, Reneau, Siling, & Williams, 2006) have consistently showed the effectiveness of virtual reality (VR) as a learning tool in a variety of learning purposes. The research has shown that many educational institutions, industries, and organizations are now using VR to provide effective and cost-efficient ways of teaching and learning preparation. The field most often reported in the VR literature is medical or dental, where lots of published studies have attested to VR's benefits (Harb, Adams, Dominguez, Smith, & Randall, 2005; Imber, Shapira, Gordon, Judes, & Mitzgar, 2003; Jaffe & Brown, 2000; Jeffries, Woolf, & Linde, 2003; Mantovani, Gaggiolo, Castelnuovo, & Riva, 2003; Moorthy, Smith, Brown, Bann, & Darzi, 2003; Patel, Gallagher, Nicholson, & Cates, 2004; Riva, 2003; Seymour, Gallagher, Rorr, O'Brien, Bansal, & Anderson, 2002; Urbankova & Lichtenthal, 2002; Wilhelm, Ogan, Roehaborn, Caddedder, & Pearle, 2002). Engineering has also reported considerable success with virtual reality instruction reality instruction (Sulbaran & Baker, 2000). Besides that, a variety of field and industries have showed positive improvement in the virtual reality research literature. Application of VR technology for career training has also been reported in recent years in a variety of other fields such as aerospace, petroleum, equipment design, manufacturing, accident investigation and analysis, law enforcement, driving, aircraft inspection and maintenance, and facilities planning (e.g. Flinn, 2005; Government Technology, 2003; Halden Virtual Reality Center, 2004; Jezernik, 2003; Sandia National Laboratories, 1999; Scavuzzo & Towbin, 1997; Sims, 2000; Shneidermann, 1993).
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3.0   GENDER DIFFERENCES AND VIRTUAL ENVIRONMENTS

While VR has shown positive impact in learning outcomes, some studies has also shown that this effectiveness has not been identical for gender differences. Research has identified several conceptual areas that suggest reasons for differential effects of virtual environments across genders. These include visual and spatial functioning, human navigation and wayfinding theory, and socially- and culturally-influenced perceptions of and experiences with computer technology. These factors come together in self-efficacy theory, as each influences the formation of an individual's technological self-efficacy, which determines an individual's performance and perception of that performance in a technology learning environment such as VR. This conceptual framework is shown in Figure 1.
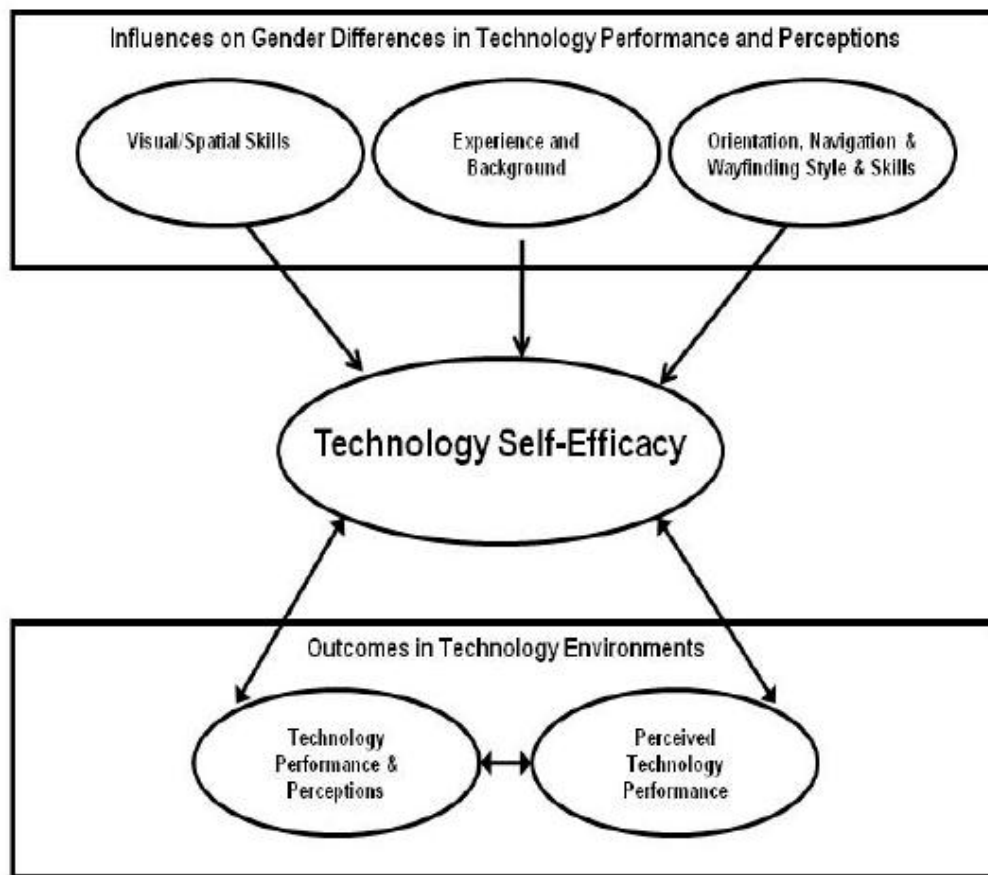
Figure 1: framework for gender effects in technology-based learning environments applies specifically to virtual reality environments.

