THE EFFECTS OF 2D AND 3D REPRESENTATIONS IN SECOND LIFE ON STUDENTS' PERCEPTION AND PERFORMANCE IN LEARNING JAVA PROGRAMMING IN SAUDI ARABIA

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BY

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DEDICATION

This work is gratefully dedicated to my family. A special feeling of gratitude to my superb and beloved parents, who are thousands of miles away, my fabulous wife, my magnificent brothers and sisters, and my adorable children. To all who supported my work and managed to understand when I had little time to spend with them. To those who were patient and continued to give me great encouragement. Thank you for being there for me through thick and thin.

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TABLE OF CONTENTS

LIST OF TABLES **Page**

LIST OF FIGURES

LIST OF ABBREVIATIONS

2D	Two Dimensional
3D	Three Dimensional
CS	Computer Science
CSD	Computer Science Department
SL	Second Life
VLE	Virtual Learning Environment
VW	Virtual World

KESAN PERSEMBAHAN 2D DAN 3D DALAM SECOND LIFE KE ATAS PERSEPSI DAN PENCAPAIAN PELAJAR DALAM MEMPELAJARI PEMPROGRAMAN JAVA DI ARAB SAUDI

ABSTRAK

Pengkaji mendapati bahawa kebanyakan pelajar sains komputer mempunyai pemahaman konsep Java yang terhad dan disebabkan ini, mereka seringkali mengalami kesulitan dalam visualisasi ruang pembelajaran. Justeru itu, pengkaji berharap untuk meningkatkan kebolehan para pelajar agar memahami ketelitian konsep mempelajari Java secara lebih jelas dalam penulisan kod. Kajian ini meneliti aspek sikap, persepsi, motivasi, keupayaan diri dan pencapaian pelajar di Kolej Perguruan, Arab Saudi dan perbandingan dalam penggunaan dua dimensi (2D) dan tiga dimensi (3D) serta faktor-faktor yang terlibat telah dilakukan. Penggunaan 2D dan 3D dibina dengan simulasi ruang informasi kompleks didalam SL. Pelajar yang menggunakan kandungan 3D dapat melihat hasil Java dengan kadar segera selepas merekakan model, objek atau menguji teori berkenaan konsep model yang digunakan mereka. Manakala pelajar yang menggunakan 2D hanya dapat menyaksikan sebahagian kandungan Java. Oleh itu, para pelajar telah memperolehi pengalaman baru dengan melihat hasil baru yang diperolehi dalam penggunaan 2D atau 3D. Hasil tindakan tersebut telah dapat membantu pelajar untuk merangka solusi penyelesaian untuk masalah pengaturcaraan program dan membolehkan mereka menyelidik penggunaan 2D dan 3D untuk menghurai dan menggabungkan pengalaman baru yang mereka perolehi. Sebuah rekabentuk eksperimen yang setaraf dengan rekabentuk kumpulan telah diguna pakai untuk tujuan kajian ini. Kajian ini melibatkan 77 orang pelajar yang telah dibahagikan kepada dua kumpulan secara rawak berdasarkan pencapaian kursus Java mereka sebelum ini. Pelajar dalam kumpulan terkawal telah menggunakan 2D dan pelajar dalam kumpulan ujikaji telah menggunakan 3D. Keputusan menunjukkan bahawa penggunaan kandungan 3D di dalam SL secara jelas menunjukkan kemajuan dalam sikap, persepsi, motivasi, keupayaan diri dan pencapaian para pelajar Java. Kebanyakan pelajar yang terlibat dalam penggunaan 3D mempunyai kurang atau langsung tiada pengalaman melibatkan Java. Tambahan lagi, pelajar yang tiada pengalaman dalam penggunaan 2D dan 3D mempunyai sikap, persepsi, motivasi, keupayaan diri dan pencapaian yang lebih memberangsangkan.

Secara keseluruhannya, penggunaan 3D dalam SL adalah sangat bersesuaian untuk pelajar yang kurang berpengalaman. Kajian ini adalah selari dengan prinsip teori simulasi yang telah diadaptasikan dalam penyelidikan ini.

THE EFFECTS OF 2D AND 3D REPRESENTATIONS IN SECOND LIFE ON STUDENTS' PERCEPTION AND PERFORMANCE IN LEARNING JAVA PROGRAMMING IN SAUDI ARABIA

