LEARNING BEHAVIORS AND INTERACTION PATTERNS AMONG STUDENTS IN VIRTUAL LEARNING WORLDS

By

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ABSTRACT

The goal of this study is to investigate how students behave themselves in the virtual learning worlds. The study creates a 3D virtual learning world, entitled the Best Digital Village, and implements a learning program on it. The learning program, the Expo, takes place at the Exhibition Center in the Best Digital Village. The space in the Expo is divided into three zones: the Lobby, the Exhibition Hall, and the DIY Rooms. Students have to form teams in four before entering the Expo and carrying out their learning tasks respectively. In the Lobby, students are encouraged to sign up in a guestbook and browse through the user guide of the Expo. The Exhibition Hall consists of 3D objects of famous architectures and landmarks around the globe. When students approach the 3D objects, information about the objects will show up in a separated window. Students are encouraged to discuss about the objects online while they are in the Exhibition Hall before taking a quiz about them. Finally, students are asked to enter their team's DIY Rooms together with team mates and create a 3D artifact with embedded online tools.

There were 16 teams of school students from two different countries who took part in a 5-week experiment for the study. Twelve items of quantitative data were collected with the data logging mechanism of the virtual learning world. The statistic t-test was utilized to analyze these data. Results show that school students engaged more in communication with peers than in navigating learning objects in the virtual learning world. The study also reveals that virtual learning community and proximal learning community play an equal role in terms of interaction patterns among school students inside the virtual learning world.

Keywords: Virtual Worlds, Virtual Learning, Community of Practice, Learning Behaviors, Game-based Learning.

INTRODUCTION

Due to the enormous promises in providing better learning experiences (Chittaro & Ranon, 2007; John, 2007; Monahan, et al., 2007) and the influence of the wide-spread of online games, the inhabited virtual learning worlds poised to be mainstream in online learning both in higher education and K-12 school levels. But there are few of evidences or knowledge so far about how school students behave in the virtual worlds in terms of learning behaviors and community of practice.

It is asserted that online community design is the key in successfully crafting the next generation IT systems (Friedl, 2003). It is also claimed that learning community is one of the decisive factors to the success of networked learning (Schwier, 2001; Redfern & Naughton, 2002; Barab, 2003; Lin, 2005). In the wake of shifting the focus on information delivery to the communication opportunities in the design of learning management systems, the application of human content is getting more attention versus generic binary content or digital content while creating networked learning environments. The trend denounces the significance of the role of learning community of practice in the fields of networked or online learning. Nevertheless, there are two distinctive categories of learning communities in the aspect of networked learning. One is composed of members who have never met in their tangible living worlds. The other one consists of members who are bound to the identical local organizations or

settings and already are acquainted with each other in their tangible living worlds. These learning communities, virtual and proximal respectively, exist in networked learning environments simultaneously.

Although it is claimed that the virtual learning community of practice is one of the most significant and invaluable features in networked learning environments (Barab, 2003; Friedl, 2003; Lin & Kuo, 2006; Lin, et al., 2007), a research finding showed that the performance of virtual learning community lagged behind proximal learning community in conventional web-based learning environments (Lin, et al., 2009). However, as the new paradigm of the networked learning environments, inhabited virtual learning worlds might hold the promise of taking advantage of virtual learning community of practice.

Objective of the Study

The objective of this study is to investigate the learning behaviors of school students in general inside the inhabited virtual learning worlds and the patterns of their interpersonal interaction in specific in terms of community of practice. An inhabited virtual learning world, the Best Digital Village (BDV), is implemented following the architecture drawn from the techniques and principles of the successful genre of Massively Multiplayer Role Playing Games. A learning program entitled the 'Expo' takes place in the Exhibition Center of the Best Digital Village and is used as the instrument for the empirical study.

