Can we calm first-year student's "neuroscience anxiety" with adaptive learning resources? A pilot study

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An understanding of neurophysiology is vital for undergraduate allied health students; however, it is often perceived as an intimidating and difficult subject. Adaptive learning presents a novel teaching pedagogy to enhance student learning and engagement in the teaching of neurophysiology to first year students. An adaptive online neurophysiology lesson was developed in the Smart Sparrow platform. The lesson was piloted and evaluated using a survey and focus group. Of the 26 students that completed the survey, 21 students indicated that they had a better understanding of the nervous system topic after they completed the lesson. Students found the lesson was helpful in assisting with their understanding of the nervous system, whilst also being interesting and engaging. Findings from this pilot project revealed adaptive learning technologies show significant promise in enhancing student learning in a difficult first year subject.

Keywords: Adaptive learning, Smart Sparrow, Innovative Practice, Nervous System.

Introduction

An understanding of neurophysiology is vital for undergraduate allied health students. Physiology of the nervous system is often taught at an introductory level in the first semester of study in tertiary allied health courses. It has been well reported that students see the nervous system as an intimidating and difficult topic and indeed the term "neuroscience anxiety" has been penned to describe student anxiety and fear about topics in the field of neuroscience (Birkett & Shelton, 2011; Salomon et al., 2015). It has been suggested that traditional teaching methods, such as lectures and practical classes used to teach the nervous system contribute to the perceived difficulty of the subject. There are however reports of improvements in student outcomes of improved learning and reduced anxiety when traditional methods are replaced with student centred learning and more interactive teaching (Birkett & Shelton, 2011; Salomon et al., 2015; Zwick, 2018). Modern adaptive learning experiences that are designed for high engagement, yet are flexible to the needs of learners present a unique way to address challenges in teaching large, practical based subjects.

Adaptive learning personalises the student experience by adjusting the level of instruction or feedback in response to individual student responses and represents the next generation of educational technologies (Oxman, 2014). Adaptive learning has the potential to offer truly individualised, efficient, flexible and engaging instruction, and offers a novel way to address the perceived difficulty and anxiety associated with the study of neurophysiology. One example of an adaptive learning platform is Smart Sparrow. There is a growing body of literature supporting the use of Smart Sparrow adaptive learning tutorials across a broad range of undergraduate disciplines (Makransky, Thisgaard, & Gadegaard, 2016; Polly, Marcus, Maguire, Belinson & Velan, 2014; Polly, Velan & Hawkins, 2015; Velan, 2015; Wong, 2015). However, there are currently no reports specifically evaluating the use of adaptive learning technologies for neurophysiology. The overall aim of this pilot study was to analyse student feedback on a newly developed Smart Sparrow lesson focused on the nervous system. In particular, we wanted to examine whether;

- completion of the lesson enhanced student engagement for first year allied health students
- completion of the lesson enhanced student learning for first year allied health students

Methods

The participants were 26 allied health undergraduate students enrolled in an introductory physiology subject in 2018. Ethics approval for this study was received from The Charles Sturt University Human Research Ethics Committee (HREC Protocol No H18024).

The Adaptive learning nervous system lesson was developed using Smart Sparrow (http://www.smartsparrow.com). The adaptive lesson, was unique in that students could "choose their own adventure" by selecting whether to navigate through explanatory slides or skip to review questions if they were confident with the material (Figure 1). The questions and content were designed to prepare students for similar questions in the final exam. Immediate feedback was built into the questions and was adapted and provided to students based on their individual responses.