(Adapted from: Lynna J. Ausburn*et. al*., 2009)

In the area of *visual-spatial functioning*, half a century of research history with paper-and-pencil and performance tests such as the *Differential Aptitude Tests* (Bennett, Seashore, & Wesman, 1973), the *Cards Rotation Test*, (Allen, 1974), the *Generic Mental Rotation Test* (Hakstian & Cattell, 1975), the *Primary Mental Abilities- Spatial Relations Test, (*Keyes 1983*)* and the Guilford-Zimmerman (1948) test of spatial orientation have revealed consistent gender differences in skill in mental rotation/manipulation of objects and spatial orientation, with females generally having lower skill and greater difficulty than males in these cognitive tasks. Numerous studies have documented this gender discrepancy. For example, Linn and Peterson (1985) and Voyer, Voyer, and Bryden (1995) both reported higher performance levels by males on mental rotation and spatial visualization tests. Terlecki and Newcombe (2005) claimed that facilitation of computer experience through training may have differential effects on men's and women's spatial performance, and reported that men not only perform at higher levels than women on tests of spatial and mental rotation ability, but also tend to have more spatial experiences. Research evidence has also suggested that the long-observed gender gap in mental rotational skills is exaggerated in virtual environments, and that men and

women perceive virtual experiences quite differently, with men preferring more interactive environments than women (Space, 2001; University of Washington, 2001). Waller, Knapp, and Hunt (1999) asserted that:

(a) understanding the spatial characteristics of virtual environments may be more challenging for women than for men.
(b) in general, tests of mental visual manipulation and spatial orientation – in which females have typically been less skilled than males – are highly predictive of the ability to acquire accurate spatial information in a virtual environment.
(c) gender-related differences in proficiency with a VR navigational interface are particularly important in determining ability to acquire spatial information.
(d) individual differences related to gender and cognitive ability account for more variance in performance on tasks requiring spatial knowledge acquisition from virtual environments than does the actual visual fidelity of the VR representation of the physical world.

According to Waller (2000), women who used VR were statistically less likely to derive accurate spatial information from it than men, and that gender was one of the most powerful predictors of spatial knowledge transfer in virtual environments. Similarly, other studies of virtual environments have reported gender differences in favor of males on a variety of performance measures (Waller, Hunt, & Knapp, 1998a, 1998b; Waller, Knapp, & Hunt, 1999). One possible explanation of at least part of observed male advantage in acquiring and using spatial configurational information in complex environments has been proposed by both Hunt and Waller (1999) and by Lawton (1994; Lawton, Charleston, & Zieles, 1996). The explanation proposed by these researchers is based in *human wayfinding and navigation theory*. The proposed rationale for male advantage in spatial wayfinding is that it can be at least partially attributed to gender differences in specific strategies used during the "wayfinding" process. They proposed that males tend to use wayfinding strategies appropriate for navigation (e.g. bearing to landmarks), while females concentrate on strategies more suitable to tracking and piloting (e.g. describing control points and route cues such as street signs).

