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Study on Storytelling-Based Making Activity using Virtual Reality Platform

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Abstract: There are active discourses about maker education as an educational counter-measure to the advent of the 4th industrial revolution. The purpose of this study is to assess the educational value of storytelling in a virtual making activity. To this end, we conducted a storytelling-based Virtual Reality (VR) maker education program using the STMSI Model with 125 student teachers for 6 weeks. The results showed that the project had a positive effect on forming perceptions of VR maker education as well as VR content making skills.

Key words: Virtual reality, Korea history, storytelling, education, skills, Virtual Reality (VR)

INTRODUCTION

The key theme of the Davos World Economic Forum 2016 was the 4th industrial revolution. The convergence of existing industries and state-of-the-art technologies such as AI and robot are set to create a new industrial structure. Experts anticipate that this will have a great impact on all aspects of society including culture, economy and education. In response to this, many countries around the world now commonly reinforce IT education, labeled with different names such as Software (SW), coding, programming and computer science for K-12 students to prepare for these future changes. For example, the British Department for Education (2014) amended its IT education into a computing curriculum consisting of computer science information technology and digital skills and provides K-12 students with this as compulsory education (Anonymous, 2013a, b). The Republic of Korea plans to include a minimum of 17 h of coding education in the national curriculum in 2019.

K-12 level IT education is expanding beyond ICT, STEM (Anonymous, 2011) and STEAM learning to include coding (Anonymous, 2013, 2016) and maker (Anonymous, 2014) education. Maker education involves realizing one's own ideas and sharing output, knowledge and experience through creative maker projects using various digital devices and tools.

'Making' in maker projects requires students to understand and make use of specific characteristics of materials and tools. It provides makers authentic learning experiences by solving real-world problems related to makers. The entire process is accomplished by the maker's direct and active participation in the project (Kafai *et al*., 2014). Learners experience consistent failures during the making process and overcoming them helps students learn perseverance and enhance their problem-solving skills (Maslyk, 2016).

A variety of materials are used in maker projects such as physical computing devices including the Internet of Things (IoT), robots and recyclable materials. It is difficult for schools to popularize these projects due to factors such as purchasing and maintaining expensive teaching aids. VR technology can be a solution to these difficulties related to implementing maker education in terms of teaching aids.

VR technology in education so far has mainly been used to help learners understand subject content and to induce their active participation by enabling them to experience content developed by experts. For example, Bricken and Byrne (1993) developed and applied a math education program using virtual reality and achieved positive learning outcomes (Bricken and Byrne, 1993).

Conversely, VR technology in maker education goes beyond just a content experience and provides learners with the opportunity to participate in designing and developing one themselves.

Existing studies which further stimulated learner's participation using digital storytelling in a VR activity imply that a genuine solution is needed to induce learner's participation in VR maker projects. The combination of a VR maker project and its storytelling structure gives the stories a sense of reality and stimulate learner's participation. This provides a foundation for recomposing and elaborating stories in many different ways.

Based on this, we assumed that storytelling is a suitable way to stimulate VR maker projects and conducted a storytelling-based VR maker study.

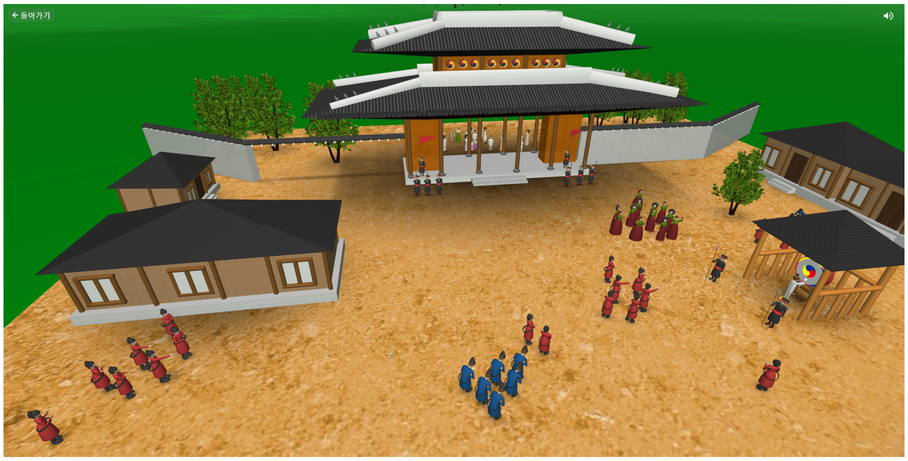

Fig. 1: The interface of COSpaces program

Virtual maker platform; COSpaces: COSpaces is a web-based VR content development platform developed by a German startup (Fig. 1).

