

Collaborative Learning Models and Support Technologies in the Future Classroom

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This study explored how the environment of collaborative learning should be set in the future classroom and what technological elements are required. Four collaborative learning scenarios were proposed, which were: 1) project based collaborative learning using presentation and communication tools; 2) story based collaborative learning using a role-playing game; 3) collaborative play using interactive rugs; and 4) Inquiry based collaborative learning using an immersive display. For each scenario, a collaborative learning model as well as classroom environment and support technologies for collaborative learning was suggested.

Keywords: collaborative learning model, collaborative learning scenario, future classroom environments & technologies

Introduction

Collaborative learning is emerging as a new future form of education in companies and schools that promotes groups' knowledge generation, improves abilities to solve high-level problems, and motivates students to participate in learning. With the advance of online communication tools, the expansion of online communities, and the introduction of new technologies such as augmented reality, ubiquitous technology, and next-generation displays, various technologies have become available for collaborative learning. According to OECD research, the ability of collaborative learning is one of the 21st century competencies for new millennium learners (OECD, 2009; Pedro, 2006; Veen, 2007).

Thus, this study designed teaching-learning scenarios that use technologies and reflect the characteristics of collaborative learning and, based on the scenarios, it explored how the environment of collaborative learning should be designed in the future classroom and what technological elements should be considered in such an environment.

In the study, we discussed the concept of collaborative learning, explored learning environments to promote collaborative learning and investigated a general collaborative model and supporting technologies (Babi et al., 2008; Huang et al., 2009; Molina et al., 2008; Suh & Lee, 2006; Wang & Kang, 2005; Yuan & Jin, 2008). Furthermore, we formulated four collaborative learning scenarios in the future classroom and derived classroom environment and support technology

elements for collaborative learning.

Theoretical Background

The General Model of Collaborative Learning

Collaborative learning is a learning method in which small groups whose members have equal standing collaborate to attain common goals, to perform common tasks and to evaluate common outcomes; through this process, they learn social and collaborative skills (Johnson & Johnson, 1986; Slavin, 1995). The ingredients of successful collaborative learning are the active interaction of group members, positive interdependency, and a strong sense of individual responsibility (Johnson & Johnson, 1986).

Like Figure 1, collaborative learning environments and supported tools are composed of tasks, communication tools, collaborative task workplace, and learning resource (Suh & Lee, 2006). Tasks are designed to produce team outcomes while each team executes inquiry-based learning and project-based learning on them. Communication tools include asynchronous or synchronous communication tools and functions to check learners' states of the progress of tasks and the connection of team members. The collaborative task workplace includes functions for preparing tasks, individual learning, team learning, and task evaluation. The learning resources include lecture contents and reading materials.



Figure 1. *Learning environments and tools for collaborative learning*
(adapted from Suh & Lee, 2006)

Table 1 shows the general collaborative learning model and supported technologies (adapted from Lee et al., 2004). The model was built on reviewing traditional collaborative learning activities such as Jigsaw, Group Investigation (GI), Co-op, Student Team Achievement Division (STAD), Team Games Tournaments (TGT), and Learning Together (LT), and also analyzing the attributes and processes of Inquiry Based Learning (IBL), Problem Based Learning (PBL), Project Based Learning (PBL), situated learning, and online learning community (Johnson &

Johnson, 1986; Kagan, 1998; Kang & Byun, 2001; Jonassen & Land, 2000; Palloff & Pratt, 1999; Stahl, 2000).

The model has five phases for promoting participants' interactions and reciprocal responsibilities among learners in order to support achievement of individual learners' and teams' goals. Five phases of the general collaborative learning are composed of identifying learning tasks, team building & planning, individual learning, team learning, and sharing & evaluating learning outcomes.

