Sense of Presence and Learning Satisfaction among Students of Different Age Groups in a 3-D Virtual World

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Abstract— **Virtual worlds are growing in popularity very quickly. This growing popularity of 3-dimensional (3-D) virtual worlds has drawn attention from educationists. Today, 3-dimensional (3-D) virtual worlds are exploited for online and virtual learning. Unlike the common online learning platforms, a virtual world environment closely resembles a 3-D video games environment. Thus the age of students might affect their sense of presence, interaction, and satisfaction in the said environment. Hence this study was conducted to investigate whether there are differences between students of different age groups on their sense of presence (place presence, social presence, and co-presence) and their learning satisfaction. The study was carried out for six weeks and involved 33 part-time diploma students with the use of interview and questionnaires as instruments. In this study, the researcher developed our own 3-D virtual world, known as ViEW, by using the Open Wonderland open source virtual world program. A nonparametric Mann-Whitney U analysis was applied to explore the differences between young and senior participants in terms of their sense of place presence, social presence, co-presence, and learning satisfaction. The results indicated significant differences between young and senior students in terms of place presence, co-presence, and learning satisfaction, but no differences were identified for social presence. These results might be in regard with the means of conducted the learning, which were in the forms of cooperative and synchronous learning by utilizing audio communication most of the time. Several recommendations for future research related to the study were also provided.**

Keywords— **virtual world; multi-user virtual environment; presence; satisfaction.**

I. INTRODUCTION

The growth of information and communication technology (ICT) has permitted many types of learning activities to be conducted virtually. Among the types of learning is cooperative and collaborative learning in which technology can support the interactions and communications between students. These types of learning activities are commonly supported by several Web 2.0 applications such as the online forum, social networking sites, and many more [1]. Nonetheless, the applications are said to have some drawbacks as they (a) are limited to text-based communication, (b) lack on nonverbal ways to communicate,

and (c) not enough collaboration tools [2]. Therefore, the teaching and learning processes have been considered as unrealistic and very limited since they are executed without any other forms of interactions other using text [3].

Affected by these limitations are students' learning especially their sense of presence in the virtual environment and their satisfaction with the activities [4]. To counter some drawbacks a new technology called three-dimensional (3-D) virtual world has been progressively applied in online collaborative learning because the method holds various potentials in supporting interaction and communication among students [5]. The technology is also capable of

generating many forms of presence, such as place presence, social presence, and co-presence [6]–[8].

Unlike the commonly used Web 2.0 applications, the 3-D virtual world is much similar to a 3-D video game environment [9]. For this reason, the application might not be suitable for all ages. Students' age should be considered as an individual characteristic that may perhaps affect their sense of presence and their learning satisfaction with a 3-D game-like environment. These matters, however, have not been extensively studied despite more senior students enrolling into online courses. These students may be facing some problems in such an environment because they are not a digital native [10]. The young and senior students may differ in term of a sense of presence in a 3-D virtual world, and they may be unsatisfied with learning in the said environment although they use the same application.

On that account, this study was aiming to find the answer for the several research questions, which were: Are there any differences between young and senior students in terms of 1) perceived place presence, social presence, and co-presence in a 3-D virtual world and 2) their satisfaction with learning in a 3-D virtual world? The sense of presence is interpreted as a psychological feeling that makes us feels that we are genuinely in a virtual environment [11]. It can make people believe that they are living inside a new environment for certain duration of time [12]. There are at least three categories of presence: place presence, social presence, and co-presence [13]. Place presence is "a sense of being there", whereas social presence is when a person is perceived as a "real person" inside a virtual environment, and it is closely related to the medium of communication [14]. Co-presence, on the other hand, is more into the physiological connection between human minds [15].

According to previous studies, a sense of presence is interrelated with students' learning outcomes such as their motivation, participation, enjoyment, and satisfaction [13], [14], [16]. This indicates that a sense of presence plays an important role in determining the success of online learning. However, such presence is not easily generated by the commonly used online applications because it clearly has certain weaknesses in supporting interaction and communication. That being the case, one of the latest technologies, the 3-D virtual world, has been progressively utilized in online learning. It has been reported that the 3-D virtual world has the potential to generate a sense of presence.

On the other hand, student's satisfaction in learning is a racial aspect to be considered by educators especially for online or virtual learning, which involves technology as a tool [13]. Learning satisfaction is described as an effective learning outcome covering an individual's perception of the value and quality of an educational activity and his or her motivation to learn [17]. Learning satisfaction plays an important role in determining the effectiveness of online learning. Hence, students' learning satisfaction with online learning has become an important research area in the field of education as of late, especially in terms of their satisfaction with the use of new technology for learning. In this case, the new technology is the 3-D virtual world, which has yet to be widely explored.