While students used to passively experience preset VR content in earlier learning activities, cospaces provides an environment in which users can create and experience VR content themselves through object placement and coding. For example, COSpaces allows users to set up their own virtual gallery in their VR space by uploading artwork, giving them an opportunity to exhibit their work to peers.

COSpaces supports both desktop and mobile environments. Learners can select a background and add objects on a stage by dragging and dropping. Learners can later give 3D animation effects to the VR space by coding. Blockly and Java script are used for coding. The extent of coding includes controlling speaking, moving and changing size and color and it is possible to code using sensors.

Blockly is a coding tool developed by Google that uses a visual method similar to scratch. Objects created by an individual can be moved according to specific conditions or commands by adding, modifying and connecting code blocks by dragging and dropping. Objects not provided as basic options on the interface can easily be created by learners through assembly and disassembly of basic objects. This possibility of creating becomes an opportunity for creative making.

In the process of VR development, learners can collaborate with peers in real time by sharing an ID irrespective of distance. The content developed can be shared through a project address and this offers an opportunity to naturally learn various making methods.

MATERIALS AND METHODS

Study content and method

Study procedure: The saying ‘the quality of education cannot outdo that of a teacher’s suggests that the competence and talent of a teacher can determine the direction and success of education. In other words, it is absolutely fundamental to enhance student teacher’s abilities to ensure the success of K-12 maker education.

The present study was conducted with 125 student teachers studying at C university from October 12 to November 16, 2017 for 2 h a week for a total of 6 weeks. Students who participated in the study were randomly assigned to the experimental group (63 students) and control group (62 students). The former conducted a storytellling-based VR maker project and the control group performed a regular VR maker project.

In the first week, both the groups practiced basic techniques related to the interface, object placement and Blockly coding on COSpaces based on a demonstration by the professor.

In the second through 5th weeks, the control group conducted 4 projects offered on COSpaces. The experimental group worked on projects using the below STMSI Model which is based on the TMI Maker Model suggested by Martinez and Stager (2013), to which storytelling and sharing were added (Anonymous, 2016).

Step 1: Storytelling-Korean history was presented to student teachers in this stage to stimulate their interest and motivation. A part of Korean history interesting enough to attract their attention was used as a storytelling theme. The story used in the activity was

'Battle of Myeongnyang' which is a great defeat won with only 12 Joseon ships against 100 Japanese ships. Participants were instructed to express their understanding of the 3 great naval battles fought by the Admiral Yi Sun-sin and a sense of triumph about the battle of Myeongnyang.

Step 2: Tinkering-freely discuss the VR making and design with peers.

Step 3: Making-implement the idea by setting a background, placing objects and coding.

Step 4: Sharing-present to share their creation with their peers.

Step 5: Improving-improve the project based on feedback from peers.

VR content evaluation was conducted in the 6th week. Each team accomplished the assignment and conducted a peer evaluation.

Evaluation tool

Evaluation of VR content realization: The essential evaluation factors of VR content are fidelity of expression of reality, immersion associated with active participation and flexibility supporting not specific but diverse experiences (Harmon and Kenney, 1994). For VR content evaluation an assignment in a form of a short story was given and student teachers were asked to produce VR content spanning 1 h. Peer evaluation was conducted on the three factors fidelity (30), immersion (40) and flexibility (30) for each team and the scores were added up.

Perception of VR making activity: The computer attitude evaluation tool developed by Todman and Dick (1993) was modified and translated for the maker project in order to survey participant's perception of making. It consists of 3 areas such as fun, usefulness and ease of use and the corrected translated version was reviewed by 5 professors. Responses were given on a 5-point Likert scale and negative questions were reversely scored in the statistical analysis (Table 1).