At the first phase, students understand the learning tasks and evaluation methods. At the team building and planning phase, students share the group goal, divide the roles, and plan the team schedule using team arrangement and schedule management functions. Through the individual learning phase, students explore individual tasks and create their own outcomes using personal performance supported tools. At the team learning phase, this phase includes both intra-team learning and inter-team learning. Students not only exchange their ideas, share their outcomes, and produce group output within team, but also share their group ideas and products among teams in same class or in different schools or in foreign countries. At the end of the processes, each team evaluates other teams' outcomes and reflects group work processes using sharing tools and evaluation function.

Table 1. *The General Collaborative Learning Model and Supported Technologies (adapted from Lee et al., 2004)*

Phase		Sub-processes	Supported technologies
Identifying Learning Tasks		<ul style="list-style-type: none"> ▪ Identifying Learning Goals, Processes & Methods ▪ Identifying Evaluation Criteria & Methods 	Task Orientation & Guidance Tools
Team Building & Planning		<ul style="list-style-type: none"> ▪ Organizing Teams for Group Goals ▪ Dividing Roles of Members ▪ Arranging for Team Learning Plans 	Team Arrangement Function Discussion Board Schedule Management Function
Individual Learning		<ul style="list-style-type: none"> ▪ Investigating Individual Tasks ▪ Producing Individual Learning Outcomes 	Personal Performance Supported Tools Resource Room Searching Tool
Team Learning	Intra-team	<ul style="list-style-type: none"> ▪ Sharing Individual Learning Outcomes within Team ▪ Collecting, Analyzing, and Sharing Information within Team ▪ Group Discussion and Problem solving ▪ Producing Team Outcomes 	Discussion Board & Communication Tools Sharing & Presentation Tools Group Resource Room
	Inter-team	<ul style="list-style-type: none"> ▪ Collaborating & Competing among Teams ▪ Exchange & Sharing Ideas among Teams 	
Sharing & Evaluating Learning Outcomes		<ul style="list-style-type: none"> ▪ Peer Evaluating & Giving Feedback on Learning Outcomes among Teams ▪ Recording and Sharing Learning Outcomes ▪ Evaluating & Reflecting CL Processes and Outcomes ▪ Maintaining the Learning Community 	Assignment Submission function Sharing Tools Communication Tools Evaluation Checklist Survey Compensation Management Function

Trend of Technologies for K-12

According to Tech Trend 2010 for K-12, reported by New Media Consortium (NMC, 2010), they estimate that the expected core technologies at K-12 schools are clouding computing and collaborative environments in 2010-2011, mobiles and game-based learning in 2012-2013, and augmented reality and flexible display in 2014-2015.

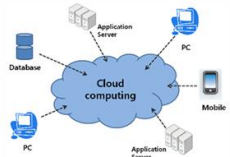





Time	~2011	2012~2013	2014~2015
Tech nology	Cloud Computing 	Mobiles 	Augmented Reality 
	Collaborative Environments 	Game-Based Learning 	Flexible Displays 

Figure 2. *Technology Trend for K-12* (KERIS, 2008; NMC, 2010)

The source of images: <http://collaborate.extension.org>,
<http://flexdisplay.asu.edu/image>, <http://keris.or.kr>

Especially, collaborative technologies range from single communication tools such as Voicethread, live video conferencing, and synchronous/asynchronous chatting and discussion, to shared document editors like Google Docs and group blogging systems, up to comprehensive platforms for collaborative work such as Moodle (future lab, 2009; NMC, 2010).

Moreover, collaborative environments sustain both the collaborative creation of content and the communication or sharing of existing content according to NMC (2010). The former technologies for content creation include such as wikis, Google docs, and group blogs. The latter technologies for exchanging and sharing ideas include online communication tools combined with social media component like Ning² and Moodle³. Other collaborative environment is a kind of off-the-shelf solution for classroom use such as ThinkQuest⁴.

Collaborative Learning Scenarios and Models

As in Table 2, we specified target learners, subjects, and support classroom technology components, and proposed four different collaborative learning models and scenarios, based on

² <http://education.ning.com>

³ <http://moodle.com>

⁴ <http://www.thinkquest.org>

the five general phases of collaborative learning presented in Table 1. The target learners ranged from preschool to high school students. Subjects such as social studies, history, science, and geography were chosen in order to promote students' collaborative work and enhance the positive interdependence and communication skills among members in learning process. Moreover, the space included both intra-classes and inter-classes with other distance schools or foreign countries, and time base was limited from 2011 to 2015.

