Key Physiology Concepts through Animations Used by about 600 CUHK Students

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Abstract

The use of animations is generally viewed as an effective eLearning tool by enabling students to visualize complicated molecular processes with both clearer and graphic-rich features when compared to text or static graphics. The objective of the study is to determine how animations help support students' learning. The subjects were students who took a physiology course with animations provided as a supplementary learning medium primarily for their self-study at home. Their perceptions of the use of animations were received via surveys and group interviews which provided both qualitative and quantitative data for our study. Most of the data collected were positive and demonstrated that animations could explain complicated contents more explicitly to students and there is a greater demand for similar learning tools from the students. Although the animations cannot replace the existing lectures, most students expressed that they would adopt a varied use of different learning tools to maximize their learning benefits.

Keywords: animation, eLearning tool, graphic-rich

Animations for teaching and learning

Dynamic concepts are difficult to explain in traditional media. Animations have the potential to deliver better representations of these concepts. Animations can be useful in explaining content of a wide range of subject areas such as chemistry and computer sciences (e.g. Kehoe, Stasko & Taylor, 2001; Payne, Chesworth, & Hill, 1992; Dyck, 1995; Harrison, 1995; Tversky & Morrison, 2001). Hegarty (2005) mentioned that animations provide students with "more realistic representations, that is more isomorphic to the reality they represent" (p. 451).

There are, however, limitations concerning the use of animations in teaching and learning. Designing and developing quality animations for teaching and learning can be challenging. Morrison, Tversky, and Betrancourt (2000), for example, remarked that fast-paced animations would impose difficulties to the students in observing detailed procedural information. Animations are also costly and time-consuming to make.

Our students are students in a foundation physiology course in The Chinese University of Hong Kong. Students taking this course are majors in a range of disciplines: Pharmacy, Chinese Medicine, Human Biology and Nursing. Almost all of the students are year 1 students. We expected that animation would be a good tool for learning many physiology concepts as many

topics in this field of study are complex, occurring in the molecular level which is not observable, and involving multiple steps and/or multiple components, such as the working mechanisms of electrical signal generated in the nerve cell, contraction and relaxation of skeletal muscle fibers and reabsorption of water in renal tubules.

Starting in 2008, with the support of Courseware Development Grants and Campus Service Award scheme from New Asia College of CUHK, four online animation modules have been developed on topics *action potential (AP)*, *skeletal muscle contraction (SMC)*, *cardiovascular physiology (CP)* and *urine formation in kidney (UK)*. These animations were then used by eight classes of full-time students who took the physiology course in the two academic years 2008–2009 and 2009–2010. The animations served as supplementary learning materials primarily for students' self-study at home.

Great care has been paid to the designs of the animations to maximize the learning potentials of these new supplementary learning materials and make our effort worthwhile. Pedagogical and technical services from the Centre for Learning Enhancement And Research (CLEAR) and Information Technology Services Centre (ITSC) have been used. Significant effort has also been paid to evaluate the new materials through surveying the students and meeting some of them over the two years of use. To illustrate the designs of the animations, Figure 1 shows a screenshot of the *action potential* animation module and Figure 2 is a screen capture of the *skeletal muscle contraction* animation module.

We can observe the following design features:

1. Animations are professionally prepared: colourful, high-quality images that are attractive to the eye and movements that are smooth-running. We aimed at providing visualization of complicated molecular processes with clearer and graphically richer features when compared to text or static graphics.
2. Students have full control of how the animations are played – through using the VCR-type button controls or through using the sliding bar. In this way, a certain step in the processes in the animations can be played slowly, paused, revisited or skipped depending on the needs of individual learners.
3. Students are also given a sense about how the current step being viewed is situated in the overall model through a timeline represented concurrently on the screen. We think this design assists understanding of the whole issue at hand.
4. The main topic is broken down into sub-topics and multiple animation scripts are available. They are selectable on the margin of the screen. Students can view them in any sequence they like. There is no prescribed learning path.
5. Difficult terms are further explained in glossaries. Students can pause at the animation at a point of difficulty and check for more explanations of the key terms.
6. The animations are also narrated (learners can opt to mute narrations). The scripts of the narrations are also displayed concurrently as captions on the screen. The design is to suit students with different learning preferences.
7. Students are constantly checked for understanding with built-in exercises. The exercises are auto-corrected and students are given immediate feedback on performance.