After the VR class, a semi-structured interview was conducted with 20 students randomly selected from the experimental group to collect more detailed information of their VR perception. Time spent on this interview was 10 min per student and questions were about both fun and difficult parts of the project in addition to being aimed at finding out what they wanted to try further.

Table 1: Questions in the VR maker survey questionnaire

Area	Question (I~VR making)
Fun	1; I think that ~ makes studying more fun
	2; I want to learn ~ more profoundly
	3; I think that ~ is a fun activity
Usefulness	4; I do not want to learn more about~(*)
	~ is more fun than other IT education activities
	5; I think that ~ is a useful education activity
Ease of use	6; I think It is difficult to understand~(*)
	7; I think that ~ activity is hard (*)
	8; It Is hard to learn the application method of~(*)

When the interviewer did not understand responses clearly, students were asked to give a more elaborate answer. To ensure the confidentiality of learner responses during the interview, the interview was conducted in an independent space through conversation.

RESULTS AND DISCUSSION

VR content implementation and evaluation: Table 2 shows the evaluation results. The experimental group scored an average of 84.97 points and the control group 73.89. The average score gap of 8.71 points was statistically significant. In other words, storytelling in the VR maker project had an effect on immersion, fidelity of making and diverse making experience.

The factors that caused differences in the VR content making skills were: various trials and errors through the process of recreating Korean history, a rise in competitive spirit from recreating the same theme within the same group and the context of learning provided by Korean history.

When given the assignment of Korean history, students from the experimental group often referred to VR contents of other teams during the development process and incorporated the ideas they liked in their project. Project sharing in an online community had a substantial effect in improving student's making skills as did the lecture room where students developed the VR content.

Figure 2 is the example of VR content which shows the king and his servants moving in the palaces of the Joseon Dynasty

Perception of VR maker project: Statistical analysis showed that both groups had positive perceptions of the VR maker project and there was no statistically significant difference. The experience of actively designing and making VR content provided internal motivation for the maker project in both groups. The student's active participation likely influenced the development of a positive perception (Table 3). Analysis of the results of the areas of perception of the maker project showed a significant difference in fun ($p<0.05$).

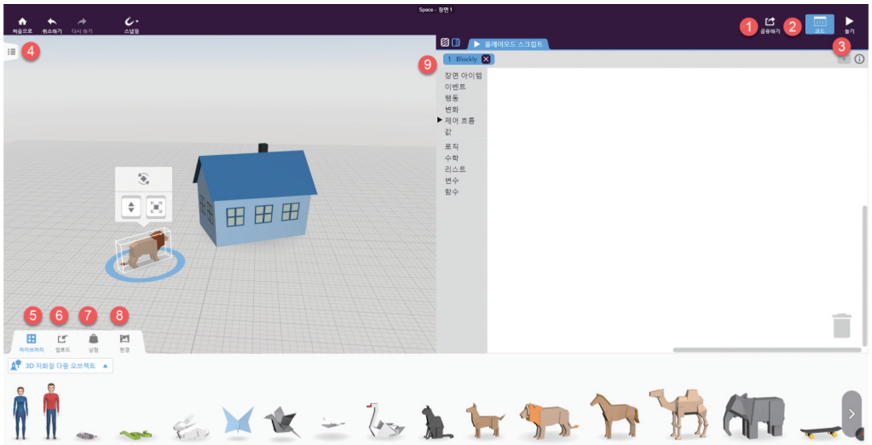

Fig. 2: The example of VR content about Korea history

Table 2: The result of comparison of experimental and comparative groups in VR contents implementation

Groups	Num	Mean	SD	df	t-values	Sig.
EG	63	84.97	7.95	123	-7.45	0.000
CG	62	73.89	8.23			

Table 3: The result of comparison of experimental and comparative groups in VR maker project perception