Four collaborative learning scenarios were proposed, which were: 1) Project based collaborative learning based on the presentation and communication tools; 2) Story based collaborative learning using a role-playing game; 3) Collaborative play using interactive rugs; and 4) Inquiry based collaborative learning using an immersive display (Caussanel & Soulier, 2008; Kang & Byun, 2001; Jonassen & Land, 2000; Palloff & Pratt, 1999; Stahl, 2000).

Table 2. Framework of Collaborative Learning Scenarios

Framework	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Collaborative learning model	Project based CL	Story based CL	Collaborative play	Inquiry based CL
Main activities	- Group investigation - Information exchanging & sharing - Presentation	- Character-driven storytelling - Character & clues exploration	- Play - Experiential activities	- Inquiry and realistic observation
Classroom environments	Presentation and communication tools	Role-playing game	Interactive rugs	Immersive display
Collaboration tools	free-single working tools / shared document editors / comprehensive platforms for collaborative work			
Target learners	middle ~ high school students	5 th grade elementary students ~ middle school students	Preschool students~ 4 th grade students in elementary school	4 th grade ~6 th grade students in elementary school
Subjects	Social studies	History of mathematics, and English literature	Geography, Science, History, and Field survey	Science
Time base (Tech trend)	2011	2012~2013	2014~2015	
Space base	Intra-classroom and Inter-classroom			

Scenario 1: Project based collaborative learning using the presentation and communication tools

In Scenario 1, there is a blackboard-like multi-touch display in front of the classroom visible to all students in the class, each team performs a joint task using the presentation tools such as digital whiteboards, and each team member collects information using the communication tools such as wikis and blog (Figure 3 & 4).

At the beginning, each team is given cyber money for founding a company and the team

members divide roles such as marketing, planning and sales, and then the team makes a company establishment contract with the teacher. In the middle of task performance, the teacher shows all the students each team's progress or management information on the digital blackboard-type display, and provide feedback to each team. In addition, each team's members in charge of marketing, planning, and sales arrange a meeting with other teams' members playing the same role and exchange information through personal communication devices such as PDA or smart phone. At the end, each team presents the company's profits and management information, and evaluates them with other students and the teacher.

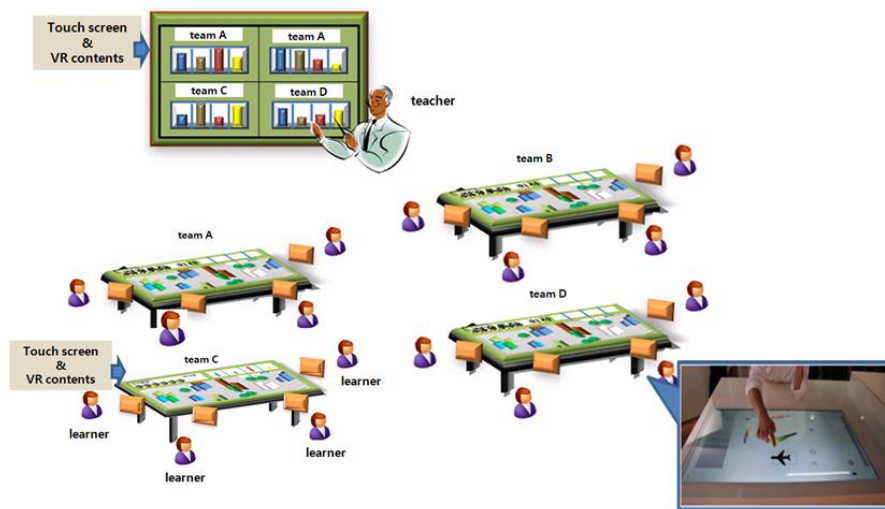


Figure 3. Use of the presentation and communication tools for problem based collaborative learning