1. The Architecture of Virtual Learning World and Its Metaphor

A virtual learning world is created for the purpose of collecting empirical data. The architecture of the implemented virtual learning world is drawn from both the successful Massively Multiplayer Online Role Playing Games (Friedl, 2003; McFarlane, 2006) and theories of networked learning (Bonk, & Cunningham, 1998). In addition to the design of the architecture, it is asserted that the metaphor of a virtual learning world could either hinder or enhance learners' perceptions about the learning environment, and affect their learning performance as a result (Tashner, Riedl, & Bronack, 2005). As such, choosing an appropriate metaphor for the virtual learning world is as important as designing its architecture. Therefore, the study implemented the virtual learning world based on the metaphor of a digital village, which provides a living space that resembles the tangible world of young learners. Hence, the virtual world the study created is entitled the Best Digital Village (BDV). The BDV is composed of a 3D World, a Supporting Pane, a Control Pane, and a Message Pane in terms of its system architecture.

1.1 3D World

The 3D World provides a metaphor of the virtual shared learning space in the three-dimension format. This is the primary component of the architecture. It consists of avatars, which are the representation of users in the virtual world, and objects such as learning materials and teleports.

The graphical presentation of the 3D shared space allows a group of people to interact socially and see each other's actions and responses through avatars. Hence, it is imperative for the immersive interface of the virtual world to equip with interaction functionality for avatars' communication that is implemented with several related interface panes in the system architecture.

In the scene of the 3D world of BDV, there are several building blocks. Table 1 summarizes the roles of building blocks in the BDV respectively.

1.2 Supporting Pane

There are several features or tools in the Supporting Pane aiming at assisting users to explore and interact with the 3D World. For instance, the Overview Map is equipped with a radar function that could spot the locations of the online avatars. Users could approach any avatar on the map by clicking at it with their mouse. In addition, users could also

Building Blocks	Descriptions
Town Hall and Plaza	Reception, Kiosk, Documents, and Archives of the town
Community Center	Information exchange, Who and Who
Exhibition Center	Exhibition, Artifacts and arts objects displays
Library	Digital Library
School	Learning Space
Mall	Shopping Mall, E-Business, Cinema, and Bank
Park	Recreation Spot and Playground
Residential Area	Apartment for single, House for senior and married couple
Airport	Teleports for connecting to other virtual worlds

Table 1. Building Blocks in the Best Digital Village

search for the current location of a target avatar by keying the name in the search box in the map. Furthermore, users can access the chat room in the Supporting Pane for chatting with peers who are surfing in the 3D World. As to the Informatics window in the pane, it provides data or feedbacks that are related to instructional design of learning activities taking place in the 3D World.

1.3 Control Pane

It is composed of tools and features that are designed to enhance the quality of usability of the virtual world. For instance, Who is Online displays the names of users who are currently presented in the 3D World. When users click on the name displayed in the Who is Online, the Learner Profile (LP), which contains information about the user's personal identity and learning status, will pop up over the name.

1.4 Message Pane

There are two kinds of message in the virtual world. One of those is the interpersonal interaction message generated by chat room. The other one is the broadcasting message initiated by the system. The Message Pane displays these two types of message in text format.

Figure 1 depicts the architecture of the BDV. Figure 2 demonstrates the 3D world of the BDV with avatars. From a technical point of view, the architecture possesses the following features: (i) It is a distributed architecture metaphorically represented by a 3D virtual world that allows multiple users to interact in a shared space. (ii) Objects in the virtual world are persistent over time. (iii) It is extendable and scalable with run-time editing capability. It allows users to extend the virtual world and make changes to it while it is running (Vellon, et al., 1998).

