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From Speaking to Acting - Enhancing Interactivities of Learning in the 3D Virtual Worlds

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Abstract: Some common educational activities being discussed for fitting 3D virtual worlds include the following types: interpersonal role-play, oral production, and traditional lecturing [1]. These examples are discussion-based or dialogue-oriented by heavily use of the text-typing or voice communication tools in the virtual scenarios. To take more advantages of the virtual space for enhancing the learning interactivity, this paper demonstrates an example which addresses the interactivities not only among learners by texting but also between learners and learning context. Through configuring the Activity Awareness (AA) model [2] with our designed learning context and activities for teamwork in computer-supported collaborations, we attempt to explore the possibility of enhancing interactivities in the virtual worlds, e.g., a learning task requiring learners to manipulate 3D virtual objects collaboratively. Rather than using commercial platforms like the Second Life, we develop a lightweight yet dedicated system to implement the experiment. Our study demonstrates that the AA model is more feasible for enhancing the interactivity among learners in the learning environment than discussion-based activity is in the 3D virtual learning worlds.

Keywords: Activity Awareness, 3D Virtual Worlds

Introduction

There has been an increasing research interest of the 3D multi-user environment in education since the MMORPG (Massively Multiplayer Online Role-Playing Game) has been introduced to the world, such as the World of Warcraft (WoW) and Ultima Online. However, educators confront challenges when they try to use this kind of 3D virtual worlds as a supplementary virtual learning material. Traditional 2D web pages with learning content, group video conference, asynchronous forum, email or instant messaging system may need to be reconfigured with a 3D rendering engine. Also, some different mechanism may require being reconsidered for 3D multi-user information sharing and distributing system. Resembling a classic type of lecturing class directly in such a virtual world is an easier and popular way. This method could enlarge the number of audience comparing to the restricted physical classrooms; however, it doesn't certainly increase the interactivity that are important for learning community and learning outcomes among learners in the learning context.

To testify and provide other feasible examples to fill the gap, we conducted the AA model to design a thematic learning activity for compromising with the taking of the 3D multi-user virtual worlds as learning environment. By reviewing guidelines and principles of pedagogies, we combined with educational theories and practical system designs to establish a collaborative type of learning activity to enhance the interactivity mentioned in the previous paragraph. We implemented a web-based 3D multi-user system, along with a small projectile motion learning activity called virtual parabola festival. The AA model was introduced to design various collaborative learning tasks and system functions in this activity for triggering the interactivity among learners, between learners and the learning context as well as the learning contents. The practice which the AA model could be used to enhance the interaction in the virtual shared activities will be discussed in section 3. Since the platform is created by researchers, the database and the designated learning data could be easily accessed.

Comparing to other similar studies which use existing Second Life or other commercial platforms as experiment environment, our study initiated from the very beginning by asking a fundamental question: What mechanism and principles should be considered for designing a 3D virtual learning system in order to support learning collaborative activities? Not only engaged in theorizing, we also developed a lightweight system for empirical test to confirm the feasibility. We have the experiment executed by the system programmers, educators and testers to verify that the AA models can enhance the virtual learning interactivities in the 3D virtual worlds.

1. Learning examples in the Second Life

Jaeger [1] proposed an evaluation framework for educational activities in virtual worlds based on Media Richness and Task Closure Theories from Management Information Systems. He used three types of educational activities in the Kamimo virtual campus project in the Second Life to find out which type was more appropriate for such kind of learning environment.

1.1 Interpersonal role-play

In this scenario, students were divided into four teams, a buyer team and three vendor teams. Their avatars were gathered in a 3D meeting room for role playing the "Response to Request-For-Proposal" activity. The activity is usually developed in a classroom, and is obviously easy to be represented in the 3D virtual world. Fig. 1 shows that the activity is discussion-based via texting or voice communication. Learners interact with each other rather than between a learner and the 3D learning context.

Fig. 1. Discussion-based activity

1.2 Breaking into conversations

This activity demonstrated how to people interaction in a polite way. The main technique was to have a buddy group discuss a topic and sit around a campfire when another buddy group broke into their conversation in a polite way. Moreover, the interactivity still focused on the learners, leaving out the 3D stage settings, objects, and insignificant elements. The scenario could be implemented by replacing the conference table with a campfire shown on the figure 1.