Participants in the pilot study evaluated the effectiveness of the adaptive online lesson by consenting to complete an online survey (n=26). Two of these students also consented and participated in a focus group. A focus group was conducted to further explore the themes arising from the analysis extending the students voice to this evaluation.
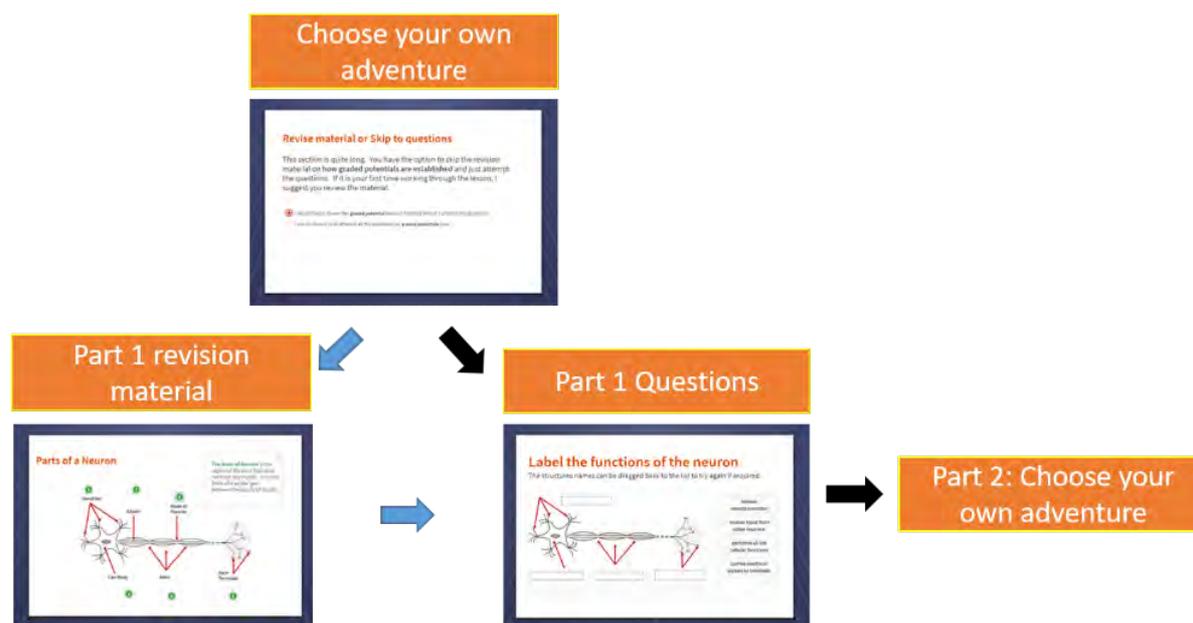
Figure 1. Flow chart indicating lesson structure. Each section of the lesson was designed so that students could select to revise content before attempting the questions, or skip straight to the questions.

A structured online survey was used to measure perceptions of learning and engagement. Some of the survey items were drawn from existing instruments used to measure student motivation, satisfaction and university experience, specifically the Course Experience Questionnaire (CEQ). Other survey items were designed by the research team. The survey contained 8 questions measured on a 5-point Likert scale and the remaining 3 questions were open-ended items asking students what they liked about the resource, did not like about the resource and suggestions for future improvements.

Data are expressed as mean ± standard deviation. Group means were compared using a paired student t-test and were analysed using the statistical package GraphPad Prism (version 7.04). The significance level was set at $p<0.05$.

Findings

Overall, the survey data in combination with the analytics revealed that the Smart Sparrow lesson not only facilitated student learning but did so in a fun, interactive and engaging way where students could progress and consolidate their learning in their own time.

Student engagement

Students reported that the Smart Sparrow lesson was interesting and engaging (4.6 out of 5; Table 1). A total of 7 open text comments mentioned interactivity as one of the most liked components of the tutorial. Students likened this experience with "games", and described the interactive resources as being more useful than conventional teaching methods. Students specifically liked the visual and audio components of the tutorial as an

enhancement to their learning. The focus group discussion also highlighted aspects of how the students engaged with the lesson as inspiring confidence to learn.

