Using Spin Object Movie in Science Teaching and Learning

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Abstract: Information and Communication Technology (ICT) brings about an increased tendency towards collaboration amongst students and teachers. In this pedagogy, students are asked to manipulate Spin Object Movies (SOM) of certain objects or experiments. Students can observe the image from different angles, magnify any part for close observation and exploration. While the teacher defines the learning goals and facilitates the learning process; students are free to discover the content on their own. They are encouraged to conduct virtual scientific investigation and construct their own theories or concepts. The SOMs are archived in the school elearning platform to support resource based learning (RBL), including experimental setup, molecular structures, models of human organs, and panoramic views of the laboratories. The resources are readily accessible on-demand over the Internet for convenience. Through RBL student learning becomes more effective than in conventionally designed curriculum. Despite limitations in using SOM., including procurement of hardware and software, and extra workload in using the software to prepare teaching resources, students can now access and retrieve related learning resources at any time at their own pace. They can learn from quality online resources instead of just static PowerPoint slides and text documents. These materials can be shared among teachers to enhance collaborative lesson preparation.
Keywords: spin object movie, virtual reality

Introduction

Over the last ten years, 3-dimensional virtual reality (3DVR) has been widely used in different applications, such as product design, 3D imaging, movies, games, entertainment and education (Churchill, Snowdon & Munron, 2001). It allows the user to navigate and manupulate in a virtual environment. With the rapid advancement in computer technology, the processing time, memory size and the cost are all reduced so that it becomes feasible to advocate the use of 3DVR in science teaching and learning in the secondary schools. The technologies of 3DVR can be classified into seven categories, namely 3D shutter glasses, panoramic scenes, spin object movie, VRML objects, analgyph images, random dot stereograms, lenticular 3D photos (王笑君，楊友源，2001; Yeung, 2002). Among these technologies, spin object movie (SOM) is the easiest to use and apply in science teaching and learning in the secondary schools.

Using SOM

The production of SOM requires a digital camera, a fixed stand, a rotary table and a commercial software. The digital camera mounted on the fixed stand is used to take 18 to 24 photos at different angles on the object which is placed on the rotary table. The photos are transferred to the computer by memory cards or USB and then stitched into one single movie by the commercial software. This technology requires Apple QuickTime plugin for display. Users can use the mouse to rotate the object for 360^o and magnify any part for close observation. It provides interactivity for the students to conduct scientific investigation and exploration.

Trial Teaching

In Physics domain of secondary three integrated science, students learn the methods of correction of eye defects. In a general school laboratory, a model eye is usually used to show the image formation on the retina, which is a liquid-filled spherical flask. Strong light beam is directed towards the lens which is placed in front of the flask. If the light beam is converged on the other side of the flask, then it represents a normal eye sight. If the light beam is converged in front of or behind the other side of the flask, short-sightedness or long-sightedness are represented respectively. However, there is only one set of model eye in the laboratory. It is difficult for all the students to observe the image formation clearly. Students were asked to come close to the experimental setup group by group and the teacher had to repeat the explanation several times. Digital video camera was used to capture and project the image on the screen in the recent years. However, it is also difficult to examine various parts of the setup. By using the SOM, the image formation can be observed clearly at different angles. After the teacher demonstrated the procedures to access and operate these movies, the students were guided by worksheet to observe the experimental set up of model eye closely at different angles and magnification through the hands-on manipulation of the SOM. Finally, the students drew ray diagrams to show the correction methods of short-sightedness and long-sightedness to consolidate their concepts.

Another topic of trial teaching was blood circulation of pig's heart in Integrated Science of secondary three. The lesson was conducted in the computer laboratory so that every student would have access to the computer. Using the computer generated SOM of a pig's heart, the structure of the heart and the blood circulation system of the human body was introduced. Students were instructed on how to rotate the 3D heart model on their computers and then allowed time to experiment with it at their own pace so that they could see the heart from all different angles. While the students were studying the heart model, questions were asked to guide their observation and ask them to complete a worksheet for consolidation of their learning.