1.3 Traditional lecturing

Some teachers use the Second Life system to display their slides or teaching materials for students as they do in the physical classroom. It is a way of passive learning since there is bare interaction among learners or between teachers and learners.

The results of Jaeger's study shows that "Interpersonal role play" and "Breaking into conversations" have greater potential to be successfully implemented than "Traditional lecturing" in the Second Life. Although the Second Life provides a universal platform for any possible virtual educational activities, there is still time and space to modify various educational activities each time. That is why we must respond to interactions between the system and activity designs.

2. The Activity Awareness Model to Enhance Interactivity in Learning

Carroll et al. proposed a framework of four aspects for understanding the joint endeavor of activity awareness [2][3], which are all important in computer-supported collaborations: common ground [4], community of practice [5], social capital [6], and human development [7]. Based on the general concept of shared knowledge [8] plus a more elaborate view that includes common beliefs, complementary knowledge, social, cultural, and physical concepts [9], the framework shifts the focus from shared concepts to shared activity, and is helpful for designing technology and enhancing team effectiveness derived from interactivity.

Table 1 summarizes the four facets of activity awareness and gives clearer guidance for designing and developing a virtual learning environment which could effectively enhance the interactivity in learning process.

Table 1: Four facets of activity awareness (Carroll, et al., 2006)

Facet	Description
Common ground	A communication protocol for testing and signaling shared knowledge and beliefs
Communities of practice	The tacit understanding of community-specific behaviors shared through enactment
Social capital	The creation of persistent social goods through networks of mutually beneficial or satisfying interaction
Human development	Innovative behavior or decisions entrained by open-ended, complex problem solving, and evolving skills of both members and teams

Collaborative learning contains social knowledge construction, peer interaction, communication and collaboration; in this research, the framework is adopted as a blueprint for developing and implementing a realistic system.

The common ground may be considered as a communication protocol for establishing the co-existing and situated learning atmosphere for learners to share knowledge and beliefs within, like the players in WoW. The learning context and relevant activities provide an opportunity for a community of practice to develop; through the deployment of sticky learning tasks in various scenarios, learners could communicate and interact with others to achieve social capital, eventually enhancing human development for both learners and their teams.

All above considerations could be easily developed in a physical classroom; however, educators seldom elaborate these facets into the 3D virtual worlds. The reason may due to the lack of system programming skills, burden of learning commercial tools, as well as the control of the platform or cooperation with the commercials; therefore, those leave a question for us to verify that if the AA model is really feasible in such new environment.

3. Design of the System and Learning Activity

A space can only become a place when an understood activity is scheduled or ongoing [10], so does the 3D virtual learning space. We designed a thematic learning activity including series of tasks - the virtual parabola festival, to bring the AA model into practice in our small yet dedicated 3D virtual space named the Best Digital Village (BDV). The main activity is deployed in the virtual buildings as series of tasks in the learning scenarios, and two kinds of tasks are designed: those for individuals and those for team collaboration.

3.1 The learning tasks for individuals to interact with learning context

The scenarios and tasks for individuals are as follows: The Town Hall is the reception and administration center wherein the learners can look up other learners' and team profiles. Team management along with information on the "Honor Roll" and "Score Board" can also be obtained from kiosks in this building. Learners who frequently visit and use the kiosks will receive experience points (EP).

The Community Center is the building where learners gather for a summit or discussion, as well as to counsel each other. Chatting or discussing topics with others will earn charisma points (CP). All dialogues will be recorded in a database and can be output in the form of a reporting document sorted by team, date, week, month, and year for further review and analysis. In addition, joining a discussion in the BDV forum on the web portal for asynchronous communication will also earn extra CP.

The Library in the BDV is used to encourage learners to contribute their knowledge. Learners can recommend or upload the related web links or digital multimedia resources to earn EP, so do those who frequently visit and use the resources in the library. Learners can examine every book shelf or digital facility in the library to gain parabola-related information to better understand the important parameters like velocity and angle in a parabolic flight motion.

In the School, there is a classroom within which a parabola knowledge test for scholarship is held, and learners can take the exam and earn extra EP. They can also discuss the answers in online forums to get more CP. Fig. 2 shows the actual screenshots of each scenario described above.