ABSTRACT

The researcher found that most computer science's students have a limited understanding of the main concepts of Java and have difficulties in visualizing learning spaces. The researcher aims to study the ability of students to understand the concepts of learning Java when writing codes. This study examined the attitudes, perceptions, motivations, self-efficacies, and achievements of the students in the Teachers' College, Saudi Arabia by comparing the contributions of a three dimensional (3D) representation to such factors with the contributions of a two dimensional (2D) representation. The 2D and 3D representations are constructed in Second Life (SL) by simulating a complex information space. Students in the 3D content representation used the outcome of Java after creating models, objects or testing their theories about their modeled concepts. By contrast, students using 2D representation only used the slides of Java contents. Hence, learners acquire new experiences by watching new actions presented in 2D or 3D representations. These actions help learners devise solutions for their programming problems and help them investigate 2D and 3D representations to abstract and to consolidate their newly acquired experiences. A true-experimental design was adopted in this research, a posttest only equivalent-groups design. The study involved 77 students, who were assigned randomly into two groups. The students from the control group used 2D representation, whereas those from the experimental group used 3D representation. Results showed that the 3D representation of content in SL significantly improved the attitudes, perceptions, motivations, self-efficacies, and achievements of the students in learning Java. Most students with one year experience in Java actively participated in the 3D more than in 2D representation. Moreover, students without any experience in 2D representations possessed higher attitudes, perceptions, motivations, self-efficacies, and achievements than the experienced students. Overall, the use of 3D representation in SL is highly suitable for students with little experience. This finding is in line with the principles of simulation theory adapted in this study.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

The adoption of information technology has introduced a new culture of learning or instructional paradigm to the present education system (Dougiamas, 2004). These technologies include virtual learning environments (VLEs) such as Second Life (SL), which has been identified as a three-dimensional (3D) virtual world (VW) (Minocha & Reeves, 2010). Educational institutions all over the world are adopting SL to support their teaching and learning methods (Kaplan & Haenlein, 2009).

Also known as an artificial world, a 3D VW is a synchronous, persistent virtual environment in which multiple users can participate through connected computers (Jarmon, Traphagan, Mayrath, & Trivedi, 2009). In this environment, users are represented by avatars, and they practice different learning tasks with other users regardless of their geographical distribution (Warburton, 2009). The 3D representation of the contents within the virtual environment facilitates communication and collaboration between users, thus improving their ability to utilize traditional communication cues of face-to-face interactions that they cannot utilize in two-dimensional (2D) VW environments (Andreas, Tsiatsos, Terzidou, & Pomportsis, 2010; Bronack, Riedl, Tashner, & Greene, 2006). Users in 3D VWs synchronously interact with one another through their avatars and converse with one another in real time through gestures, audio, and text-based (e.g., chat and instant messaging) communication (Minocha & Reeves, 2010).

SL provides both 2D and 3D representations for different education domains and enables users to customize and utilize their learning materials easily (Warburton, 2009). Therefore, many educational institutions (such as Monash University, Australia (Henderson, Huang, Grant, & Henderson 2009) and University of Trás-os-Montes e Alto Douro (UTAD), in Vila Real, Portugal (Esteves, Fonseca, Morgado, & Martins 2011)) have begun to use SL for different purposes, such as for distance education, presentations and meetings, historical recreations, and literature and language acquisition(Wankel and Kingsley, 2009). The absence of a guiding narrative in SL allows educators to design learning spaces for their pedagogical needs (Jamaludin, Chee, & Ho, 2009). In other words, educators can design the learning space for their pedagogies based on the represented dimensions of the contents rather than the other way around, such as in other off-the-shelf VLEs.

The representation of 2D elements in online environments may confuse some users with regard to the structuring of the contents (Dougiamas, 2004). These environments usually comprise classroom settings and features, such as discussion forums, calendars, and chatting spaces, in which students can communicate with one another in real time (Sánchez & Hueros, 2010). SL-based 2D representation allows the customization of files, such as text documents, sound files, pictures, and videos, which can then be uploaded to a virtual classroom for the viewing of students. This customization feature makes the learning environment resemble a personal website in which students can control their learning process.

Wang, Low, and Woo (2013) reported that the utilization of 3D virtual environments in educational institutions could match the attitudes and perceptions of students toward the learning services that these environments offer. Online environments provide students with a sense of place and context that motivate them to develop their learning skills as well as to build and share their learning experiences (Conrad & Donaldson, 2011). The design of physical learning spaces also provides students with a sense of belonging (Oblinger, 2006). Therefore, designers must aim to recreate the learning vision of an educator or institution when modeling new learning spaces (Downey, Mohler, Morris, & Sanchez, 2012).

Learning a programming language involves several difficulties. Rodger (2002) stated that programming is a difficult subject for beginners to learn considering the required set of programming-related skills. Such difficulty is reflected in the great number of programming students who have failed their entry-level courses (Rodger, 2002). These difficulties are mostly attributed to the lack of contextualization in the learning process as well as to the abstraction of traditional learning methods and basic programming concepts, such as variables, data types, or memory addresses, which do not have equivalent real-life representations. Therefore, the 3D representation has become an alternative medium for programming education and for facilitating the learning processes of students.

