Higher Education Research and Development Society of Australasia Inc

Research and Development in Higher Education:
[Re] Valuing Higher Education

Volume 41

Refereed papers from the
41st HERDSA Annual International Conference

2-5 July 2018
Convention Centre, Adelaide, Australia

Rekhari, S. & Sinnayah, P. (2018). H5P and Innovation in Anatomy and Physiology Teaching. In D. Wache and D. Houston (Eds.), *Research and Development in Higher Education: (Re)Valuing Higher Education*, 41 (pp 191 - 205). Adelaide, Australia, 2-5 July 2018.

Published 2018 by the
Higher Education Research and Development Society of Australasia, Inc
PO Box 6106, Hammondville, NSW 2214, Australia
www.herdsa.org.au

ISSN 1441 001X
ISBN 978-0-908557-96-7

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H5P and Innovation in Anatomy and Physiology Teaching

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Abstract

Many universities across Australia have shifted towards blended learning environments, with new technologies providing the opportunity to drive student-centred learning through a combination of traditional classroom teaching methods with online tools.

Foundational Anatomy & Physiology (A&P) (Bioscience) knowledge is integral to all health education courses. However first year students often struggle with the volume and complexity of the content. To improve the progression and retention of potentially hundreds of commencing students across many health-related courses, we leveraged the use of technologically enhanced interactive learning tool H5P, which allows staff to create mobile friendly, interactive HTML5 learning content in units of study. The learning design, based on specific pre-class and in-class activities, enabled students to participate in online pre-class H5P learning interactives, along with other online activities. After engaging with the online learning interactives, which included polysynchronous modes of learning, students then attended team-based guided-inquiry workshops to discuss their observations that lead to deeper understandings of the intended learning objectives for the unit. In this paper, we describe our project, the processes used to create interactive content and early findings from the data collected, which shows that students were able to develop self-directed learning skills. We postulate that the creation of this type of innovative content can lead to deeper understandings of A&P and ultimately contribute to overall student success, learning and skills development.

Keywords: Anatomy and Physiology education, H5P interactive content, self-directed learning.

Background

The development of self-directed learners, engaged in active and creative learning, remains a key area of study for Higher Education scholars and practitioners. In health education, there is a rich body of literature that supports the use of technology-enhanced learning such as digital interactives (Ray and Berger, 2010), along with the importance of self-directed study in health (Cason et al., 2009; Fisher and King, 2010) and Blended approaches to learning (Brandt et al., 2010). Providing students with the opportunity to use a range of online tools that enable

interaction and informal self-testing in a non-threatening way has been shown to be beneficial by engaging a variety of learners actively. This helps students follow a clear structure and allows them to pace their own learning (Nichol, 2007), and caters to a diverse range of learning styles and abilities.

The flexibility of pace, place and time in which students are able to access and revise their learning activities also allows for the unit content to equitably reach a wider, more diverse student body that facilitates their own learning. Student engagement in the learning process identifies the types of learning that can occur – passive and active. “Students learn both passively and actively. Passive learning takes place when students take on the role of “receptacles of knowledge”; that is, they do not directly participate in the learning process. One common passive instructional mode is the ever-popular lecture. Active learning is more likely to take place when students are doing something besides listening” (Ryan & Martens, 1989, p 29). While passively learning, students often act as an object in their education. They learn and reproduce material that is transferred to them by their lecturer or “sage on stage”. Students do not get the opportunity to interact, communicate or problem-solve tasks. Ryan and Martens (1989, p 29) continue that “students learn more material, more quickly, and retain what they have learned longer if they learn using active rather than passive methods”. While actively learning, the student becomes the subject of educational activity. They enter into a dialogue with their lecturer and their peers, actively participate in the pedagogical process, perform cognitive activities that can be creative and develop problem solving skills. In this paper, we additionally suggest that this type of active learning can be fostered through self-paced, technologically enhanced learning tools, created in the Learning Management System (LMS), scaffolder to learning outcomes, in-class activities and discussion. This “blended” approach to learning combines self-directed learning activities and classroom discussion, with the aim to lead to a “thoughtful infusion” Garrison and Vaughan (2008) of face to face teaching and learning, and technology.

Why H5P?