Category/Groups	Mean	SD	df	t-values	Sig.
Fun					
EG	3.90	0.56	123	2.61	0.03
CG	3.68	0.58			
Useful-ness					
EG	3.71	0.40	123	1.21	0.23
CG	3.61	0.53			
Easy of use					
EG	3.74	0.40	123	1.14	0.26
CG	3.64	0.50			
Total					
EG	3.79	0.43	120	1.74	0.09
CG	3.64	0.51			

The difference in enjoyment most probably occurred because student's motivation for VR making was stimulated by competition with their peers in the Korean history assignment and the series of failures and solutions they repeatedly experienced over the course of the project. In addition, students had to identify various characteristics of the objects to render a more realistic expression of Korean traditional styles and this learning process likely induced voluntary learning in students. The online and offline sharing provided students with the opportunity to share their experiences and knowledge with other teams. The entire activity and feedback afterward had an effect on forming a positive perception. The detailed reasons were surveyed through interviews with students.

Fun parts: It was really exciting to share our thoughts with peers and recreate Korean history based on our imagination It was really great to implement my imagination on a VR platform. And now I find Korean history much more interesting. It was interesting to appreciate the works of our peers, the same theme of Korean history but expressed from different perspectives.

Difficulties: It was a pity that the stage space given was too small to put everything into. It was quite difficult to transform the objects with my creativity due to the lack of variety in the assortment. It also made it kind of hard that the available movements were very limited and the characters had no facial expressions. It was not possible to simultaneously control the same object with my peers and we had to do it through constant conversations. It was tough to arrange and place every object. It was hard to render the images three-dimensional even if we wanted to do so. The background image was very flat.

What they wanted to do further, beyond Korean history? They wanted the activities to be implemented in other classes for example, making a VR exhibition hall with artworks of other students from an art class and representing a story during Korean language class in a VR space.

CONCLUSION

Maker education is a trending topic in public discourse as a means for education to prepare our students for the era of the 4th industrial revolution. Practically, however, it is substantially difficult to equip real classrooms with the digital devices and materials required for maker projects in schools. In this context, the present researchers conducted a study of VR maker projects based on a story from Korean history on a web-based VR platform.

VR technology provided a context for the maker project connected to Korean history. Learners were able to have a free and direct experience in the virtual world they created for themselves with their peers.

Above all, storytelling in the VR maker project significantly contributed to forming a positive perception of the project as well as improving their VR content realization skills. Finally, the study demonstrated the potential of VR maker projects in the education field.

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REFERENCES

Anonymous, 2011. Educate to innovate. White House, Washington, DC., USA.

Anonymous, 2013a. National curriculum in England: Computing programmes of study. Department for Education, London, UK.

Anonymous, 2013b. The national curriculum in England: Primary curriculum. Department for Education, London, UK.

Anonymous, 2014. The White House maker Faire: Today's DIY is tomorrow's made in America. White House, Washington, DC., USA.

Anonymous, 2016. Computer science for all. White House, Washington, DC., USA.

Bricken, M. and C.M. Byrne, 1993. Summer Students in Virtual Reality: A Pilot Study on Educational Applications of Virtual Reality Technology. In: Virtual Reality: As Real as you Want it to Be, Cadigan, P. (Ed.). Academic Press, Cambridge, Massachusetts, USA., pp: 199-217.

Harmon, S.W. and P.J. Kenney, 1994. Virtual reality training environments: Contexts and concerns. Educ. Media Intl., 31: 228-237.

Kafai, Y., D. Fields and K. Searle, 2014. Electronic textiles as disruptive designs: Supporting and challenging maker activities in schools. Harv. Educ. Rev., 84: 532-556.

Martinez, S.L. and G. Stager, 2013. Invent to Learn: Making Tinkering and Engineering in the Classroom. Constructing Modern Knowledge Press, Torrance, California, USA., ISBN:9780989151108, Pages: 237.

Maslyk, J., 2016. STEAM Maker: Fostering Creativity and Innovation in the Elementary Classroom. SAGE Publications, California, USA., ISBN: 9781506311241, Pages: 168.

Todman, J. and G. Dick, 1993. Primary children and teachers attitudes to computers. Comput. Educ., 20: 199-203.