This notion of technology self-efficacy raises the possibility that gender differences in success with learning from and in virtual environments may be related to different experiences and perceptions of digital technologies. The technology literature of the 1980s – 2000 period presented many studies showing that attitudes toward technology differed significantly between males and females, reporting that males had greater interest in and knowledge of technology, and that females perceived technology as more difficult and less interesting. Typical of the period were studies by Temple and Lips (1989) that found males generally reported more comfort and confidence with computers, and by Waller, Knapp, and Hunt (1999) that found gender-related differences in prior computer use accounted for considerable variance in performance on tasks requiring gaining spatial knowledge from VR. Also abundant over the last 15 years have been studies documenting female "technophobia" and computer anxiety (e.g. Gilbert, Lee-Kelley, & Barton, 2003; Rainer, Laosethakul, & Astone, 2003; Schumacher & Morahan-Martin, 2001; Todman & Day, 2006; Weil & Rossen, 1995; Whitley Jr., 1996).

Bain and Rice (2006-2007) recently reviewed the body of literature on gender and technology and then addressed the question of whether gender differences in perception and use of technology still existed. They found that the majority of females in their study did not perceive computers as being difficult and were using them more than in the past, but did not have the same level of confidence or technology self-efficacy as their male peers. In another

recent study, Hogan (2006) documented the persistence of higher levels of technophobia among older women and men in Ireland, suggesting this persistence may not be confined to the United States.

Research has frequently identified gender as a strong predictor of technological self-efficacy, with females more likely to rate self-perception of their computer skills lower than males (Bain & Rice, 2006-2007; Busch, 1995; Hargittai & Shafer, 2006; Hogan, 2006; Temple & Lips, 1989). Women have also frequently reported less confidence and more anxiety with usage of spatially-related materials and computer software (Terlecki & Newcombe, 2005). It would thus appear from the research evidence that despite gains in their positive perceptions and usage of computers, females may still lag behind males in technology self-efficacy, which may continue to impact their performance in high-technology learning environments such as VR.

Several reasons have been proposed for gender differences in technology self-efficacy. These have included (a) the spatial ability differences discussed by Waller and his associates, (b) differences in interest and experience with video games and related technologies such as VR (Philips, Rolls, Rouse, & Griffiths, 1995), (c) psycho-social gender differences in preferences related to functions and features of games (Heeter, Chu, Mishra, Egidio, & Lee, 2005; Heeter, Mishra, Egidio, & Wolf, 2005; Heeter & Winn, 2005; Heeter, Winn, Egidio, Mishra, & Lownds, 2003; Heeter, Winn, & Greene, 2005), and (d) a general "masculinization" of computer gaming and related technologies. For example, Graner (2004) asserted that males are encouraged to gain pleasure from aggressive behavior and competitive play of violent games while females, because of their historically more nurturing care-giving roles, are less comfortable with aggressive competitive violence in gaming.

The relationships among the variables impacting the gender differences observed in research on learning technology have been well documented over more than two decades in the reported literature in educational technology, computing and information sciences, cognitive sciences, and sociology. This research history was synthesized by Cooper (2006) in an extensive review of 20 years of digital divide literature based on gender. In a psychological analysis of these variables, Cooper contended that the gender digital divide in technology self-efficacy and performance is fundamentally a problem of computer anxiety rooted in gender socialization interacting with stereotype of computers as toys for boys. For Cooper, this anxiety leads to, and manifests itself in, the differences in computer attitudes and performances that are frequently observed and reported in cross-gender computer studies (2006).

4.0   CONCLUSION

Engineering Education can be greatly enhanced and facilitated by the use of virtual reality. Virtual reality offers a large array of potential uses. Regarding the educational benefits of VR, we feel that VR can benefit some students in some situations, when it is properly implemented. However that implementation is not straightforward. And VR should not be considered as replacement for real experiences when the latter is available. VR should be used as supplement to real experiences, and/or in situation where the real experiences is inaccessible. Increasing numbers of education programs and industries are taking advantage of cost-effective VR technology and are using VR for instruction and for product development and prototyping. Mastery of complex or dangerous environments, risk-free manipulation of expensive equipment, cost-effective product development and evaluation, and interactive exploration of multivariate problems are all now feasible at the desktop in virtual

settings. New high-quality VR is now within the technical and fiscal reach of many schools, programs, and instructors. These developments have important implications for career and technical education programs in which mastery of such skills are frequently critical in providing optimum curricula. However, if VR is to reach its full potential as a career and technical education programs instructional tool, it will be the task of VR designers to develop, and of career and technical education instructors to carefully evaluate and select, user interfaces and implementation strategies to overcome gender-specific limitations of this medium. career and technical education instructors wishing to implement VR in their curricula should be aware of potential gender-related learning issues and take steps to maximize the learning benefits of this exciting new technology for everyone.

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