1.2 Background of the study

Fuller (1999) argued that students usually process a complex assortment of beliefs, experiences, and expectations in a learning situation. These elements in turn affect their learning approaches (Scherer, 2005). In addition, these approaches affect the motivation of students to improve their learning and to achieve their goals. They also reflect the future achievement of students as well as other behavior-related factors

(Prosser & Trigwell, 1999). Some researchers have emphasized the need to address how a student conceives and approaches his/her learning process before the appropriate type of support can be provided to them (Ong & Lai, 2006; Shaw & Marlow, 1999; Wen, & Tsai, 2006). This objective may be fulfilled by utilizing different dimensions in representing objects that are related to science courses, such as computer science (CS).

A student may possess a positive or a negative attitude toward the learning of CS. courses; such attitude must be identified to develop the self-efficacy of a student, which in turn may improve his/her academic performance (Kasser & Rizzo, 2012; Law, Lee, & Yu, 2010). Craker (2006) confirmed that "the attitudes toward science change with exposure to science, but that the direction of change may be related to the quality of that exposure, the learning environment, and teaching method" (Craker, 2006).

Other studies have revealed that the learning environment and the teaching method affect the attitude of the student toward learning CS. courses (Modi, 2012; Moses, Wong, Bakar, & Mahmud, 2013; Tella & Bashorun, 2012). These studies have demonstrated that most students develop a positive attitude toward CS courses when they receive the necessary details of the learning process within their learning environment, which is associated with the type of representation. This observation has been supported by other researchers, such as Koballa and Crawley (2010), who emphasized the importance of the attitudes and perceptions of science students toward their learning process. Several studies (e.g.,Huang, Backman, & Backman, 2010; Lee, 2010; Reid, 2011) have stated that the positive attitudes of students toward science courses are highly correlated with their academic achievements.

The achievement, motivation, and interest of students are influenced by their positive and negative attitudes toward their learning (Singh, Granville, & Dika, 2002). This observation has also been supported by previous studies (Amodio, 2010; Yen, Tuan, & Liao, 2011) that emphasize the importance of motivation, personality, information processing, and intention factors (e.g. rote versus meaningful, deep versus surface) to the learning environment.

Educators have long recognized the importance of the motivation and perception of students toward their academic achievements to their learning efficacy. Previous studies on the self-beliefs of students have largely ignored the role of environmental influences, such as the specific features of performance contexts or the domains of academic functioning (Beghetto, Kaufman, & Baxter, 2011). One of the most important studies on such topic has focused on self-efficacy (Marra, Rodgers, Shen, & Bogue, 2009). Bandura (2012) identified self-efficacy as the personal judgment of the individual toward his/her capability to organize and execute action to attain his/her goals in different activities and contexts (Bandura, 2012).

Therefore, the measurement of the attitude, perception, and motivation of students toward learning CS. courses must consider environmental influences (Wee, Fast, Shepardson, Harbor, & Boone, 2010). These measures can be used when designing the virtual learning environment for CS students.

Modeling or designing the main learning activities in 3D environments becomes complicated in terms of the text-based multiple-user domains object-oriented (MOOs) and multiple user dungeon (MUD), which enable users to play the role of gamers when solving logical problems. According to Dickey and Faller (2005), VWs "afford the communicative and constructivist opportunities of text-based, chat type applications such as MOOs" along with the importance of launching online learning environments that are supported with 3D representations to replace the currently used 2D representations. Winn (1993) suggested that a VLE-based 2D representation "allows first-person experiences by removing the interface that acts as a boundary between the participant and the computer," thereby allowing the researcher to "construct knowledge from direct experience, not from descriptions of experience." Childress and Braswell (2006) reported that the use of 3D in learning could help educators closely monitor the learning activities of their students. They explained this process by replicating an experience that was extracted from the real world, which could only be obtained through face-to-face interaction. They found that different learners can discuss and interact with one another while performing their learning tasks based on the details and information provided by the 3D representation.

Therefore, considering the effect of learning environments that are supported by 3D representations can help students with specific learning needs develop their skills and abilities in multidisciplinary learning, which usually occurs when learners are engaged in VW contents (Harley, Winn, Pemberton, & Wilcox, 2007). In this case, the structure of the contents in these 3D environments is no longer associated with the attainment of knowledge considering that the learner is expected to have an educated structure of such contents (Livingstone & Kemp, 2008). Therefore, the implications of traditional learning approaches to the structure, plan, place, and learning contents in VWs are no longer valid (Warburton, 2009).