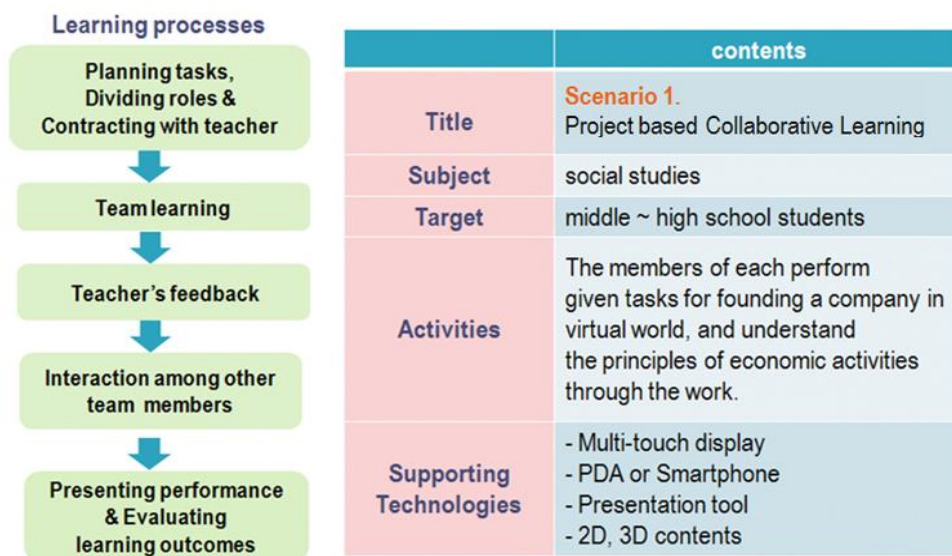


Figure 4. Project based collaborative learning model

Scenario 2: Story based collaborative learning using a role-playing game

A story based collaborative learning using role-playing game is a method that is familiar to students and can stimulate their interest (Caussanel & Soulier, 2008; Lindley, 2005). The students play a role-playing game for learning the history of mathematics, and compose a story by themselves using multimedia authoring tools. Each team is provided with a personal tool (personal digital active board) and a collaborative tool (main display) in one body as in Figure 5 and 6. The team members first understand the contents of the task and directions shown on the main display, and then they set historical background and avatars necessary in the role-playing game and can set necessary interface and save the problem-solving process and workbook. Students can also work the game learning with students or group in different schools or in foreign countries using online role-playing game environments.

In case a role-playing game is used in English learning, the digital active board supporting multimedia clips and authoring tools can produce animation effects by inserting multimedia background with an English poem or novel. In addition, it is possible to narrate a story by adding sound in important parts. Furthermore, when a student does English homework at home, he/she can practice English composition or pronunciation using the English writing-pronunciation program on the digital active board without the teacher's help. Different from textbook-based learning, with a digital active board, students can improve their English conversation skills smoothly while forming a team, making stories by themselves, and discussing in English. The digital active board includes multimedia clips, English writing-pronunciation program, multimedia authoring tools, and role-playing scenario DB functions.