Learning Effectiveness

Pre-test and Post-test Result

To evaluate the learning effectiveness by using SOM in teaching and learning, a pre-test and a post-test were carried out. Sample questions were "Where is the image formed for a normal eye-sight, short-sightedness and long-sightedness?", "What kind of defect is it?", "What kind of lens is used to correct this eye defect?" and "Sketch a ray diagram to show how the correction is made."

Table 1: *Pre-test and post-test result*

Questions	Percentage correct in pre-test (n = 39)	Percentage correct in post-test (n = 36)	Differences
1. Image is formed on the retina for a normal eye sight.	85%	100%	15%
2. Defect is short-sight.	82%	100%	18%
3. Use concave lens to correct the defect.	80%	100%	20%
4. Draw correct ray diagram to shown the correction of short-sightedness.	85%	100%	15%
5. Defect is long-sight.	85%	97%	13%
6. Use convex lens to correct the defect.	80%	97%	17%
7. Draw correct ray diagram to show the correction of long-sightedness.	44%	76%	33%

The result of pre-test and post-test in Table 1 showed that there is an overall improvement in the performance of the students after the learning activity. With the help of SOM, the students clarified the concept in correction of eye defects. They were able to identify the eye defects, apply suitable lens to correct the defects and draw ray diagrams to show the correction methods.

Three open-ended questions were asked after completion of the learning activity to evaluate the interest and difficulties met by the students towards this approach. The result was shown in Table 2. In the result, 72% of students agreed that SOM is better or more effective than the traditional way of teaching. 66% of students liked to use similar approach to learn other science topics. Only 23% of students found difficulties in this learning activity. The responds from the students were positive. Some scripts were "It is more interesting, funny and interactive.", "We can observe the object at any angles.", "We can have hands-on activity.", "It can attract our attention. I would like to have more lessons like this.", "It is easier for me to understand.", "It can make the boring more interesting."

Table 2: *Open-end questions result*

Open-ended questions	Agree (n)	Disagree (n)
1. Do you think that using spin object movies is better or more effective than the traditional way of teaching?	72% (26)	28% (10)
2. Do you like to use a similar approach to learn other science topics? Why?	66% (23)	34% (12)
3. In this learning activity, did you find any things difficult or unclear to you?	23% (8)	77% (27)

Reflection in Teaching and Learning

The topics for SOM were carefully chosen because it would help students a lot in their learning if they had the chance to see or even touch the object of learning for real, and with SOM the image of the model could be enlarged for display and rotated on the screen simulating the hands-on experience. The lessons worked out fine and most of the students showed excitement and were responsive. The SOM served the purpose of showing the authentic image of an object and arousing students' interest in pursing the subject.

Moreover, SOM can help teachers to explain complicated structures and abstract science concept. It can help to eliminate misconception and simulate experiments which are difficult to carry out or observe. It allows the students to observe rare objects or experiments. Spin object movies can be used in the inductive pedagogical approach. Students learn how to ask questions, find answers or solutions through exploration and discovery. They are encouraged to conduct virtual scientific investigation and construct their own theories or concepts. Besides, the images can be stored and edited for future use. The SOM can also be archived in the school elearning platform to support resource based learning (RBL), including experimental setup, molecular structures, models of human organs, and panoramic views of the laboratories. The resources are readily accessible on-demand over the Internet for convenience. Through RBL, student learning becomes more effective than in conventionally designed curriculum. The teaching material can be shared among teachers through this platform to enhance collaborative lesson preparation. In learning, SOM can arouse students' attention and interest. It allows the students to observe experiment setups, models or creatures at different angles so that students can explore and observe freely through strong interaction. The hands-on ability and self-learning ability of the students can be improved.

Conclusion

Spin object movie is a useful and powerful tool in enhancing teaching and learning. It allows students to observe the experimental setup or objects at different angles, magnify any part for close observation and to carry out scientific investigation and exploration freely. The result of pre-test and post-test showed that students held positive attitudes towards this pedagogy. Students' performance can also be improved after the learning activity. Despite limitations in using SOM, including procurement of hardware and software, and extra workload in using the software to prepare teaching resources, students can access and retrieve related learning resources through school elearning platform. They can learn from quality online resources instead of just static PowerPoint slides and text documents more effectively. These materials can also be shared among teachers to enhance collaborative lesson preparation.

References

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