Several studies have investigated the issues that are related to the learning of different science-related courses (Palloff & Pratt, 1999; Piccoli, Ahmad, & Ives, 2001; Van Raaij & Schepers, 2008), particularly mathematics, CS., and geography. Learners in virtual communities must be constantly guided in their learning activities to motivate them to join VW communities (Garrison, Anderson, & Archer, 2001). This scenario is often observed in different VLEs that support various types of representations (e.g., Moodle, SL, and virtual reality) (Kopeinik & Vanessa, 2010), such as the avatars that represent users in VWs. Avatars provide a higher level of social presence in virtual environments than in text-based environments because they are visual representations of their users (Bailenson, Yee, Merget, & Schroeder, 2006). Using avatars to communicate with other learners within the same environment can promote effective learning (Dillenbourg, Schneider, & Synteta, 2002). Although the learner can use different learning tools, he/she must communicate with other learners to discuss and evaluate his/her level of understanding of the content that is being presented in the 3D VW. This situation suggests that the creation of a virtual class among learners of a specific learning group can provide users with a sense of realism, embodied experiences, and authentic social interaction.

Therefore, this study uses SL with 2D representation for the control group and uses SL with 3D representation for the experimental group to determine if such environments can help students develop their attitudes, perceptions, motivations, self-efficacies, and achievements when learning Java programming. This study also examines other alternative factors and their roles in the development of the study variables. This study measures the capability of SL to build different learning objects in 2D and 3D representations that correspond to a variety of classes for designing the virtual class and for learning Java. The Java course environment in SL that is supported by both 2D and 3D representations is designed based on the needs of students for learning the specified programming language.

1.3 Statement of the problem

The main objective of programming educators is to enhance the ability of students to understand the concepts that are involved in the use of a particular learning object when writing codes (Kölling, Quig, Patterson, & Rosenberg, 2003). Some of the new techniques that enable students to develop algorithms for problem solving are centered on visualizing objects and their behavior through 3D animation environments. One of these techniques is Alice, which was utilized by Al-Linjawi and Al-Nuaim (2010) to teach the main concepts of object-oriented programming to the students of King Abdullah University in Saudi Arabia.

Based on my personal experience, most programming instructors in Saudi universities, especially in the Teachers' College, are confronted by difficulties in helping their students develop programming skills that mostly involve the writing of codes, the development of ideas, and the operation of computer programs. Dann, Cooper and Pausch (2000) addressed these difficulties and identified the students who could quickly learn such technology. They also found that the class size presents an overwhelming challenge for programming instructors, who often wonder why their students struggle in their learning of the main programming concept. These difficulties emerge when students attempt to consolidate the constructs, identify which constructs to use and how to coordinate those constructs, and determine the cause of errors (Cooper, Dann, & Pausch, 2000).

This study underlines the research problem by interviewing four programming instructors in the Computer Science Department (CSD) of the Teachers' College. The interview questions are mainly focused on the challenges and difficulties faced by students in learning Java. This study also examines the effectiveness of the current teaching methods and tools in helping programming students understand the contents of their subjects. In addition, this study investigates the experiences of the programming instructors and the course records to confirm the issues faced by the Java programming students of the CSD. Three of the four lecturers find that the first year students lack a basic understanding of programming concepts. This deficiency in turn affects their academic achievements. All lecturers agree that current teaching methods and learning tools, such as e-learning, are not in demand among the programming students. They acknowledge the problems faced by CSD students when learning programming concepts. These problems are summarized as follows:

i. Students do not fully comprehend the Java development environments.
ii. Most students have a limited understanding of the main concepts of Java and are having difficulties in visualizing learning spaces.
iii. Students are unable to progress in their learning of some programming concepts.

iv. Most students are hindered from understanding the concepts of Java because such concepts are discussed in their classes within a limited time.

Hence, this study aims to study the attitudes, perceptions, motivations, self-efficacies, and achievements of the students of the Teachers' College in Saudi Arabia by comparing the contributions of a 3D representation to such factors with the contributions of a 2D representation.

1.4 Research objectives

The objectives of this study are outlined as follows:

1. To investigate the differences in the a) attitudes, b) perceptions, c) motivations, d) self-efficacies, and e) achievements between the control group (using 2D representation) and experimental group (using 3D representation) in learning Java programming.
2. To investigate the differences in the a) attitudes, b) perceptions, c) motivations, d) self-efficacies, and e) achievements between the control group (using 2D representation) and experimental group (using 3D representation) in learning programming Java in terms of their experience in Java programming.
3. To investigate the differences in the a) attitudes, b) perceptions, c) motivations, d) self-efficacies, and e) achievements between the control group (using 2D representation) and experimental group (using 3D representation) in learning Java programming in terms of their experience in 2D representation.

4. To investigate the differences in the a) attitudes, b) perceptions, c) motivations, d) self-efficacies, and e) achievements between the control group (using 2D representation) and experimental group (using 3D representation) in learning Java programming in terms of their experience in 3D representation.