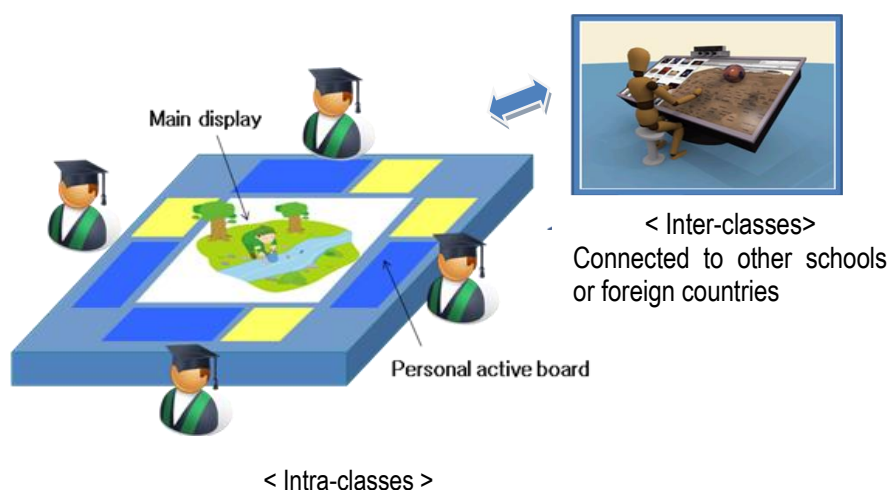


Figure 5. A role-playing game environment with a digital active board

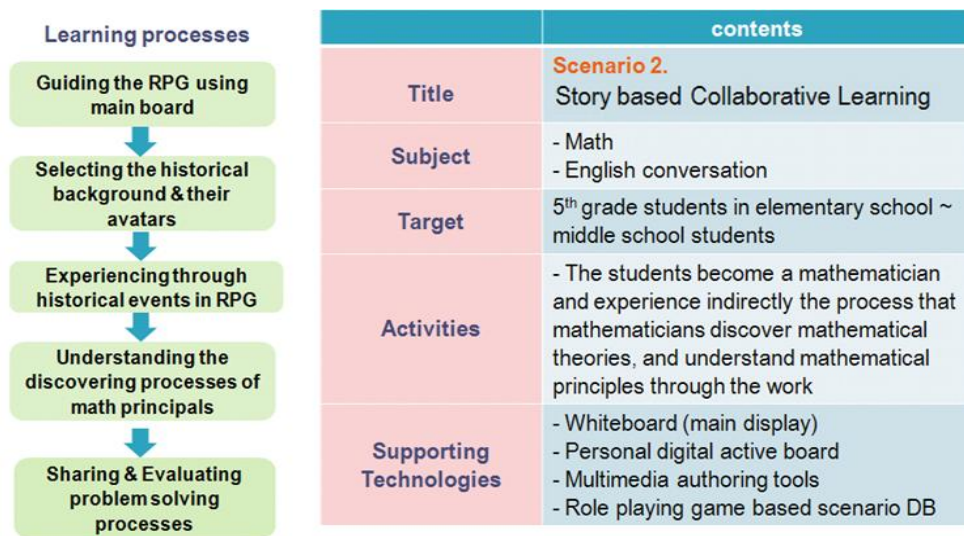


Figure 6. *Story based collaborative learning model*

Scenario 3: Collaborative play using interactive rugs

Collaborative play using interactive rugs is a learning method in which all the students understand through writing and drawing on the floor together instead of studying at a desk in classroom (Figure 7 & 8). This learning environment enhances not only students' imagination and creativity but also their participation compared to other collaborative learning methods.

The classroom floor is implemented as a display, and a circular rug area appears for each team. Then, the team member students sit around on the floor and study through viewing and manipulating the contents of learning displayed on the rug. The teacher strolls among the students and provides contents suitable for the whole class or each team using a personal communication device, and also receives the results of collaborative activities from the students. Sitting and studying around the rug on the classroom floor can increase the students' concentration and participation, and it is expected to help the students pay more attention to the contents of learning because they can manipulate the contents with interfaces such as hand and electronic pen without extra equipment like PC and mouse.

Interactive rugs are applicable to preschoolers' or elementary school children's activities for surveying weather or historic sites, learning of geography and history using a world map, and indoor sports activities. They are useful when outdoor activities are difficult due to bad weather or a long distance to the field survey. They can also be used as a tennis court, a handball court, a basketball court or a gymnasium if the sports field is not sufficient. Interactive rugs are also considered applicable as a system to support children with disabilities.