The challenge for the design and teaching team became to identify technologically enhanced teaching and learning tools that could meet these essential requirements. Existing eLearning tools tended to be technically complex, expensive, and often bypassed the LMS, which meant that analytics on student progress could not be acquired. H5P provided an innovative solution in this technological and educational space, and allowed teaching staff to create interactive learning opportunities. Being free to use and open-source, meant that teaching staff could create, share and reuse interactive and mobile friendly HTML5 content, thus eliminating the need for large SCORM (Sharable Content Object Reference Model) packages and Flash content. Most importantly, teaching staff did not need any special technical expertise to create H5P content. Unlike alternative interactive multimedia applications such as Articulate Storyline and Adobe Captivate, the H5P content types are easy for staff to learn and adopt (for a further comparison of H5P and other eLearning authoring tools, see Appendix 1). Teaching staff can gain proficiency in creating one content type such as “Drag and Drop” or “Fill in the Blanks” and then progress to another. In this way, staff can build smaller chunked learning materials, or combine H5P activities to build more complex learning activities. In total H5P users can create over 40 different kinds of interactive content. New content is added to the directory every few months. Examples of some of the content types that can be used are shown in Figure 1.

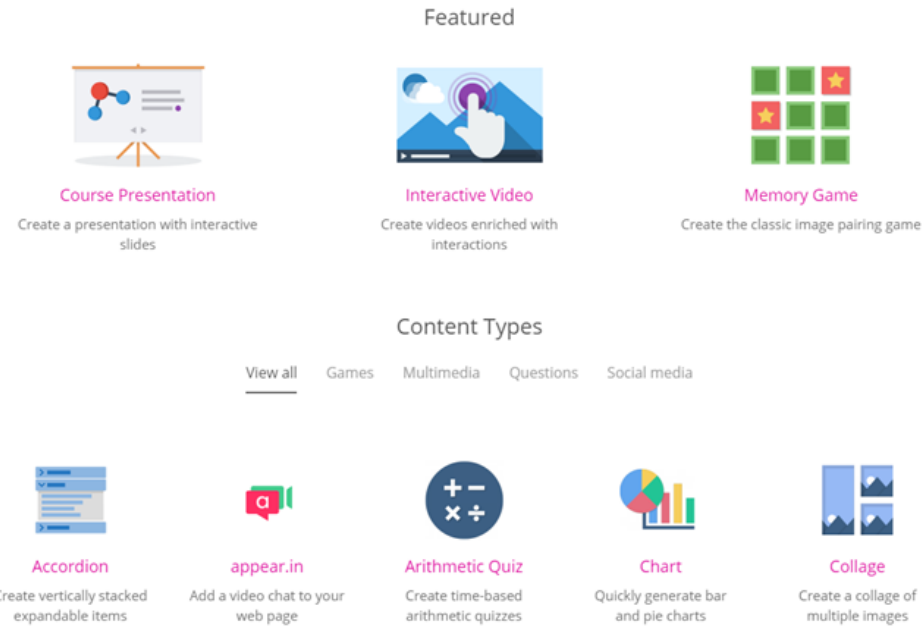

Figure 1: Excerpt of H5P content types from https://h5p.org/

Using combinations of these H5P content types, varied types of teaching, learning and assessment can be enhanced, building staff capacity and ultimately lead to scaffolding learning within and away from the classroom. To support this, our teaching team was initially trained in the creation, use and development of H5P learning objects within the university's LMS via an LTI (learning Tools Interoperability) integration. This allowed for more rapid development and any alterations or corrections to the content were carried out quickly. Building within the LMS encouraged staff to supplement their existing teaching material such as PDF readings. In addition, each of the H5P Interactives are linked via the LTI integration to Gradebook which provides valuable learning analytics on student performance.

A key aspect of the LTI integration was to provide a means for staff to develop content in "bite sized" chunks that they then made available to other staff via a sharing/co-authoring option. These chunked H5Ps include information about each activity via instructional text (Introduction, To Do, Hints and Time taken to complete). An example of the chunked activity's instructional text is seen in Figure 2.

ACTIVITY 2

Introduction: Negative Feedback Systems

Most homeostatic control mechanisms are **negative feedback** mechanisms. In these systems the output shuts off the original effect of the **stimulus** or reduces it's intensity. These mechanisms cause the variability to change in the direction 'opposite' to the stimulus to return it to it's ideal value, thus the name **'negative' feedback** mechanisms. Maintenance of **body temperature** and **glucose levels** are examples of this type of feedback.

To do: (1 & 3) **Drag and Drop** the items into their appropriate categories. Click 'Check' once you are happy with your answers. (2) **Drag and Drop** the **words** to the appropriate definitions regarding homeostasis and feedback systems.

Hint: (1) Consult your prescribed textbook for assistance

Time taken to complete: 10 mins

Figure 2: Instructional text for chunked H5P activities

Within the A&P unit LMS, the chunked H5P activity is viewed by the student with the instructional text immediately preceding it (Figure 3). The "Hint" text acts as a link to the textbook, lecture material or any relevant unit learning material. Feedback is the student's primary mechanism to determine their progress within a learning task (Lucas, 2012). The H5P learning interactive provides immediate feedback with a "check' or "show solution" option, which is so important to reinforce and guide learning. There is also research to suggest that clear, consistent feedback can increase the motivation of a student towards a subject (Hoskins, 1999).