1.5 Research questions

The main research questions of this study are outlined as follows:

1. Do significant differences exist in the a) attitudes, b) perceptions, c) motivations, d) self-efficacies, and e) achievements between the control group (using 2D representation) and experimental group (using 3D representation) in learning Java programming?
2. Do significant differences exist in the a) attitudes, b) perceptions, c) motivations, d) self-efficacies, and e) achievements between the control group (using 2D representation) and experimental group (using 3D representation) in learning Java programming in terms of their experience in Java programming?
3. Do significant differences exist in the a) attitudes, b) perceptions, c) motivations, d) self-efficacies, and e) achievements between the control group (using 2D representation) and experimental group (using 3D representation) in learning Java programming in terms of their experience in 2D representation?
4. Do significant differences exist in the a) attitudes, b) perceptions, c) motivations, d) self-efficacies, and e) achievements between the control group (using 2D representation) and experimental group (using 3D

representation) in learning Java programming in terms of their experience in 3D representation?

1.6 Theoretical framework

Learning and teaching theories are usually adopted in the design of 2D or 3D representations by emphasizing the kind of learning that must take place. Many researchers highlight the effects of the social interaction among learners or a "socially and culturally situated context of cognition, in which knowledge is constructed in shared endeavors" (Duffy & Cunningham, 1996). Constructivism is a theory of knowledge that argues that humans generate knowledge and meaning from the interaction between their experiences and their ideas (Von Glasersfeld, 1991).

Bandura (1994) emphasized the importance of concreting the achievement of a learner and linked such factor with this learner's self-efficacy to learn different subjects. He related perceived self-efficacy to the belief of a learner in his/her ability to influence events that affect a definite process. Then, Bandura (2006) identified this belief as the foundation of human motivation, performance accomplishments, and emotional well-being. He also acknowledged that other factors could motivate or guide the belief of a learner that one can make a difference by acquiring new experience. This argument of Bandura is examined in the present study.

Constructivism has also been considered in the development of the research framework, in which the view of learning is explained based on three broad principles. The first principle focuses on the mechanism that helps the learner form his/her own representation of knowledge and consequently apply such representation in the learning context (Von Glasersfeld, 1984). The second principle, which is attributed to Piaget, involves the learning process during the exploration of knowledge. At this stage, the learner uncovers a deficiency in his/her knowledge or an inconsistency between his/her current knowledge representation and experience (McInerney, McInerney, & Sinclair, 1994). Sinclair (1994) described the process of knowledge exploration as a way to provide an effective learning experience by enhancing the attitude of students toward science and their classroom participation. Meanwhile, Dalgarno (2001) justified the importance of adopting the latest technology in learning to develop the attitude of students toward learning different subjects effectively. The third principle, which is attributed to Vygotskiĭ (1978), argues that learners process different learning activities within a social context and that the interaction between learners and their peers is an essential part of the learning process (Vygotskiĭ, 1978). This situation can be observed in an online environment in which students interact and learn with one another. The 2D and 3D representations in SL are used as the social contexts in the present study.

A 3D representation is constructed in SL by simulating a complex information space. This process is similar to the endogenous interpretation of constructivism, which emphasizes that the learner acquires knowledge by interacting with his/her environment rather than by receiving direct instructions from the educator (Dalgarno, 2001). The simulation can provide a realistic context in which learners can explore, experiment, and construct their own mental model of their environment. The interactivity in these environments allows learners to see immediate results after creating models or testing their theories about their modeled concepts (Rieber, 1992).

Learners can also explore knowledge by using an interface and other hypermedia applications, such as 2D representations, which provide a small space for learning and communication (Ben-David, Eiron, & Simon, 2003). Dalgarno (2002) argued that the most important benefits of simulations come from an endogenous constructivist perspective, in which learners interact with the objects within their environment. This activity helps learners further understand the dynamic nature of several entities. This understanding then drives their academic achievement.

The present study adopts the simulation theory of Gordon (2005), which provides one of the most dominant hypotheses about the nature of the cognitive mechanisms that underlie the human mind. This theory argues that an individual can simulate the actions of another person and the stimuli he/she is experiencing by using his/her own behavioral- and stimulus-processing mechanisms. This process allows the individual to predict the behavior and mental states of others in different settings based on his/her mental states and behavior during the event. The researcher can simulate new experiences by assuming a different identity that he/she can control through cognitive, behavioral, and motivational systems. These simulated experiences can help the researcher develop his/her understanding of the learning process of programming students who use 3D representation in virtual environments and simulate their identities through avatars.

Learners acquire new experiences by watching new actions presented in 2D or 3D representations. These actions help learners devise solutions for their programming problems and help them investigate 2D and 3D representations to abstract and to concert their newly acquired experiences. Figure 1.1 shows the theoretical framework of the present study.

