Basic Research on Video Production for Educational Support by Virtual Technology

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Abstract

As a result of conducting a questionnaire about science classes to high school students in 2016, the percentage of high school students who answered "I like science" and "Science is important" is lower than other subjects. However, more than 80% of elementary and junior high school students said they like experiments and observations. In addition, the 2019 smartphone penetration rate survey found that it is popular among about 90% of students. In addition, VR technology has recently made remarkable progress. From the above, I researched the idea that creating a simulation application using VR technology using smartphones would change the way high school students think about science classes. In this paper, we have developed a simulation application for science experiments. Subjects were asked to experience the newly created app and complete a questionnaire. As a result, the average score is 4 out of 5 and it is not bad. But at the same time, a problem was found. The problem was that this app was a simulation app, so there wasn't much user operability, so I wanted a little more operability. I want to make apps in other fields while improving the problem.

Keywords: Education, science, chemistry, physics, experiment / observation, virtual reality, simulation app

1. Introduction

In the materials related to science surveyed by the Science Working Group in 2016, it was found that the percentage of high school students who answered "I like studying science" and "It is important to study science" is lower than other subjects. However, the percentage of elementary and junior high school students who answered "I like experiments and observations" exceeds 80%.

A survey of smartphone penetration in 2019 found that about 90% of students have it. Most schools have PC classrooms. In addition, each classroom has a personal computer for teachers. Under these circumstances, it is

thought that the educational effect can be further improved in various classes.
Based on the above, the purpose of this research is to contribute to education by creating a science simulation application using VR technology.

Fig. 1. Example of an English conversation learning app that supports VR

2. Physics experiment app

In this study, we tried to create physics simulations of "projectile motion (projectile motion)" and "falling body motion". Since these experiments require large experimental tools and it may be difficult to obtain accurate numerical values, we thought that they would be suitable as experiments to be performed in a virtual environment.

2.1. *Development environment*

This survey was conducted in the environment shown in Table 1.

operating system	Windows10
Programming language	C#
software	Unity 2019.2.15f1

Table. 1. Development environment

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.

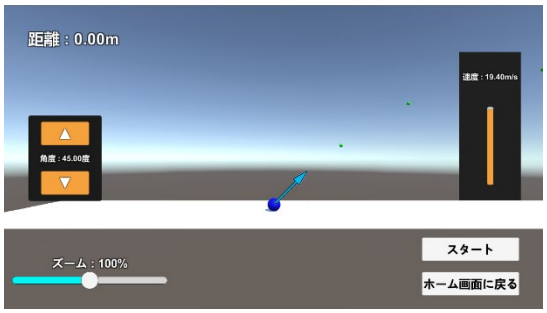

Fig. 2. Created projectile motion app

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.

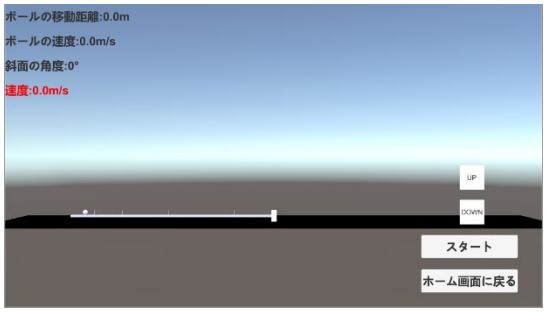

Fig. 3. Created Falling exercise app

3. Chemistry 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. *Development environment*

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

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

Table. 2. Development environment

3.2. *Implemented function*

In this study, we implemented the following two simulations of chemical experiments.

1. Flame reaction
2. Silver mirror reaction

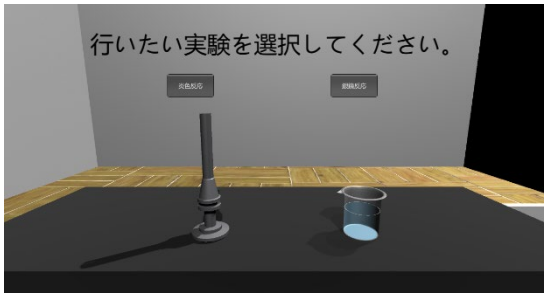

Fig. 4. Created scientific experiment simulation app

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.

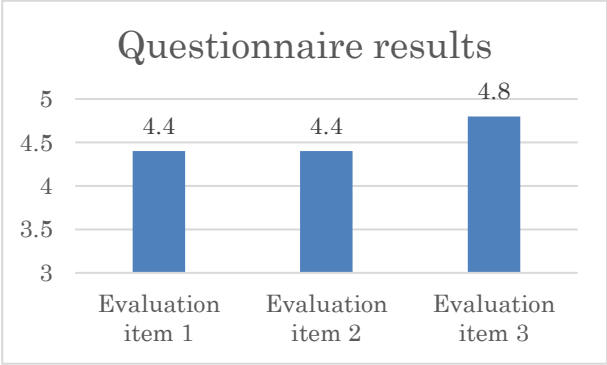

Fig. 5. Questionnaire average score

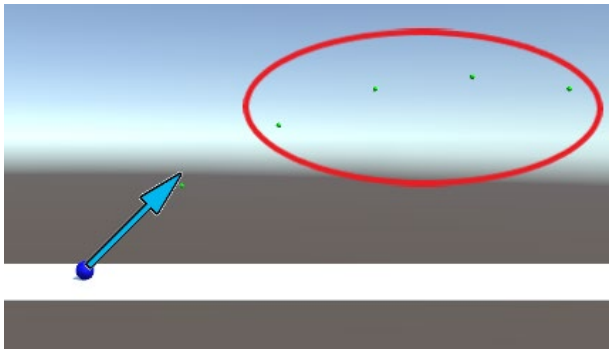

Fig. 6. Examples of questionnaire improvement points

5. Consideration

Regarding evaluation item 4, there were many opinions about the expansion of functions. Extension to VR was also mentioned as an extension of the function. With regard to expansion to VR, effects such as immersive feeling and easy image of physical phenomena can be expected. However, since VR-specific equipment is required, I think we must 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 usually handle, we can support education not only in science but also in various subjects. Also, before creating an app, you need to think about what kind of app can support student education.

This time, it could not be expanded to VR. If it is possible to expand to VR, it will be possible to realize a more immersive feeling by actually expressing the sound and science room during the experiment, so this is a future issue.

7. Summary

As mentioned at the beginning, VR technology has grown remarkably in recent years. In this research, we tried to create an application that can perform science experiments using virtual reality, but as mentioned in future tasks, special equipment is required to reproduce VR. It has become a trial of only CG images. However, from the results of the evaluation experiment, it was found that a useful application was created. Ultimately, I think it is to create a system that will help support education.

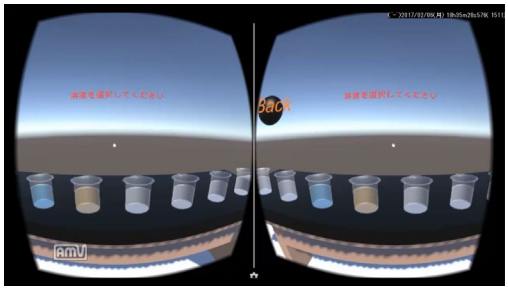

Fig. 7. Extension to VR

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