The virtual world is a 3-D virtual space that looks like a role-playing game, but it has no specific objectives or goals as the users are free to do whatever they wish within the environment [13]. Also known as a multi-user virtual environment (MUVE) [18], the 3-D virtual space is unlike the commonly used online applications in teaching and learning; it can (a) generate a realistic learning environment and digital avatars for the user, (b) provide various methods of communication and interaction, and (c) support many types of user interactions within the world [19]. These features have made the 3-D virtual world a popular learning platform in most modern countries today, particularly countries in North America and Europe [20]. However, the technology has yet to be widely applied in other countries, including Malaysia. Second Life, Open Wonderland, and OpenSim are some of the virtual world that are available online [5]. For educational purposes, many educators prefer to use Second Life [13]. Each of the applications including Second Life, however, has its strengths and weaknesses. Therefore, we need to choose the virtual world that meets our need properly.

II. MATERIAL AND METHOD

A. Virtual World Development

In most Malaysian educational institutions, the virtual world is not a commonly used technology for teaching and learning, especially in universities. Therefore, this study attempts to spearhead discovering the use of this superb technology in our educational context. In this study, the researcher developed our 3-D virtual world, known as ViEW, by using the Open Wonderland open source virtual world program.

Open Wonderland is a very flexible multi-platform program, which offers developers with a variety of controls over the environment [18]. Hence, the researcher was able to set up the size and privacy of the environment, manage in-world objects, and control the number of users. The program also allows the users, who are our students, to customize the avatar, use avatar gestures, communicate through text and voice, change the camera view, and manipulate in-world objects. As for the creation of ViEW's in-world environment, the researcher developed several 3-D buildings and objects by using the Google SketchUp software and imported them into the environment. The researcher also utilized some of the built-in objects. A screenshot of the environment can be seen in Fig. 1.

Fig. 1 The ViEW learning environment

B. Participants

This study involved 33 diploma students from the Multimedia class. The class consists of students of different age groups in which the youngest is 22, and the oldest is 49.

Almost half of the participants are above 35, which were 14 students. Not all of them had any prior virtual world experiences. To conduct the study, this class was held in one of the largest computer laboratories in our university.

C. Instruments

Two questionnaires were used in this study. The first questionnaire seeks the participants' demographic information such as gender, age, and prior virtual world experiences. The second questionnaire consists of 4 sections. The first three sections seek to measure participants' sense of place presence, social presence, and co-presence respectively. Whereas the fourth section contains items that measure participants' satisfaction with learning in ViEW. The items in place presence section were adapted from [21], whereas the items in each section of social presence and co-presence were modified [22], [23]. The satisfaction section was adapted from [17].

Two sections were measured by using a 7-point Likert scale (place and co-presence) whereas another two sections were measured by using a 5-point Likert scale (social presence and satisfaction). The calculated Cronbach's alpha values for place presence, social presence, co-presence, and satisfaction were .73, .74, .85 and .87 respectively. Therefore, all the scores were satisfactory [24]. Several interview questions on each variable were also structured in order to support the main findings.

D. Procedures

The study was fully conducted in a computer laboratory. On the first week, the demography questionnaire was distributed to the participants. Afterward, each participant was assigned into one of the seven learning groups based on the result of the questionnaire where each group consisted of young participants (below 35 years old) and senior participants (35 years old and above). The purpose was to create heterogeneous groups. To avoid any direct communication and interaction between the participants from the same group, their workstations were located at different sections, quite far from one another. Then the participants went through two training sessions on the first and second week. They were trained on how to navigate the world, customize an avatar, switch the camera, and insert and manipulate objects.

For the next 3 weeks, the learning activities in ViEW were held for approximately 90 minutes for each class meeting. The activities covered different topics of Introduction to Multimedia subject. The researcher encouraged the participants to utilize all tools provided in ViEW during the learning process. A screenshot of learning activity can be seen in Fig. 2, Fig. 3 and Fig. 4. Then in the final week, the second questionnaire was distributed to all participants. Shortly afterward, an interview session was organized with four randomly selected participants from each group of ages.
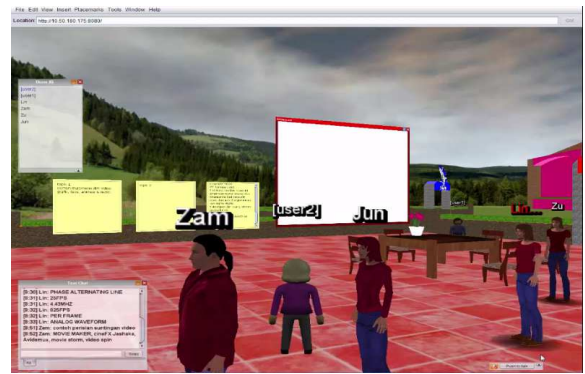