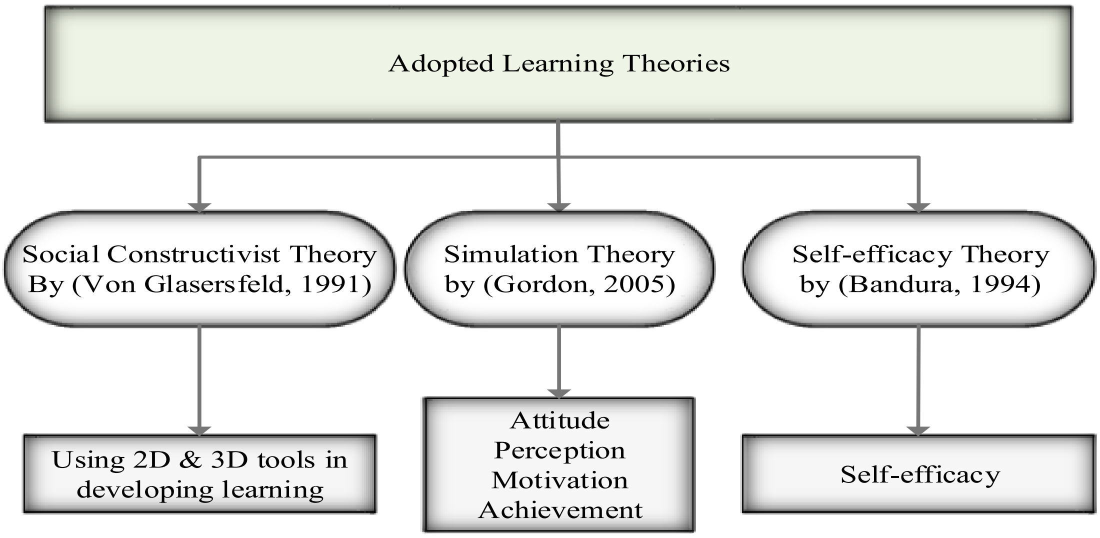

Figure 1.1. Theoretical Framework

1.7 Research framework

Many studies on education-related topics have focused on the applications of VLE. Several institutions have adopted 3D VLE as a learning environment for teaching Java to programming students. One of the reasons for such adoption is the ability of 3D VLE to provide appropriate information for learning in a constructivist paradigm. Some researchers have elaborated the relationship between the attitudes of students toward learning and their self-efficacies (Chau, 2001; Kinzie, Delcourt, & Powers, 1994; Meinhold & Malkus, 2005). These researchers argued that self-efficacy can be estimated based on the level of attitude that an individual possesses during his/her learning process. The self-efficacy of a student is also associated with the development of his/her learning achievement. However, few researchers (Agha, 2003; Pajares & Schunk, 2001) have identified the effects of self-perception on the development of self-efficacy in technology-assisted learning. This observation emphasizes the importance of the perception and achievement of students in the development of their learning experience in a VLE.

Several researchers (Bandura & Schunk, 1981; Maddux & Rogers, 1983; Schunk, 1991) have found that the self-efficacy of students in learning a subject is driven by their motivation to process an adequate level of understanding (Gist & Mitchell, 1992; Zimmerman, Bonner, & Kovach, 1996).

The variable relations in the research framework are constructed based on the abovementioned arguments and their relation to the development of the attitudes, perceptions, motivations, self-efficacies, and achievements of students. The rationale for applying 3D-simulated and 2D-non-simulated learning environments is explained in Section 1.6. Figure 1.2 shows the learning environment setting in which students learn programming languages by integrating learning spaces into 2D and 3D representations. This learning process is initiated by engaging the programming students of the Teachers' College with live 2D and 3D representations. Chapter Three explains the research procedure.