2. Methodology

In order to explore how students behave inside virtual learning worlds in empirical manner, a learning program, entitled the Expo, was designed and implemented on the BDV as an international online collaborative learning program. The program was announced to the international K-12 community through Internet for recruiting autonomous participants. Since the program was implemented as a team-based learning activity, school students had to form a team online with four members

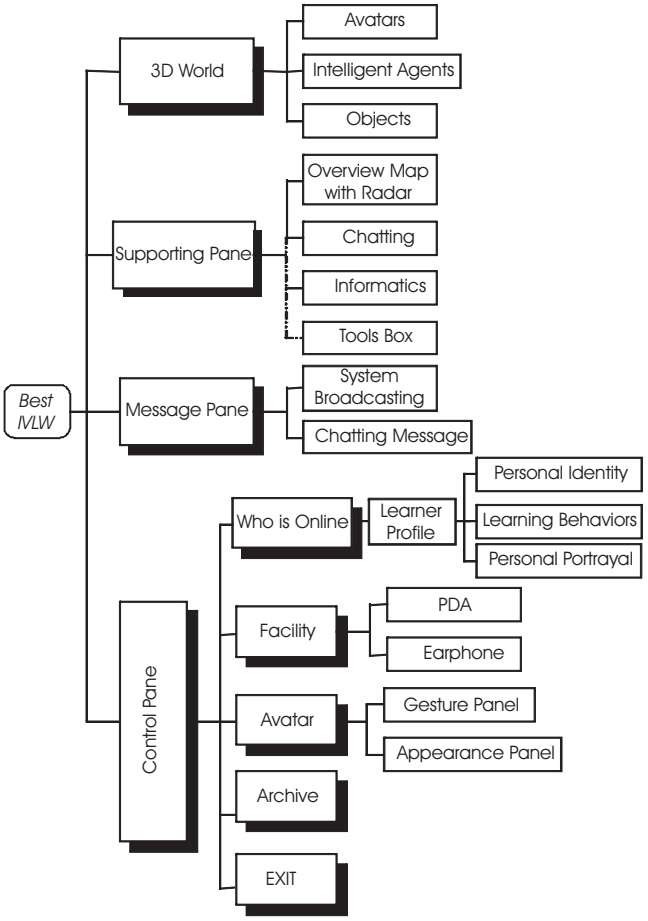

Figure 1. The Architecture of BDV

Figure 2. Avatars in Best Digital Village

before participating in the learning activities of the Expo. The time span of the program was 5 weeks.

2.1 Design of the Learning Program: the Expo

The Expo takes place in the Exhibition Center of the BDV and it is composed of three zones in space, which are Lobby, Exhibition Hall, and DIY Room.

2.1.1 Program Overview: the Lobby

There are both a user guide of the Expo and a guestbook in the Lobby for participants' convenient access. In essence,

the Lobby is the place of entrance to the Expo and it provides participants the opportunity for getting acquainted with each other and ready for the program.

The learning tasks for participants of the Expo are divided into individual and group tasks in sequence, which are located at the Exhibition Hall and the DIY Room respectively.

2.1.2 Individual Task: the Exhibition Hall

In the Exhibition Hall, there are 3D objects of representative architectures, landmarks, or statues in different countries. Figure 3 is a screen shot of the Exhibition Center.

To complete the individual task, participants have to earn two types of sticker, which are artwork sticker and charisma sticker. To receive an artwork sticker, participants need to pass quizzes about the exhibits. When participants approach an object in the exhibition area, the information about that object will show up in the Informatics window in Supporting Pane. After reading the information about the exhibiting object, participants can click on the "Get a Sticker" button and answer a question about the object. An artwork sticker is awarded when participants provide the correct answer to the quiz. Each participant is required to collect at least three artwork stickers.

To receive a charisma sticker, each participant needs to collect charisma points by chatting with people or reviewing information about online participants containing in learner profiles (LP) or the Guestbook in the Lobby. Table 2 explains how the charisma points are calculated:

The sum of the three parameters is the total amount of charisma points a participant receives. A participant needs to collect at least 10 charisma points for exchanging a charisma sticker.