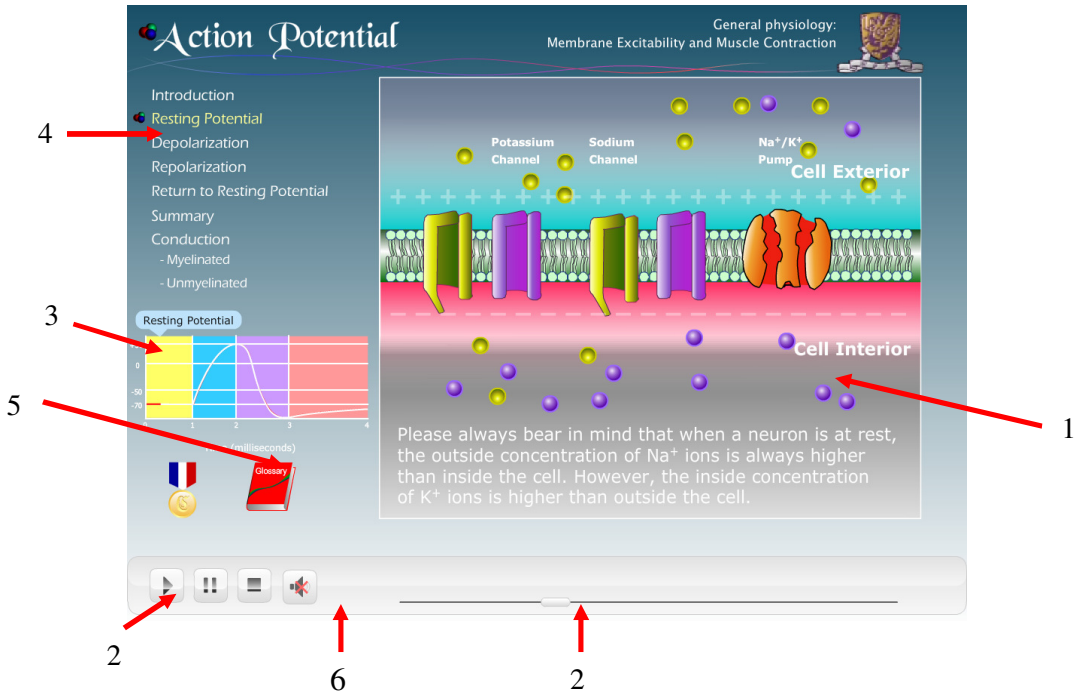

Figure 1: Screen capture of the AP module

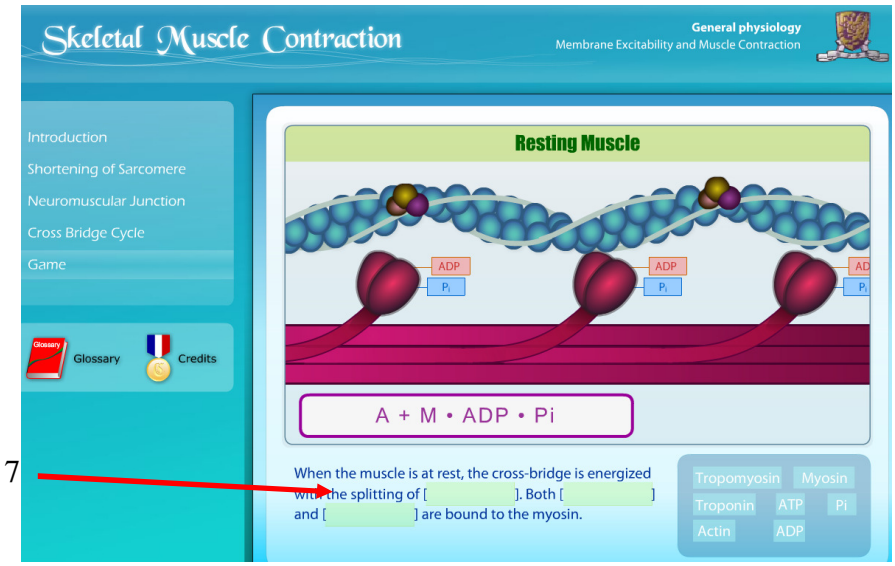

Figure 2: Screen capture of the SMC module

Evaluation

Students' perceptions of the use of animations were received via surveys and focus-group interviews which provided both qualitative and quantitative data for our study.

Table 1 represents the details about what animations were used in each of the classes over the two-year period and the evaluation data collected in each class.

	2008 - 2009				2009 - 2010			
Animations used	Nursing (184 replies out of 195 students)	Pharmacy (25 replies out of 30 students)	Chinese Medicine (23 replies out of 31 students)	Human Biology (13 replies out of 13 students)	Chinese Medicine (24 replies out of 36 students)	Pharmacy 30 replies out of 38 students)	Human Biology (23 replies out of 46 students)	Nursing (145 replies out of 200 students)
AP	√	√	√	√	√	√	√	√
SMC	√	√	√	√	√	√	√	√
CP					√	√		√
UK	√	√	√	√	√			√
Survey	√	√	√	√	√	√	√	√
Interview	--	--	--	--	√		√	√

Table 1: Types of animations used and the evaluation strategies used in each class

The survey consisted of two parts: Likert-scale questions and open-ended questions. A total of 467 students (out of 589 students, response rate being 79%) replied the surveys over the two years in the eight different classes.

