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Research Article

Basic Research on Virtual Technology for Educational Support Video Production

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ABSTRACT

In 2016, we conducted a survey of high school students regarding science classes, and found that the percentage of high school students who answered that they "like science" or "science is important" was lower than for other subjects. However, more than 80% of elementary and junior high school students answered that they ``like experiments and observations." Additionally, a 2019 smartphone penetration rate survey found that approximately 90% of students use smartphones. Additionally, recent advances in VR technology have been remarkable. Based on the above, I thought that creating a simulation app using VR technology using smartphones could change the way high school students think about science classes. In this paper, we developed a new simulation application for science experiments. The subjects were asked to experience the newly created app and answer a questionnaire. The average score was 4 out of 5, which was poor. However, a problem was also discovered at the same time. The problem is that this app is a simulation app, so the user experience is not very good, so I would like to develop an app that is a little more user-friendly in the future. I would like to create apps for other fields while improving the problem.

1. Introduction

In 2016, the Science Subcommittee surveyed materials on science and found that the percentage of high school students who answered that they ``like studying science" or ``studying science is important" was lower than for other subjects. However, more than 80% of elementary and junior high school students answered that they "like experiments and observations." A 2019 smartphone penetration survey found that approximately 90% of students own a smartphone. Most schools have computer classrooms. Additionally, each classroom is equipped with a computer for teachers. Under these circumstances, it is thought that the educational effects of various classes can be further enhanced. Based on the above, this research aims to contribute to education by creating a scientific simulation application that utilizes VR technology (Fig. 1) [1], [2], [3].

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2. Physics experiment app

Fig. 1 Image of cargo handling training at a container terminal using VR (Sakamoto Lab.)

In this study, we attempted to create a physical simulation of "projection motion" and "falling object motion." Since these experiments require large-scale experimental equipment and it may be difficult to obtain accurate numerical values, we thought it would be appropriate to conduct the experiments in a virtual environment.

2.1. *Development environment*

This survey was conducted in the environment shown in Table 1[4], [5].

Table. 1 Development environment

operating system	Windows10
Programming language	C#
software	Unity 2019.2.15f1

2.2. *Implemented function*

In this study, we implemented the following two physics experiment simulations.

1. Projectile motion
2. Falling exercise

2.2.1. Projectile motion

Projectile motion moves from the initial position. After deciding the angle and speed and pressing Start Button, the object will be fired and the distance will be displayed. If it is difficult to check the current situation, you can zoom in and out on the ball with the zoom below (Fig. 2).

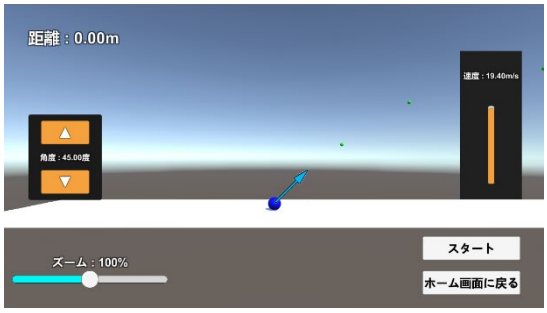

Fig. 2 Created projectile motion app

2.2.2 Falling exercise

I made a slope that controls the falling speed by rolling the ball while changing the angle of the slope. Determine the angle of tilt and press Start to start spinning the sphere. The tilt angle, ball speed, and ball position are displayed (Fig. 3).

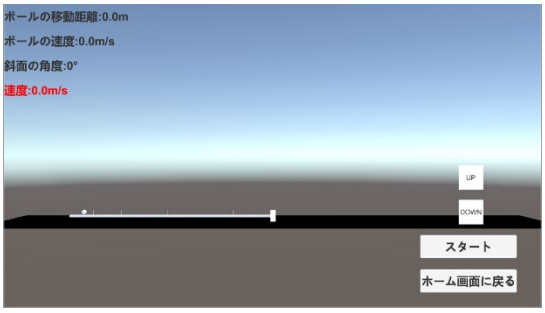

Fig. 3 Created Falling exercise app

3. Chemical experiment app

In this study, we tried to make prototypes of chemical experiment simulations of "flame reaction" and "silver mirror reaction". Since these experiments use many solutions and experimental tools, it may be difficult to prepare and clean up, and since the experiments take time, we thought that they were suitable for solving the shortage of class time.

3.1. A. *Development environment*

This survey was conducted in the environment shown in Table 2.

Table. 2 Development environment

operating system	Windows10
Programming language	C#
software	Unity 2019.2.15f1
	Blender 2.81

In this study, we implemented the following two simulations of chemical experiments (Fig. 4).