2.1.3 Team Task: the DIY Room

After all team members have explored the Exhibition Hall and completed the individual task described in the previous section, the team is then granted access to its own DIY Room – a room for the team to design a 3D artifact collaboratively with teammates (Figure 4). In the room, team members are asked to arrange several lego-like blocks and create a 3D artifact by manipulating imbedded tools such as "Translate Object", "Rotate Object", and "Scale Object".

Each team's DIY Room is open to public for visiting and reviewing of the artifact. The participants in the program are encouraged to evaluate the quality and creativity of 3D artifacts created by their peers by providing scores to artifacts in peer evaluation manner.

2.2 Research Questions

There are two research questions that the study will address on, which are:

- Are school students more interested in reviewing learning objects than interacting with peers?
- Are school students more interested in interacting with their virtual peers than proximal ones?

Overall, the study wants to explore how school students behave themselves in the virtual learning worlds in terms of learning behaviors and interpersonal interaction patterns.

Figure 3. The Exhibition Hall in the Expo

Evaluation Parameters	Weighted Points
Frequency of chatting with people. (X)	X * 5
Frequency of reviewing the Guestbook. (Y)	Y * 1
Frequency of reviewing learner profiles. (Z)	Z * 2

Table 2. Evaluation Rubric for Earning Charisma Points

Figure 4. The Screenshot of DIY Rooms.

3. Results of the Data Analysis and Discussion

There were 19 teams from two different countries enrolled in the program of the study autonomously. The teams were also from different schools, which are located at different geographic sites respectively. The fact implies that participants were strangers to each other among teams before the program started.

There were 3 teams who didn't really completed assigned learning tasks and dropped out of the program before the ending. Therefore, the valid team number and amount of participants for data analysis are 16 and 64 respectively.

Twelve items of quantitative data were collected through the system data logging mechanism. Those 12 items are frequency of login, time spent in the Lobby, time spent in the Exhibition Hall, time spent in the DIY Rooms, frequency of chatting with teammates, frequency of chatting with other teams, frequency of accessing user guide, frequency of accessing my learner profile, frequency of accessing others' learner profiles, score in quiz, score in charisma, and score in artifact in DIY Rooms. The t-test is utilized to analyze these data.

The average of frequency per team in accessing the Expo within 5 weeks is 78.9. The average of total time per team in accessing the Expo is 472 minutes in the duration of 5 weeks. Table 3 is the data about the time students in 16 teams spent in three different zones of the Expo respectively. The data indicates that the time students spent in the program varies in three zones significantly as anticipated due to the facts that each zones has its own specific required learning tasks respectively. Whereas the standard deviation of time spent in DIY Room, which required the most sophisticated learning skill among the three zones, is too big due to be ignored, the data implies that students like to spend time on manipulating objects in the virtual worlds.

It is one of the hypotheses of the study that people are more interested in discovering what others are and what they are doing in the virtual space than tracking their own status. Table 4 indicates that frequencies performed by students in the program in accessing their own learner profiles and others' learner profiles (LP) are not different significantly ($P > 0.05$).

How about the frequencies in chatting? Table 5 also indicates that school students in the program chatted with their own teammates almost in the same amount of times as chatted with their virtual peers from other teams.

The facts shown in both Table 4 and Table 5 imply that students did not concern more on their virtual peers than on themselves and these are not aligning with the hypothesis claimed by the study. The detour probably is resulted from the consequence of few occasions for participants to be online at the same time with virtual peers and, subsequently, they did not have many opportunities to chat with their virtual peers or access their learner profiles, which are only available when people are online together. The fact implies that if there were virtual peers online together, they would have interacted with each other intensively.

The other alternative response to the aforementioned hypothesis claimed by the study, the facts in Table 4 and Table 5 might have revealed the hidden desires in participants while they were residing in the virtual learning world that, in addition to their virtual peers, they were also concerning about what their teammates and themselves have done or what were doing inside the virtual space. Above all, the data here suggest that both virtual learning community and proximal learning community all have their own roles to play in virtual learning worlds.