> Being interactive I found it more useful than lectures or reading texts. (Student 25, 2018)

> Great connection between videos and content. (Student 8, 2018)

> I think because it was interactive as well…it wasn't boring, it wasn't monotonous, it wasn't repetitive in its presentation methods. (Student 8, Focus group)

Table 1: Compiled Responses to Likert Scale Questions (rated out of 5 stars)

| Learning and Engagement	/5	SD
How useful was the resource in helping you understand the nervous system?	4.8	0.6
Having more of these resources would help me in my learning.	4.8	0.43
The feedback provided in this resource helped me to understand the topic.	4.2	0.7
I found the resource was interesting and engaging	4.6	0.6
Flexibility		
The resource was personalised or tailored to me	3.9	0.99
I felt in control of the experience of using the resource	4.3	0.84

Student learning

When asked "*How useful was the resource in helping you understand the nervous system?*" 100% of students selected 4 or 5 out of 5 (4.8; Table 1). Likewise, students reported that they would like more of these resources (4.8; Table 1) and that the feedback provided in this resources helped with understanding the nervous system topic (4.2; Table 1). This data was confirmed in the open text comments. A total of 10 open text comments referred to the capabilities of the lesson in regards to enhancing their learning. Students used the tool to test their knowledge, gain understanding, and cement information about the nervous system. Comments included reference to individual learning styles, methods of learning and the different approach the lesson gave them.

> It is a visual and auditory platform of learning. (Student 15, 2018)

> The short quizzes throughout helped cement the information. (Student 10, 2018)

> Can progress at my own pace and review parts that I was uncertain about. (Student 17, 2018)

After completing the lesson, students were asked to *rate your understanding of the topic on a scale of 1 to 5 before you used this lesson*, and to *rate your understanding of the topic on a scale of 1 to 5 after you used this lesson*. Of the 26 students that completed the survey, 21 students indicated that they had a better understanding of the nervous system topic after they completed the lesson (2.8 vs 4.1, $p<0.0001$; Figure 2). This is consistent with other studies that have found that adaptive learning resources improve students learning over more conventional teaching methods (Samulski et al., 2017; Wong, 2015). Indeed, adaptive learning offers students an opportunity to gain comprehension and knowledge with the flexibility of working at their own pace (Booth et al., 2016).
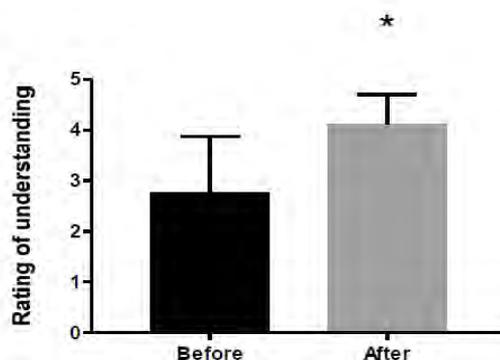
Figure 2. Improvements in students' self-reported understanding of the neurophysiology content before and after completing the Smart Sparrow adaptive lesson * p<0.0001.

Student feedback in the survey and focus group highlighted how students used the tutorial for revision and exam preparation, and also found the lesson helpful for topic management, insight into the subject, and positive reinforcement of learning. The theme of exam preparedness was further explored in a focus group with two students discussing their use of the tool within their own individual learning styles.

> And because the nervous system is just mammoth in its content, even from just participating in the lectures. The volume of content was huge...I sort of invested confidence in the Smart Sparrow, because I thought you are going to be, the creator is going to be focusing on really important stuff. (Student 8, Focus group)

> I would manipulate it [Smart Sparrow], in that I would use it in the areas in which I felt my weaknesses were. Or where my lack of understanding was in that area. (Student 9, Focus group)

Conclusion

This concise paper describes the results from a pilot study of adaptive learning resources in first-year neurophysiology. Our results overwhelmingly indicate that students found the adaptive learning resources engaging and self-reported improvements in their understanding of this difficult topic area following completion of the adaptive lesson. As students can progress through the lesson in their own time, this well-designed, adaptive learning resource can be used to calm "neuroscience anxiety" in first-year undergraduate allied health students! As we now know that these types of interactive learning resources promote learning and engagement, future lessons will contain course specific feedback to demonstrate to students the importance of understanding neuroscience and other physiology topics.

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