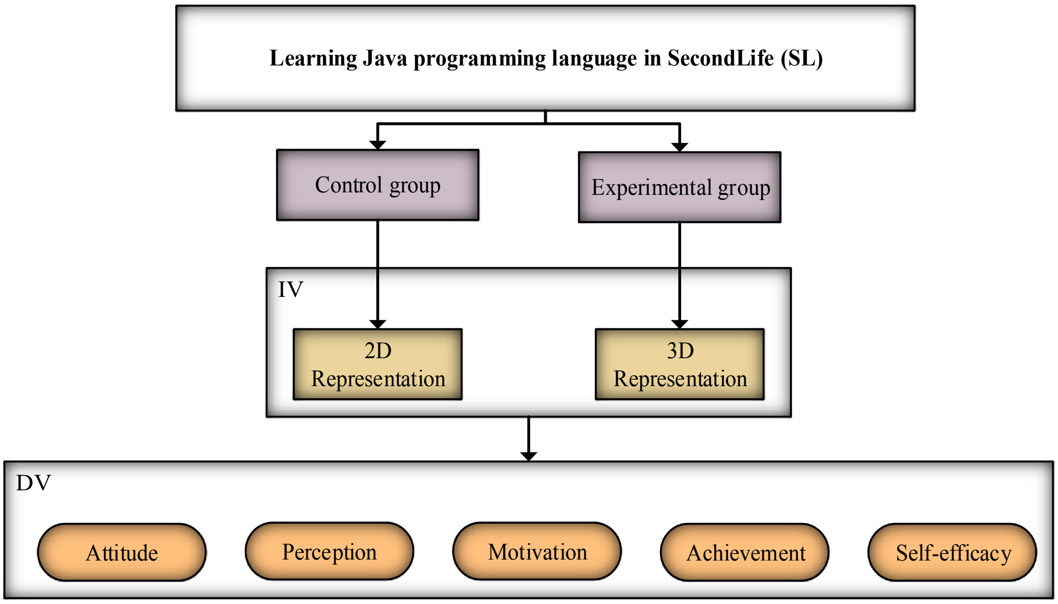

Figure 1.2. Research framework

1.8 Research significance

This research contributes to the extant literature by describing the effects of SL environment on the teaching of Java to programming students. This study can benefit universities by offering an alternative learning tool that is empirically tested in Saudi universities. The modern versions of 3D learning materials (e.g., SL) can provide students with a friendly, interactive content representation. This research can also provide the following components of education readiness:

i. The integration of SL-based 3D representation into Java programs in Saudi universities would enable programming students to share their ideas, materials, and work with skilled members of the community.
ii. This method provides highly informed alternatives and connections among the members of the same educational community, who in turn can provide assistance to and promote collaboration among fellow community members.
iii. This method creates a strong, active community that provides a sense of "population" and "belonging."
iv. This method enables students to be connected with the criteria, learning tools, objects, and locations of an existing educational community.
v. This method allows students to interact with and change their world directly.
vi. This method provides students with a deep sense of immersion that facilitates the learning process.
vii. This method provides students with suitable learning spaces through the creation of a customizable learning environment that generates several possible scenarios that can facilitate the learning of programming languages.

viii. This method reduces the time and effort needed to reconstruct materials and extends the desktops of users into the VW, which is then extended to the WWW.

ix. This method allows students to join groups that can strengthen their sense of belonging to the virtual community and allow them to communicate with other users who possess common interests.

The constructivism-based approach that updates the course representation in 3D (Thramboulidis, 2003) can help students explore their real-life experiences and allow them to build their own conceptual frameworks of programming education in these environments.

1.9 Research limitation

The limitations of this study are listed as follows:

i. The population of the study is limited to the undergraduate students of the CSD of the Teachers' College in Saudi Arabia.

ii. The sample is limited to 80 students who are taking the second course of Java.

iii. This study merely compares the use of 2D and 3D representations in SL in terms of their effects on the attitudes, perceptions, motivations, achievements, and self-efficacies of the students in learning Java.

1.10 Operational definition

i. Attitude refers to the influence of SL technology on the disposition of students toward their self-efficacy and ability to learn a programming language (Lin, 2003) through 2D and 3D representations. The questionnaire items on attitude were modified from Hofer and Pintrich (1997) to examine the attitude of students toward using 2D (Appendix B) and 3D representations in SL (Appendix C) to learn Java.

ii. Perception refers to the awareness of students about the main concepts of programming. The relational communication questionnaire (RCQ) of Burgoon (1987) was used to collect quantitative data regarding the perceptions of students toward using 2D and 3D representations in SL to learn Java.

iii. Motivation refers to the process that initiates, guides, and maintains the goal-oriented behavior of programmers toward the use of 2D and 3D representations in SL. A modified Keller model for Attention, Relevance, Confidence, and Satisfaction (ARCS) by Huang, Diefes Dux, and Imbrie, 2006) was adapted in this study to measure the motivation of students to use 2D and 3D representations in SL to learn Java.

iv. Achievement refers to the degree that indicates the achievement of students in learning Java using 2D and 3D representations in SL. The Java questions was adopted from Kjell (2012) and Hock-Chuan (2012) were used to measure and compare the achievements of the students after using 2D and 3D representations in SL to learn Java.

v. Self-efficacy is defined as the judgment of learners toward their capabilities to learn and execute the programming courses for attaining the designated types of learning levels. The questionnaire items on self-efficacy were constructed based on Bandura (1997) to measure the self-efficacy judgment of the learner in using 2D and 3D representations in SL to learn Java.

vi. 3D representation refers to the process of rendering a scene to achieve a multi-dimensional representation. The scene presents a geometrical figure. Texture information is associated with every surface of this geometry, which can be viewed from different angles. In this study, 3D representation of Java content was achieved by rendering the scripts in a geometrical manner, wherein the code is obtained by the texture information of the surfaces of this geometry.

vii. 2D representation refers to a single view of one side of an object, which is typically viewed from the top, front, or sides. Examples of 2D representation include PowerPoint slides, photos, and videos. Java representation in this study was supported by the representation of one side of the Java code from a view from one side.

