

# Development of a LabTutor experiment to simulate an *in vitro* Ussing chamber frog skin practical

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## Introduction

- The Ussing chamber experiment demonstrating sodium ion flow through frog skin is a classic practical exercise in undergraduate physiology.
- The technique is used to measure short-circuit current as an indicator of net ion transport taking place across an epithelium. It may also be used to demonstrate how various pharmacological inhibitors may be used to identify the channels and transporters involved in cellular function.
- Due to issues obtaining sufficient supplies of the common frog, *Rana temporaria*, to undertake such practical classes, our institution now uses a combination of videos and workshops to convey the important concepts involved in this experiment.
- The aim of this project was to establish if the LabTutor teaching platform could be used to develop an interactive online practical exercise using real data and video recordings from previous classes where tissue was readily available (see Fig 1).

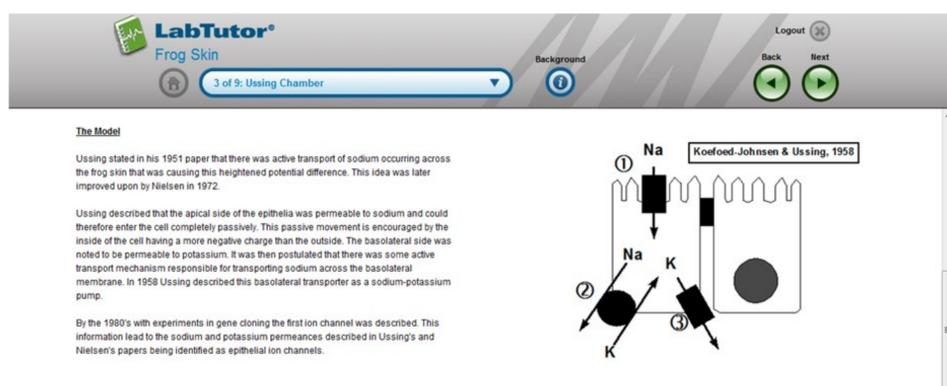


Figure 1. Typical screenshot from the LabTutor Frog skin practical.

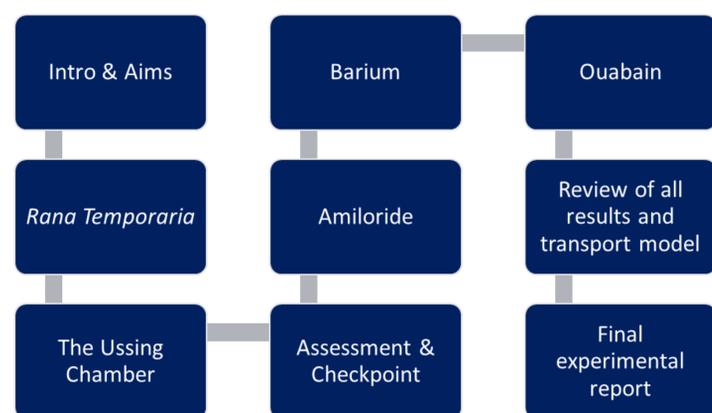
Students and staff report that the inclusion of graphic and audio-visual resources in the online practical guide helps students better understand practical protocols and the rationale behind them. We no longer rely on long, paper-based practical manuals or submitted work, and students can easily work through the experiment at their own pace.

## Methods

- Video recording and real experimental tracings from a previous practical class were identified and used as source materials for the LabTutor experiment.
- LabAuthor was used to develop a new lesson that could be used with the LabTutor platform.
- The lesson was designed to be interactive, with students being expected to undertake the calculations, data manipulations and measurements they would need to perform if they had actually done the real experiment with frog skin tissue.
- A storyboard was developed to ensure logical progression and map key learning opportunities.
- Students were asked to rate the current 'dry' replacement practical exercise in terms of how it engaged them, improved their understanding, complemented the course material, and whether it was enjoyable. This was achieved using Likert scale questions, with scores from 0-10, where higher score indicated more favourable responses. Completion was completely voluntary, with 43 students completing the questionnaire.
- The questionnaire was repeated after volunteers had tried the LabTutor version of the practical. Voluntary participation in the follow-up questionnaire was lower, with 15 responses.

Figure 2. Storyboard for the LabTutor Frog skin practical.