Fig. 2. Actual screenshots of the scenarios: From left to right, top to bottom: Town Hall, Community Center, Library and the Classroom in the School

The Exhibition Center has various zones using interactive 3D parabola-related objects and artifacts that demonstrate how the parabola formula works and is applied in daily life. Learners who visit these zones and interact with the 3D artifacts to learn more about the topic will get EP, and details of these zones are as follows. Concept Zone: This zone is decorated with posters of parabola mathematics, physics, and formula drafts from historic to scientific factors, and is helpful for understanding the evolution and recalling the calculations related to parabola. Entertainment Zone: This zone shows Frisbee, quoits, fishing rod swinging, and many other entertaining parabolic activities. Learners can click on the objects to see how these games are played. Daily-Life Zone: This zone introduces parabolic applications and phenomena in our daily life. Military Zone: This zone gives details of the ancient and modern weapons using the parabolic flight formula. Learners can click on the vivid 3D models to see how they work. Sports Zone: This zone illustrates basketball shooting, pitching, and many other parabolic games. Learners can click on the sports items to see how the parabola formula is applied. The thematic zones are illustrated in Fig. 3:

Fig. 3. Actual screenshots of the different zones: From left to right, top to bottom: Lobby of Exhibition Center, Zone of Concepts, Life with Parabola, Entertainment, Military and Sports

3.2 The learning tasks for team collaboration to enhance interactivity among learners

In the Exhibition Center, the Innovative Artifacts Gallery allows team leaders hold a brainstorming session to create new ideas by applying what they have learned. They put a blueprint or draft on a web page, including a brief description of the ideas, and then upload the information to the gallery.

All teams are required to score and comment on the other teams' ideas and innovations and initialize "peer reviewing" by clicking on the work of each team on the gallery wall, and earn CP during the process. Domain experts are also invited to examine and evaluate the practicality and creativity of each idea, then give each team extra EP. Fig. 4 shows the interior of the gallery along with the scoring and commenting interface, used in the library scenario for learner-contributed materials.

Fig. 4. From top: The Innovative Artifacts Gallery and the interface for peer reviews

The other collaboration task is a catapult simulation game in the Park scenario, which utilizes the virtual game currency as gold converted from EP and CP by rubrics. After all team members earn enough gold, they can get together in the park to play the catapult simulation. Each team involved in the simulation game needs to fulfill the following five roles to coordinate the parameters of the parabola formula. The Commander, played only by a team leader, is responsible for coordinating and negotiating about solutions among teammates; he or she is the only one who can press the "fire" button to launch the virtual catapult. The Observer has binoculars to observe surroundings and is responsible for reporting back the results; the Navigator is responsible for calculating the fire angle parameter. The Controller is responsible for resolving the initial velocity parameter. The Counselor is generally a teacher who can give minor adjustments to the final solution. Thus, a game-based role-playing learning prototype emerges from this arrangement of interactivities, while the learners form a team and achieve a consensus on the solution.

Fig. 5 shows a collaborative firing condition, along with the simulation game flow. The Commander asks for a new target and coordinates teammates to input and confirm the firing parameters. Every time after the commander pushes the button to fire, the observer reports back the position between the target and the point of impact, as well as the firing results, which may be: “perfect,” “excellent,” “not bad,” and so on, each with an appropriate amount of rewarded EP and CP given back to each team member. The team then discusses and decides whether keep playing with the same target until they achieve a bull’s eye, or to give up and ask for another new target. The colored blocks in the flow chart represent the processes where interactivity and social capital should occur.