1. Flame reaction
2. Silver mirror reaction

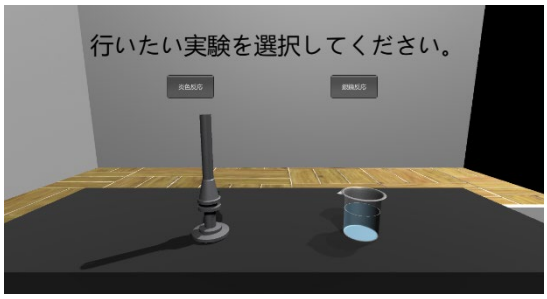

Fig. 4 Created scientific experiment simulation app

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4. Evaluation experiment

An evaluation experiment was conducted to verify whether the developed science experiment simulation

app was useful. We conducted a questionnaire to 10 people, including students in the laboratory, and evaluated the usefulness and usability of the system. The contents of the questionnaire are the following four points.

Evaluation item 1: Was it easy to operate?
Evaluation item 2: Was the result of the experiment easy to understand?
Evaluation item 3: Was it easy to imagine a physical phenomenon?
Evaluation item 4: Opinions and points to be improved (free description)

Evaluation items 1 to 3 will be evaluated on a scale of 1 to 5 points, and evaluation item 4 will be freely described.

4.1. Experimental result

The figure below shows the average of the evaluation results for evaluation items 1 to 3.
The average score for evaluation item 1 and evaluation item 2 was 4.4 points.
The average score for evaluation item 3 is 4.8 points, which is higher than that of evaluation item 1 and evaluation item 2.

For evaluation item 4
- good point

"Physics experiment"
✓ Easy to understand the trajectory of the sphere
"Chemical experiment"
✓ Easy to understand the flow of the experiment
There were opinions such as.

- Improvements

"Physics experiment"
✓ Display of the distance of the object that was skipped one before
✓ Change the trajectory of the ball from a point to a line
"Chemical experiment"
✓ Addition of tutorial
✓ Change the touched part to make it easier to understand
There were opinions such as Fig. 5 and Fig. 6.

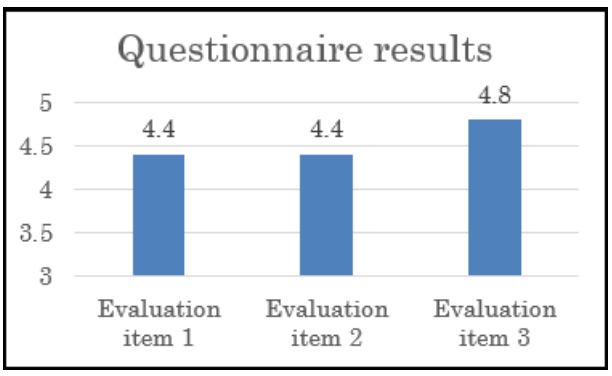

Fig. 5 Questionnaire average score

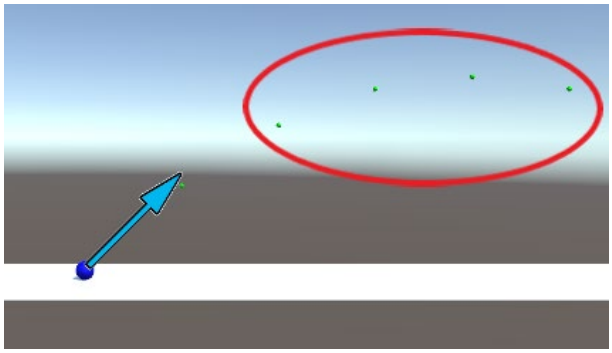

Fig. 6 Examples of questionnaire improvement points

5. Consideration

Regarding evaluation item 4, there were many opinions regarding the expansion of functionality. Expansion to VR was also mentioned as an expansion of functionality. When applied to VR, we can expect benefits such as a sense of immersion and ease of imagining physical phenomena, but since it requires VR-specific equipment, it is necessary to devise ways to make it easy for anyone to use.

6. Future tasks

If we can create a simulation app that is similar to the teaching materials that students normally use, it will be possible to support education in a variety of subjects, not just science. Also, before creating an app, it is necessary to think about what kind of app can support student education. Although it was not possible to expand to VR this time, if expansion to VR is possible, it would be possible to achieve a more realistic feeling by actually representing the acoustic room and science room during the experiment. This will be a future issue.

7. Summary

As mentioned at the beginning, VR technology has made remarkable progress in recent years. In this research, we attempted to create an application that allows science experiments using virtual reality, but as mentioned in the future work section, special equipment is required to reproduce VR, so we only attempted CG images. . However, the results of evaluation experiments revealed that a useful application had been created. The ultimate goal is to create a system to support education (Fig. 7).

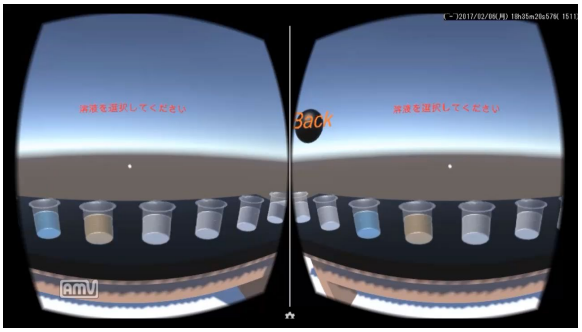

Fig. 7 Extension to VR

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