1.11 Summary

This chapter introduces the main research problem and proposes several solutions to the problems that hinder students from effectively learning Java. This chapter also describes the effect of SL on the learning process of programming students. The objectives and significance of this study as well as the theoretical and research frameworks are explained in detail in this chapter. The second chapter reviews the related literature by discussing the main elements and settings of SL, the different forms of learning, the VW, the education setting in Saudi, the Java programming course, and the related learning theories.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents the related literature and the historical background of learning in a virtual environment. The elements and settings of Second Life (SL), the different forms of learning, the Virtual World (VW), the education setting in Saudi, the Java programming course, and the related learning theories are also presented in this chapter. Previous studies on technology-assisted learning are also reviewed.

2.1 Introduction

Learning and teaching styles constantly change according to the needs of learners and the advancements in technology. Changes in the learning environment have created a new type of learner whose expectations need to be fulfilled. Some end users require distance education because of their geographical distribution, but many of distance learners today prefer this environment to achieve increased flexibility. Unlike face-to-face lectures, asynchronous learning settings allow people to lead an ordinary adult life while completing a higher education program. Therefore, distance learning can expand the availability of education geographically and socially (Bates, 2005).

Although many higher education institutions offer distance learning courses through the Internet, these institutions usually fail to exploit the full potential of modern computer programs and networks. These platforms are often restricted to simple sequences of Web pages (Bronack et al., 2006). According to Bronack, Riedl and Tashner (2006), “Postsecondary enrollments are rising, and, in response, most colleges and universities offer some form of distance education, which utilizes the Internet and uses asynchronous tools as the primary mode of instruction." However, the widely available tools today offer little support for the formation of Web-based learning communities or for the promotion of different kinds of teaching and learning techniques. The potential of Internet-based learning systems is by no means contentious, and various factors still need to be improved.

Therefore, 3D VWs can be used as supporting learning platforms in the asynchronous and synchronous delivery of distance education (Monahan, McArdle, & Bertolotto, 2008). Lee (2009) reported that Virtual Learning Environments (VLEs) create social communities for distance students. These environments also provide numerous applications in education. Different learning and teaching courses, such as programming courses, are uploaded to these VWs to support learning through the SL environment.

The island of an institution in SL can provide an environment conducive to learning, thus promoting a sense of belonging and purpose (Minocha & Reeves, 2010). Minocha and Reeves (2010) analyzed the role of "place" in virtual environments and found that such factor provides the basis for the four key processes in a constructivist learning environment, namely, context (meaningful and authentic), construction (of knowledge), collaboration, and conversation (between students and educators as well as among students). A VLE provides the basis for a place, but the place itself requires an architectural design.

2.2 History of virtual learning

Technology has fundamentally changed the field of education. However, some educators resent the strong influence of technology on the educational arena and remain steadfast in their traditional pedagogical practices. Nevertheless, this resentment may have little effect on the iniquitousness of distance learning (Garrison & Vaughan, 2008).

According to Delwiche (2006), the convergence of high-speed Internet connections, sophisticated graphic cards, and powerful microprocessors has paved the way for immersive virtual environments that are populated by thousands of users. Yunfei (2011) addressed the similarity between SL and 3D avatar games and pointed out that SL differs from 3D games in such a way that its virtual environment is created by users themselves to reflect their real-life experiences.

By conducting a survey on educators who support the use of SL for teaching, Kemp, Livingstone and Bloomfield (2009) found that SL is better than other learning management systems (LMSs) because of several features, such as synchronous chat sessions, live presentations, or distance class discussions. SL is an emerging virtual environment development platform. Its immersion, ease of use, wide availability, and low barrier to entry make it an excellent educational tool.

Although VWs have a long history, the early forms of these environments are mostly used for entertainment purposes. SL environments are not frequently used in educational institutions and public libraries. VWs provide several other opportunities to learners aside from being an outcome-based model of exploration and knowledge development. However, the usefulness of VWs in education has only been discovered in recent years.

VWs provide new types of interactions that can enhance the educational experience of students. VWs allow students to learn through interaction and eliminate passive learning by incorporating games into the course curricula. These real-time interactions extend beyond simple asynchronous distance education. The anonymity offered in distance education encourages each learner to participate in the discussions, especially those learners who are not willing to partake in face-to-face classroom discussions. Each student in a VW is represented by avatars.

SL is a community that comprises social, cognitive, and teaching presence (Bruns, 2008). Social presence is defined as the ability of a learner to connect with other members of a learning community on a personal level. Cognitive presence is defined as the ability of a learner to construct meaning through collaboration and collaborative inquiry. However, educators must not use SL to replicate real-world class settings.

SL allows educators and learners to interact with each other and to access varied content and rich media in a live virtual space, thus suspending time and space. A suspension of disbelief may occur in the personal development of an SL user when he/she immerses himself/herself entirely into the environment and views his/her avatar as an extension of himself/herself rather than as a mere representation (Warburton, 2009).