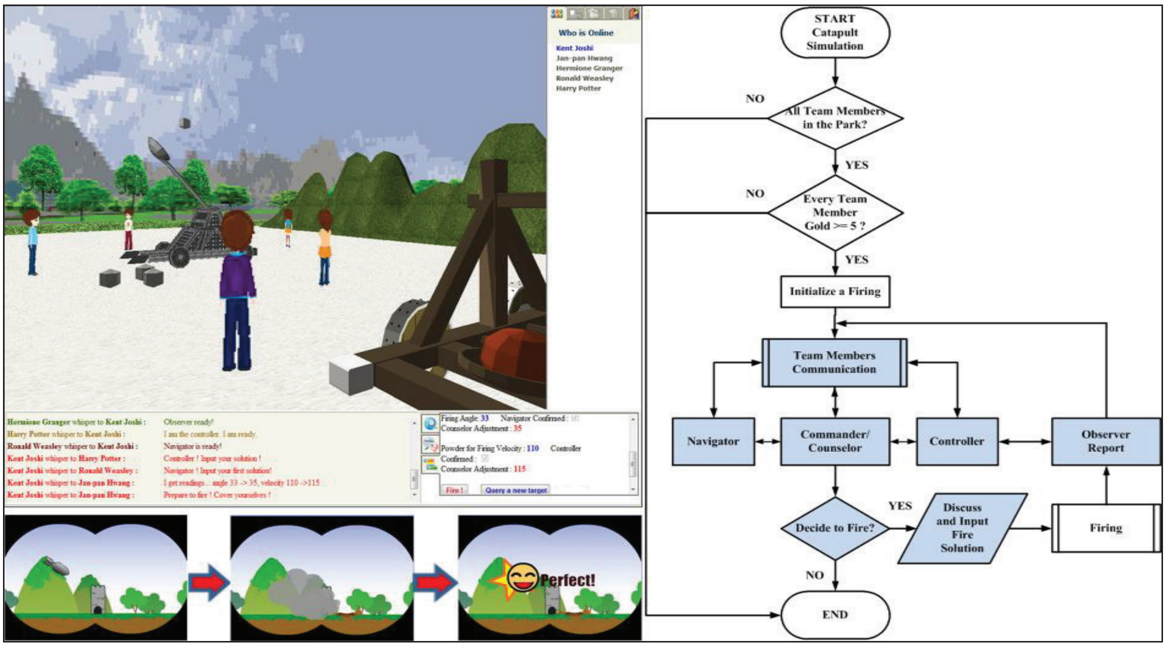

Fig. 5. The catapult game play and the activity flowchart

Discussion and Conclusion

Comparing to the discussion-based activities, the AA model could enhance interactivities among learners and between learners and the learning context in the 3D virtual worlds. Although the AA model is easy to implement and to be testified in a real classroom, it is seldom discussed in the 3D virtual worlds. One reason may be that educators lack the experiences to either develop a complex activity in a commercial platform or learn how to bring the script alive in the Second Life, thus leave the learning context for only background decorated curtains on the stage. We tried to design more interactive activities with our own applied system supports and empirically confirmed that the AA model could be improved and configured for learning in the 3D virtual worlds, not only for science education but also for any other virtual collaborative activities to enhance interactivities in many aspects, increase the bonding of learners, learning context and learning activity, and thus promote the learning performance accordingly.

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References

[1] Jaeger, B. (2009). *What educational activities fit virtual worlds: towards a theoretical evaluation framework*. Paper presented at the 3rd IEEE Intrnational conference on digistal ecosystems and technologies (IEEE DEST2009).

[2] Carroll, J. M., Rosson, M. B., Convertino, G., & Ganoe, C. H. (2006). Awareness and teamwork in computer-supported collaborations. Interacting with Computers, 18(1), 21-46.

[3] Carroll, J. M., Neale, D. C., Isenhour, P. L., Rosson, M. B., & McCrickard, D. S. (2003). Notification and awareness: synchronizing task-oriented collaborative activity. *International Journal of Human-Computer Studies, 58*(5), 605-632.

[4] Clark, H. H. (1996). *Using Language*. New York: Cambridge University Press.

[5] Wenger, E., McDermott, R., & Snyder, W. M. (2002). *Cultivating Communities of Practice: a Guide to Managing Knowledge*: Harvard Business School Press, Cambridge, MA.

[6] Coleman, J. S. (1988). Social Capital in the Creation of Human Capital. *American Journal of Sociology, 94*(S1), S95.

[7] Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes* (14 ed.). Cambridge, MA: Harvard University Press.

[8] Mathieu, J. E., Heffner, T. S., Goodwin, G. F., Salas, E., & Cannon-Bowers, J. A. (2000). The Influence of Shared Mental Models on Team Process and Performance. *Journal of Applied Psychology, 85*(2), 273-283.

[9] Mohammed, S., & Dumville, B. C. (2001). Team mental models in a team knowledge framework: expanding theory and measurement across disciplinary boundaries. *Journal of Organizational Behavior, 22*(2), 89-106.

[10] Redfern, S., & Naughton, N. (2002). Collaborative Virtual Environments to Support Communication and Community in Internet-Based Distance Education. *Journal of Information Technology Education, 1*(3), 201-211.