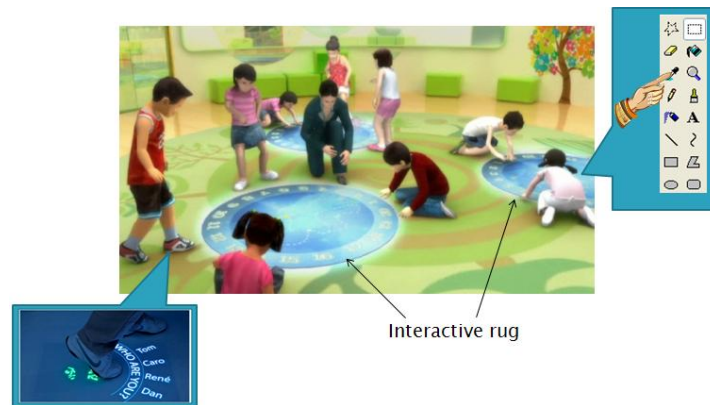


Figure 7. *Interactive rugs and interaction interface in the classroom* (Suh, 2010)
The source of image: adapted from <http://future.keris.or.kr>

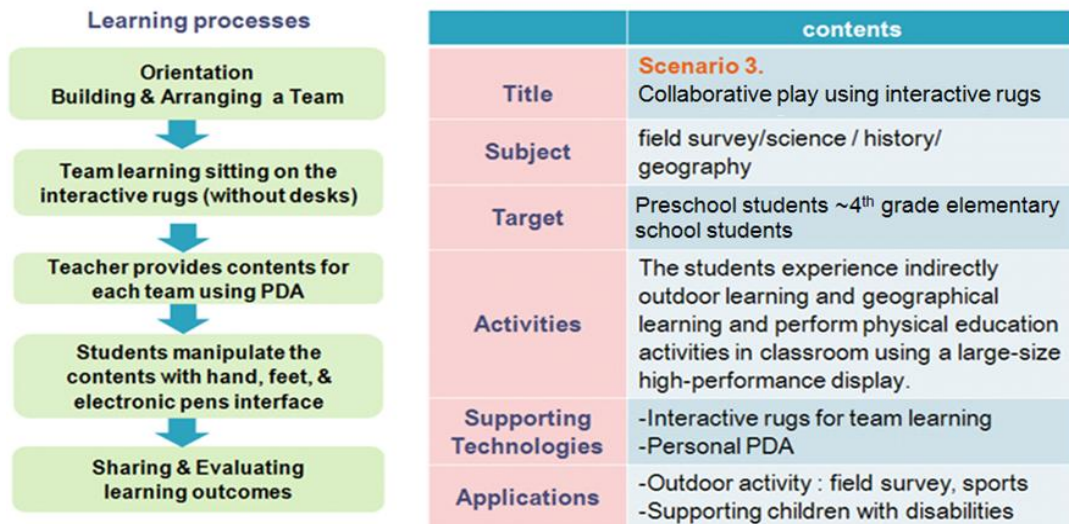


Figure 8. *Collaborative play model using interactive rugs*

Scenario 4: Inquiry based collaborative learning using an immersive display

Through an immersive display, each team can simulate the movements of the universe such as the rotation and revolution of the earth, the waxing and waning of the moon, meridian altitude, and the change of the seasons in classroom (Figure 9 & 10). After the students observe simulations by team, they can examine differences by changing the conditions of the simulations using a keyboard, a joystick, and a personal control device and each team can keep a research diary or make a report on the contents of its research.

For earth science class, which has used 2D materials that are not much understandable to students, the use of 3D and virtual reality technology makes it easier for students to understand

the contents of learning and allows more realistic observation activities by team. Besides science, other subjects like engineering, fine arts, and architecture can show 3D immersive forms for more effective learning.

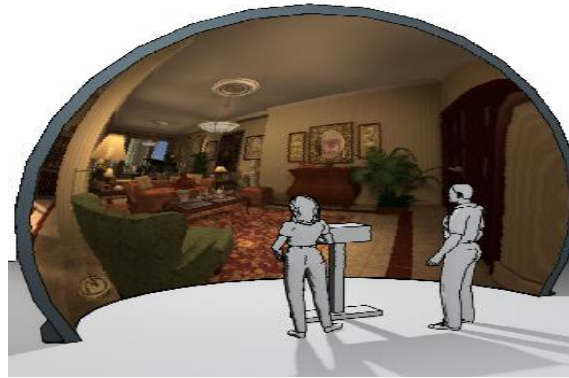


Figure 9. *An immersive display for group work*
 The source of image: <http://www.immersivedisplay.co.uk>