In addition to interaction patterns, the study also wants to explore whether participants were more interested in accessing learning objects, such as the user guide in the Lobby, than communicating with people? Learner profile, which is embedded in the BDV system, contains

Zones	N	Mean	SD
Lobby	16	17.9	7.5
Exhibition Hall	16	54.0	36.8
DIY Room	16	400.5	1046.6

Table 3. The Time Teams Spent (Minutes) in Zones in the Expo

Variable	N	Mean	SD	Ψ	df	P
Accessing My Own LP	16	24.2	32.5	0.71	15	0.49
Accessing Others' LP	16	19.8	22.5			

Table 4. Summary t-test: Frequencies in Accessing LP

Variable	N	Mean	SD	Ψ	df	P
Chatting with Teammates	16	13.9	17.2	0.24	15	0.82
Chatting with Other Teams	16	12.9	17.7			

Table 5. Summary t-test: Frequencies in Chatting

information about people in the community and it is a tool for enhancing the quality of communication. Figure 5 shows that students accessed a lot more on LPs as a whole than on the user guide. When the frequencies of accessing learner profiles were aggregated together as a whole and compare with the frequency of accessing the user guide in the Lobby with a t-test, the result in Table 6 indicates that the difference is significant ($P < 0.01$).

The comparison of the frequency in chatting with people with the frequency in accessing the user guide was also conducted with another t-test. The result in Table 7 also indicates that participants were more interested in communicating with people than browsing the learning objects such as the user guide significantly ($P < 0.01$) in this case.

The facts in both Table 6 and Table 7 imply that participants in the virtual world were more interested in discovering people than browsing or exploring learning objects. In addition, after examining the averages of Frequencies of Chatting and the Scores of Charisma teams received against the average Frequencies of Login, the study also realizes that participants did spent a great deal of time on interaction with or learning about their peers when they

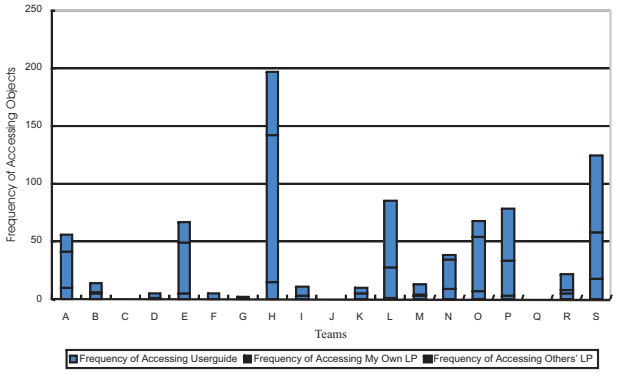

Figure 5. Proportion in Accessing LPs and User Guide

Variable	N	Mean	SD	t	df	P
Accessing Lps	16	43.9	50.0	3.26	15	0.00
Accessing User Guide	16	5.8	5.1			

Table 6. Summary t-test: Frequencies in Accessing Lps and User Guide

Variable	N	Mean	SD	t	df	P
Chatting	16	26.8	29.9	2.92	15	0.00
Accessing User Guide	18	5.8	5.1			

Table 7. Summary t-test: Frequencies in Chatting and Accessing User Guide

Variable	N	Mean	SD
Frequencies of Login	16	78.9	51.1
Frequencies of Chatting	16	26.8	29.9
Scores of Charisma	16	64.3	77.2

Table 8. Proportion of Interpersonal Interaction in the Virtual World

were in the virtual world (Table 8). Overall, these all imply that students were more interested in interaction with peers than in navigating digital learning objects inside the virtual learning world.