The sections of the lesson were designed to progress logically and had a variety of conceptual, measurement, calculation and interpretation questions throughout. Students can work through the experiment at their own pace.



## Results

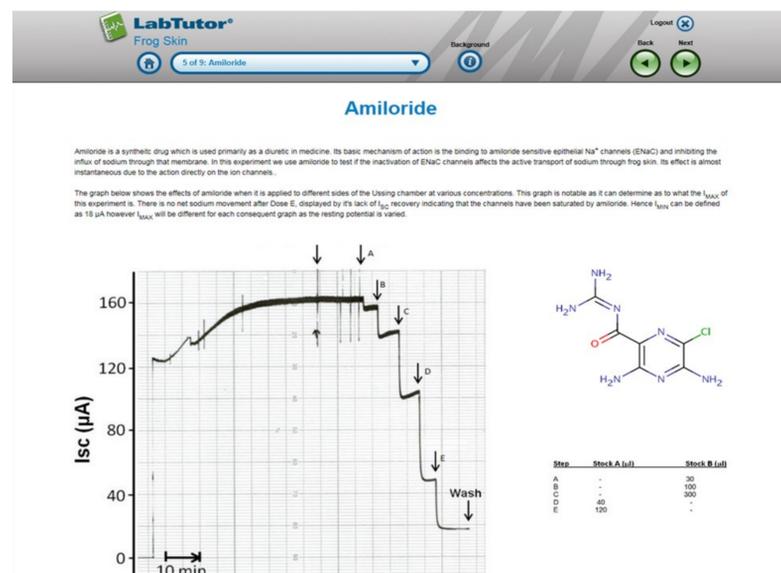


Figure 3 Example of experimental data page. Students were required to measure the data from the traces provided and calculate drug concentrations used during the concentration-response protocol.



Figure 4 Short videos were used to help students understand the experimental protocol. Questions to test understanding were inserted after videos to ensure students understood the concepts. Feedback was also provided so students could check their understanding of what was being done.

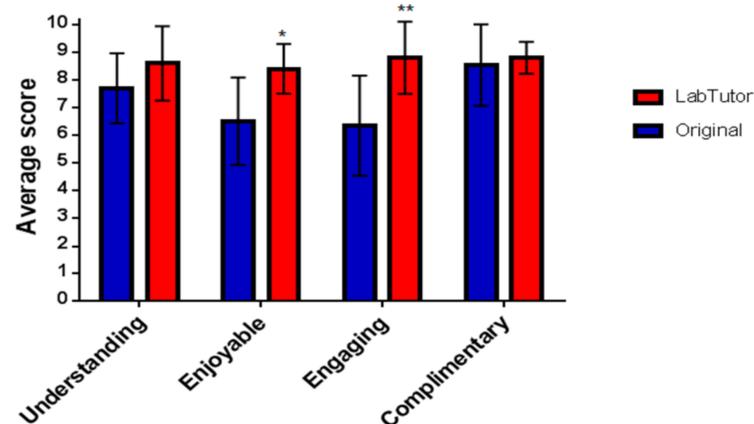


Figure 4. A comparison between both the average scores in the original and LabTutor® exercises. Error bars (standard deviation) are shown in black and the colour of the bar represents the practical as indicated in the key to the figure. Both 'Enjoyability' and 'Engaging' were found to be significantly increased compared to the original exercise. For Original group N=43; For the LabTutor® group N=15. \* P<0.05; \*\* P<0.01, ANOVA.

## Discussion

- LabTutor allowed us to provide a more interactive replacement for the traditional *in vitro* Ussing chamber frog skin practical.
- Even though the LabTutor experiment was an improvement on the previous 'dry' replacement activities, students would still prefer to undertake the actual 'wet' experiment.
- Integration of real experimental data and audio-visual resources enhanced student appreciation of the activities.
- Staff reported that students of all backgrounds required less help and found it much easier to work through the tasks, with the focus being more on understanding concepts rather than worrying excessively about equipment set-up or calibration.
- Use of LabTutor may enable teachers to provide scientific training using real experimental data, even when they have limited practical resources at their institution.
- Raw experimental data from research groups may be an untapped resource that could be used to produce better educational resources on learning platforms such as LabTutor.