For the focus-group interviews, an invitation was sent to all students who took the course in the academic year of 2009–2010. Participation was voluntary. A total of 12 students accepted the invitation and we held three focus-group meetings in May and June 2010. They were students from three disciplines: Human Biology (6 students), Chinese Medicine (5 students) and Nursing (1 student). A list of simple interview questions (protocol) was prepared to guide the interviews. They were about students' perceived effectiveness of using animation to learn, choice of animations or text for study, and suggestions for improvements.

The quantitative data collected in the surveys were promising in general. Table 2 shows students' replies in two of the questions that best represent our main objectives in developing the animations: clearer explanation of the concepts and students' better understanding as a result of the additional resources. Students stated how much they agreed to the achievement of these benefits on a 5-point Likert scale Scores, with '1' being strongly disagreed and '5' being strongly agreed. As you can see from Table 2, students' ratings of the usefulness of the animations in 1) better explaining content, and 2) promoting better understanding as a result were about 4 in all classes.

Animations used	Nursing	Pharmacy	Chinese Medicine	Human Biology	Chinese Medicine	Pharmacy	Human Biology	Nursing	**Overall**
Clearer explanation?	3.9	3.8	4.0	4.1	4.1	3.9	4.1	4.1	**4.0**
Better understanding?	3.8	3.6	3.9	3.9	4.0	3.9	4.1	4.1	**3.9**

Table 2: Replies of students in two items of survey

Students' open-ended replies on the surveys also echoed the same positive attitudes towards the new materials. For example, students mentioned many advantages of the animations and the key ones were:

- Animations stimulated students' interest to learn (mentioned in 11 replies (22.9% out of the total number of open-ended comments collected) in 2008–2009 & 6 replies (28.6% of total) in 2009–2010);
- Animations improved students' understanding of concepts (mentioned in 10 replies (20.8% of total) in 2008–2009 & 5 replies (23.8% of total) in 2009–2010);
- Animations provided clear explanations on the subject matters (mentioned in 16 replies (13.2% of total) in 2008–2009 & 12 replies (16.9% of total) in 2009–2010).

As for ideas for improvement, one main suggestion obtained from students was actually not about enhancement of the existing ones but was about demanding for more – development of similar learning tools for other topics as well (mentioned in 10 replies (16.2% of total) in 2008-2009 & 3 replies (8.8% of total) in 2009-2010)).

In the focus-group interviews, students had the opportunity to elaborate on how animations had assisted learning.

- "I just partially understood the process of osmolarity change (in the topic of kidney) during lesson but fully understood after I had viewed the animation … Although there were figures in textbook that showed the value changes of osmolarity in kidney, such changes were still difficult to perceive. I just noted they were discrete changes but not trends of changes" (a Nursing student)

Students also elaborated on what other topics had been challenging to them could be good candidates for our future work.

- "It would be better to have animations as a supplementary tool for our learning of complicated process in human body such as the mechanism of filtering wastes in blood by kidney. That process involved many steps, components (ions coming in and out), and flows of fluid." (a Chinese Medicine student)
- "Some physiology topics involve too many types of hormones and interactions. This was quite confusing. Presenting them with animation will be a good practice." (a Human Biology student)

Animations, however, are not without limitations. Some students remarked that going through the animation sequences can be time-consuming and may not worth the effort if they can understand them anyway in the traditional method. Also, when students were asked to choose between animations and traditional text as the learning materials they would opt for when coming across a new concept, only five out of the twelve interviewees picked to view animations. Seven of the 12 interviewees preferred to study text. The main argument of students who picked traditional text was that text tends to provide more in-depth knowledge of concepts than animations.

Discussion and conclusion

In this project, we developed animations as supplementary learning resources for students in a physiology course for challenging and dynamic concepts that are difficult to represent on text and static images. About 600 students used all or some of the animations in eight different classes of the same course over a period of two years. Perceptions of students, collected through surveys and focus-group interviews, were positive and demonstrated that animations could explain complicated contents more explicitly to students and there was a great student demand for similar learning tools for other challenging topics in the discipline as well.

We thus strongly believe that animations are good supplementary learning materials for students particularly for learning of complicated concepts. However, we should warn ourselves against over-use of animations. It may not be worth the effort (for both the developers and the learners) if the knowledge at hand can be quickly understood through the traditional medium. Also, provision of good text is always essential to in-depth learning of the subject matter. Animations may be a good starting point for students but they are not the end points.

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