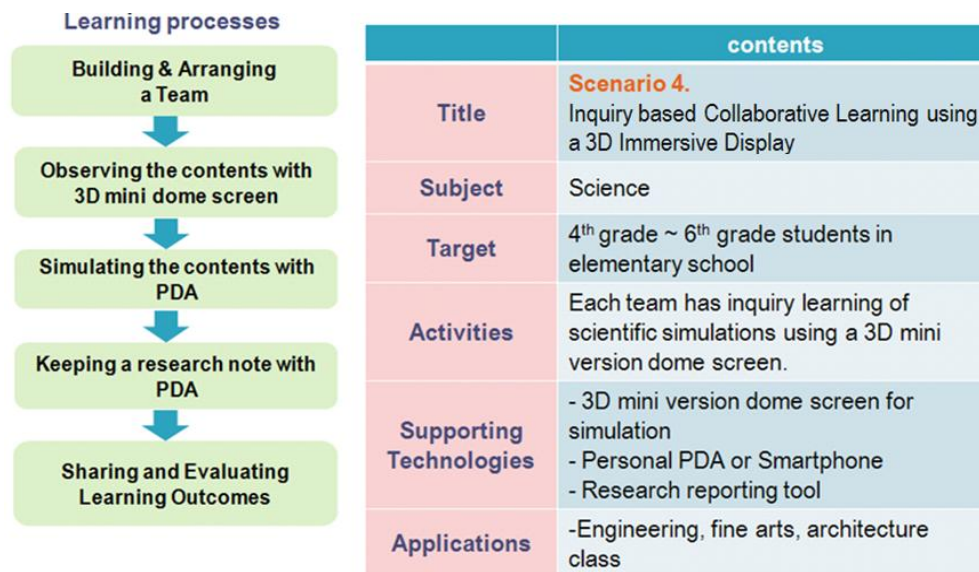


Figure 10. *Inquiry based collaborative learning model using an immersive display*

Conclusion

Through this study, we designed four collaborative learning scenarios, models, and classroom environments supporting technologies for collaborative learning. The four scenarios and support technologies for collaborative learning in classroom setting can be utilized not only in K12 but also in corporate education. Given future ubiquitous environment, furthermore, the collaborative learning support technologies are expected to be applicable together with next-generation new

media technologies such as personalized learning environments, virtual reality technologies, ubiquitous technologies, and intelligent robots (Futurelab, 2009; NMC, 2010).

Based on the results of this study, we make suggestions as follows. First, the formulated scenarios and identified classroom environment and support technologies for collaborative learning should be tested and validated further through surveying demands from the field of education and relevant experts' opinions. Second, technological elements supporting assessment in collaborative learning should be studied additionally. Third, R&D is required for intelligent and personalized systems and synchronous collaboration tools that support collaborative learning (Chen & Wasson, 2005; Tedesco, 2003). Finally, young generations are growing up in the prosperity of computer technologies and have different cognitive and affective characteristics, compared to adult generations (Veen, 2007; Wang & Kang, 2005). Therefore, curriculum and instructional methods for young generation should be changed and studied empirically. The result may contribute to plan collaborative teaching-learning in the future classroom setting and develop collaborative supported classroom environments.