The study is also wondering about what would be the facts which influence the learning performance of participants inside the virtual learning world? In the experiment, the scores teams received both in quizzes and peer evaluations on artifacts are the only two indicators related to learning performance of participants. But both of them don't have any correlation relationship significantly at all with the rest of variables collected in the study. Hence, the study is unable to generalize the conclusion about the factors which could influence the learning performance. Obviously, more vigorous and bigger scale research design is needed in order to exploring the issue regarding learning performance in virtual learning worlds.

Conclusion

Research and practice in the field of networked learning in the past couple of years have shown that the issues of telepresence and community of practice have to be resolved before virtual learning can really take place and be relevant to education (Lin & Kuo, 2006). This study designed and implemented a virtual learning world, which capitalizes on the strengths of online 3D shared learning space: a combination of immersion, telepresence, immediate visual feedback, and interactivity. The virtual learning world provides a 3D shared learning space for avatars, which are the representations of individual learners in networked learning environments. Through the use of such avatars along with their learner profiles, geographically isolated learners can inhabit inside virtual learning worlds simultaneously and communicate with each other in a more immersive manner theoretically. The rationales of the study for implementing the virtual learning world are that telepresence and shared space are important to both fostering vibrant virtual learning communities and developing unique collaborative

learning experiences for learners in networked or virtual learning environments.

The expectation of the study is that the virtual learning worlds might be possible to create a networked learning environment that not only resembles real-life learning environments, but also augments the value of traditional education by immersing students in the virtual learning space and extending the horizon of learning experiences, in the sense that virtual learning worlds might hold high promises for resolving issues of virtual learning communities and scaffolding learning supports in networked learning environments.

For enhancing the practice of the virtual learning worlds in the context of global education, the purposes of this preliminary study are to explore and investigate how school students behave themselves inside the virtual learning worlds in terms of learning behaviors and communication patterns among peers. Based on the empirical data collected by the study, there are two significant findings. One of those findings is that participants were more interested in communicating with peers than navigating static or semantic learning objects while they were inside the virtual learning world in terms of learning behaviors. The finding pertaining to learning behaviors has two implications, one is positive and the other is negative in the aspect of current practices of virtual learning worlds. The positive implication is that the immersive and telepresence features of the virtual learning worlds could indeed foster interpersonal interaction among peers which might in turn bring up exchange or construction of knowledge. In essence, raising the quality and quantity of interpersonal interaction is one of the critical issues that have been targeted for years in the field of networked learning. The negative implication is that the design of learning objects, which are embedded in the virtual learning worlds, definitely needs more sophisticated consideration and enhancement. As a matter of facts, instructional design, especially in the categories of learning content and activities, has been the toughest issue for years in the practice of networked learning. The unique features of the 3D virtual learning worlds make the issue even more complicated than in the conventional web-based networked learning environments.

The other finding of the study is about interaction patterns, which is that participants interacted equally in terms of frequency with their own teammates and people in other teams whom they were unacquainted with inside the virtual learning world. The finding implies that both proximal learning community and virtual learning community play their roles respectively in the virtual space and might hold equal impacts on learning behaviors. The significance of this finding is that with sound implementation of the networked learning environments, such as the virtual learning worlds, the virtual learning community, as the existing proximal learning community, could has its own role to play with in terms of facilitating scaffolding learning supports and peer coaching.

Although results of the study provide strong empirical evidences on learning behaviors and interaction patterns of school students inside virtual learning worlds, which is one of the most prominent tools in education currently, the extent of impacts of the study on the practice of virtual learning worlds is limited by lacks of measurement pertaining to learning performance in the research design. It would be an enormous contribution to the field if the learning performance is embodied as an dependent variable in the future study and administrate the correlation analysis between it and both learning behaviors and interaction patterns respectively. However, such a study would need a great deal of efforts on designing learning objects and activities for virtual learning worlds before considering the measurement of learning performance, not to mention developing an appropriate approach of measuring learning performance in the sense of constructive learning. Explicitly, a bigger scale of study that place focus on figuring out how to gauge what and how students learn in the unique virtual learning worlds is favored to proceed based on current research findings.

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