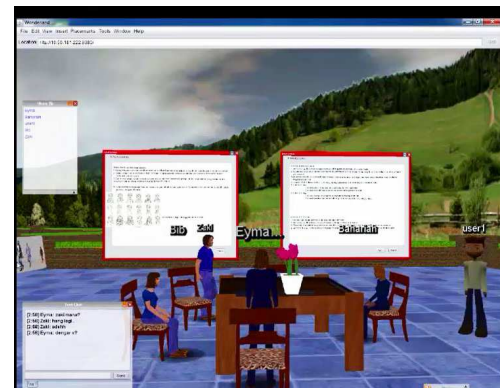Fig. 2 The learning activity of Group A

Fig. 3 The learning activity of Group B

Fig. 4 The real world situation

III. RESULTS AND DISCUSSION

A. Results

A nonparametric Mann-Whitney U analysis was applied to explore the differences between young and senior participants in terms of their sense of place presence, social presence, co-presence, and learning satisfaction. To facilitate analysis, the young participant's group were coded as G1 (Group 1) while the senior participant's group were coded as G2 (Group 2). Findings for each calculated variable were illustrated in Table 1.

TABLE I
THE RESULT OF MANN-WHITNEY U TEST

Mean rank	Presence			Satisfaction
	Place	Social	Co	
G1	21.45	19.03	20.87	20.21
G2	10.96	14.25	11.75	12.64
Test Statistic:				
Mann-Whitney U	48.5	94.5	59.5	72.0
Wilcoxon W	153.5	199.5	164.5	177.0
Z	-3.09	-1.41	-2.73	-2.23
Asymp. Sig. (2 tailed)	.002	.156	.006	.026
Exact Sig. [2*(1-tailed Sig.)] a. Not corrected for ties	.001[a]	.163[a]	.006[a]	.026[a]

From this data, we can observe a significant difference between G1 and G2 in terms of perceived place presence [U ($n1$=19, $n2$=14) = 48.5, $p < 0.05$], perceived co-presence [U ($n1$=19, $n2$=14) = 59.5, $p < 0.05$], and learning satisfaction [U ($n1$=19, $n2$=14) = 72.0, $p < 0.05$] as the U values for those three variables were smaller than the critical value in the table of critical value of the Mann-Whitney U test (88) [24].

Based on the mean rank values of place presence, social presence and satisfaction from both categories, we can conclude that compared to senior participants, the young participants experienced more place presence and co-presence and they also felt more satisfied with the learning. Moreover, there were no significant differences between both groups on social presence since the U value of social presence is 94.5. In order to support the findings, we have utilized the boxplot graphs. Fig. 5, Fig. 6 and Fig. 7 illustrates the findings on the differences between G1 and G2 in terms of the sense of presence.

In a boxplot type of graph, the range between the median values (represented by a long horizontal line) of each group determines how big the difference is between the groups. Based on that concept, we can see in Fig. 5 that the difference between G1 and G2 was substantial in terms of perceived place followed by perceived co-presence in Fig. 7. However, the range of the median values for both groups is relatively small on the perceived social presence (see Fig. 6). Fig. 8 illustrates the finding of the difference between both groups in terms of learning satisfaction. The boxplot graph in Fig. 8 clearly shows that the satisfaction's median values of both groups are totally at different levels. Thus, these graphs support the findings of the Mann-Whitney U test.
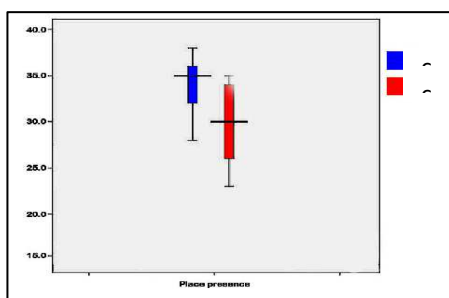

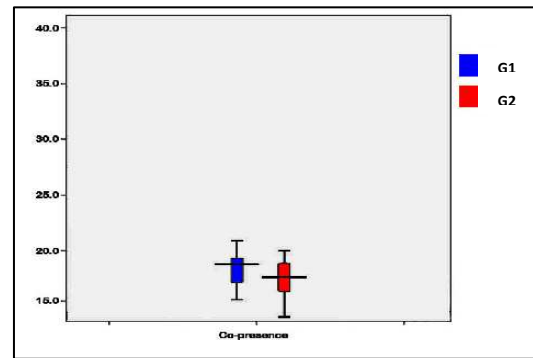Fig.5 The boxplot graph on the place presence