References

- Babi, F., Wagner, J., & Parali, J. (2008). The role of ontologies in collaborative systems. *SAMI 2008 6th International Symposium on Applied Machine Intelligence and Informatics*, 119-123.
- Caussanel, J., & Soulier, E. (2008). Story telling based learning and knowledge sharing. *Journal of e-learning and Knowledge Society*, 4(2), 193-204.
- Chen, W., & Wasson, B. (2005). Intelligent agents supporting distributed collaborative learning. In F. O. Lin (Ed.), *Designing distributed learning environments with intelligent software agents* (pp.33-66). Hersey: ISP.
- Futurelab (2007). *2020 and beyond: Future scenarios for education in the age of new technologies*. Futurelab. [on-line]. Available: www.futurelab.org.uk (2010. April 1)
- Futurelab (2009). *Using digital technologies to promote inclusive practices in education*. Futurelab. . [on-line]. Available: www.futurelab.org.uk (2010. April 1).
- Huang, C., Chen, H., & Chen, C. (2009). Developing argumentation processing agents for computer-supported collaborative learning. *Expert System Application*, 36, 2615-2624.
- Johnson, D., & Johnson, R. (1986). Computer-assisted cooperative learning, *Educational Technology*, 25(1), 12-18.
- Jonassen, D., & Land, S. (2000). *Theoretical foundation of learning environment*. NJ: Lawrence Erlbaum Associates Publishers.
- Kagan, S. (1998). *Cooperative learning*. Timothy Publishing House.
- Kang, J., Suh, H., & Moon K. (2005). Relationships among Presence Factors and Perceived Outcomes in Online Collaborative Learning. *ED-MEIDA 2005 Conference*, 2844-2849.
- Kang, M. H., & Byun, P. H. (2001). A conceptual framework for a web-based knowledge construction support system. *Educational Technology*, 41(1), 48-53.
- KERIS (2008). *A study on effects of educational contents in augmented reality environments*. Korea Education & Research Information Service. [on-line]. Available: <http://www.keris.or.kr> (2011. Feb. 1).

- Lindley, C. A. (2005). Story and narrative structure in computer games. In B. Bushoff (Ed.), *Developing Interactive Narrative Content: sagas-sagasnet reader*. Munich: High Text.
- Lee, I., Leem, J. Jin, S., Sung, E., Moon, K., & Seo, H (2004). Analysis of collaborative learning behaviors and the roles of collaborative learning agent. *E-learn 2004 Conference*, 2748-2754.
- Molina, A. I., Jurado, F., Giraldo, W. J., Redondo, M. A., & Ortega, M. (2008). Specifying scripts and collaborative tasks in CSCL environment using IMS-LD and CIAN. *ICALT '08 Eighth IEEE International Conference on Advanced Learning Technologies*, 775-777.
- New Media Consortium (2010). *Horizon Report 2010 K-12 Edition*. NMC.
- OECD (2009). 21st Century Skills and Competences for New Millennium Learners in OECD Countries. *EDU Working paper. 41. OECD*.
- Palloff, R. M., & Pratt, K. (1999). *Building learning communities in cyberspace: Effective strategies for the online classroom*. San Francisco, Jossey-Bass Inc.
- Pedro, F. (2006). *The new millennium learners: Challenging our view on ICT and learning*. Paris: OECD.
- Slavin, R. E. (1995). *Cooperative learning: Theory, research, and practice* (2nd ed.). Boston.
- Stahl, G. (2000). A model of collaborative knowledge-building. *The fourth International Conference of the Learning Sciences (ICSL)*, 70-77.
- Suh, H. (2010). A study on models and support technologies for collaborative learning in the future classroom. *ICoME 2010*, 96-101.
- Suh, H., & Lee, S. (2006). Collaborative learning agents for promoting group interaction. *ETRI Journal*, 28 (4), 461-474.
- Tedesco, P. (2003). MArCo: Building an artificial conflict mediator to support group planning interactions. *International Journal of Artificial Intelligence in Education*, 13, 117-155.
- Veen, W. (2007). Homo zappiens and the need for new education systems. *OECD Conference -The New Millennium Learner-*, Firenze.
- Wang, M. J., & Kang, J. (2005). Cybergogy of engaged learning through information and communication technology: A framework for creating learner engagement. In D. Hung, & M. S. Khint (Eds.), *Engaged learning with emerging Technologies*. Netherlands: Springer Science.
- Yuan, Z., & Jin, G. (2008). Sketch recognition based intelligent whiteboard teaching system. *2008 International Conference on Computer Science and Software Engineering*, 5, 867 - 870.