Fig. 6 The boxplot graph on the co-presence

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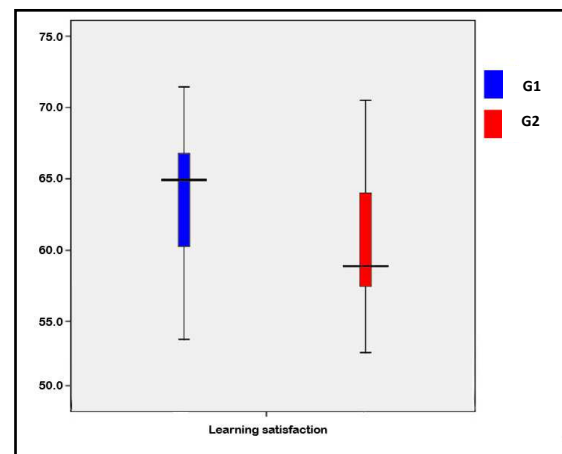

Fig. 7 The boxplot graph on the learning satisfaction of both groups

The results from the interview also show that some G2 participants did not perceive place presence and co-presence in ViEW, and they were somewhat dissatisfied with the learning compared to some participants from G1. Some participants give the selected interview answers from both groups on their sense of place presence, co-presence, and learning satisfaction, which support the differences found in the Mann-Whitney U test.

- Question (Place presence): Had you ever feel so focus on ViEW that made you forgot about your surrounding?
  G1: Yes, because I was so excited.

G2: No. There were always some technical problems. So I cannot focus while these problems keep on happening

- Question (Co-presence): Did you consider your friends' avatar as a real person?

  G1: Yes.

  G2: No, just 3-D objects.

- Question (Satisfaction): Are you satisfied with ViEW as a learning platform?

  G1: Yes, I am satisfied.

  G2: Not really, for me it was not interesting. It was hard to use sometime.

It is apparent from the given answers above that there were differences between G1 and G2. Hence, those answers have also strengthened the findings of the Mann-Whitney U test.

B. Discussion

Overall, this study sets out to answer two research questions. The first research question is "are there any differences between young and senior students in term of their perceived place presence, social presence, and co-presence in the 3-D virtual world?." With the use of the Mann-Whitney U analysis, the result showed that there were differences between G1 and G2 in terms of perceived place presence and co-presence, but not for perceived social presence. By looking at the values of the mean rank in Table 1 and the boxplot graph presented in Fig. 5 and Fig. 7, the researcher can determine that compared to senior participants, the young participants perceived higher place presence and co-presence when they were in ViEW, although both groups were learning in the same 3-D environment. One possible explanation is that a 3-D virtual world environment is unique as it is more similar to a 3-D video games environment. Thus, it is likely that the senior participants who are commonly not digital natives [10] were not familiar with that sort of environment.

On the other hand, the young participants are likely more experienced in dealing with such environment especially when they were playing online video games, which require the player to interact inside a virtual fantasy world. Thus, the younger participants could easily feel as if they were in the environment and at the time, even considered others as real persons. One study [8] found that the place presence scores were moderate although the participants had prior virtual world experiences. Hence it is unsurprising for the senior participants of this study to have lower place presence scores than did the young participants. Another possible explanation for the finding concerns technical issues. Finding from [25] showed that technical issues could jeopardize participants' sense of place presence.

From the observation throughout the weeks, the researcher found that technical issues frequently occurred to all students and most of the time the young participants could solve them by themselves in a shorter time. However, the senior participants always sought for help. This problem might hinder their sense of place presence, as stated in an interview response in the previous section. The avatar appearance, on the other hand, might be the reason for the senior participants feeling less co-presence than the other group. While avatar can generate a sense of co-presence [26],

it is not considered as a real person, as mentioned by one participant from G2. This might be due to the limitation of avatar customization provided by ViEW.

As for the social presence, there was no difference between young and senior participants possibly because both groups made full use of audio communication throughout the learning. Audio can add naturalness and realism into an environment [27]. As for the second research question, there was a difference between both groups on their learning satisfaction. One possible explanation is that the finding might be similar to what has been previously discussed. As the senior students are commonly not digital natives and had less experience in dealing with a game-like environment, learning in ViEW might be uninteresting and difficult for them, causing them to be unsatisfied. Moreover, technical issues might also affect their satisfaction with learning in the new environment [23]. As in this study, the senior participants often could not independently solve the problems, which might have frustrated them.

IV. CONCLUSION

The study examined the differences between young and senior students in terms of their sense of place presence, social presence, and co-presence in the virtual world including their learning satisfaction. The objectives were to study the effect of one of the individual characteristics on the variables above. The findings showed significant differences in terms of place presence, co-presence, and learning satisfaction. No difference was found for social presence. However, these results might be in regard to the means we conducted the learning, which was in the forms of cooperative and synchronous learning by utilizing audio communication most of the time. A similar study can be conducted in different settings to produce different results probably. Students' interaction and performance should be included in the future study. Still, this research has added some insights into this field of study.

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