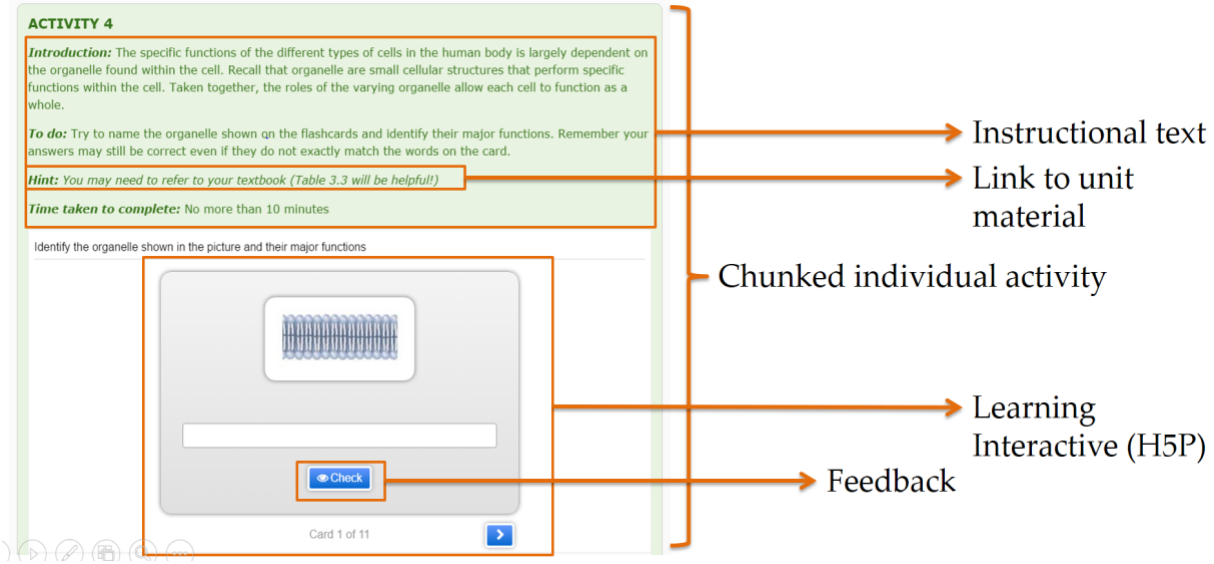

Figure 3: Key elements of chunked H5P activity

In the long run, the introduction of H5P modules into A&P units shifted the emphasis of online teaching resources away from passive screen capture presentation and didactic learning and focuses on interactive experience and thought provoking content. Here, the learner interacts with the H5P content which aims to guide and engage them in their knowledge acquisition in an active rather than passive way (Anderson and Elloumi, 2004), promoting higher order thinking skills (Bloom, 1956) and professional skills.

In addition to this, H5Ps are tagged with metadata: originating College, discipline and given a description and keywords to allow other staff to locate them and use "as is" within their own units or adopt the concept and manipulate and contextualise. Since the start of this project, 150 H5P learning objects have been created for A&P content. The ability to share H5P content with colleagues has had a major impact on capacity building. This ultimately encourages the formation of communities of practice for technology enhanced teaching and learning across the A&P units and the wider university community.

Design of H5P modules

Our approach in using H5P in the A&P units provided substantial additional support and enhanced curriculum design, where H5P interactives were tightly aligned with learning outcomes of the units. To achieve this, our Design process started with a curriculum mapping meeting with the lead Designer and the unit coordinator (authors of this paper). A tangible

object was produced from this meeting, a unit Storyboard using post-it notes. This Storyboard mapped the units" weekly learning objectives, current (if any) pre-class, in-class and post-class activities, assessment tasks and any other scaffolded activities, such as case studies. A second iteration of this Story Board replaced current activity post-it notes with innovative redesigned activities, for example, replacing hard copy A&P practice activities with chunked H5P interactives, developing H5P interactive videos by inserting reflective/discussion questions from videos shown in class. While the design maintained the connections between LMS activities and face-to-face classroom practice, it also mapped a combination of H5P activities with existing in-class and A&P lab resources that consistently promoted participation in the learners" own educational journey. Key to this Design were meaningful conversations, visual metaphor and collectively forming a "cognitive map" for students that was goal specific (Tolman, 1948). The Storyboard reified learning outcomes of the A&P unit, based on the current and future potential of unit resources. Activities mapped on a week-to-week basis in grid-like fashion, captured conversations about practice "as is" and embedded future practice that "can be". This facilitated brainstorming and the reification of pedagogical ideas in a structured and systematic manner.

This process also leveraged on the implications of Ruben Puentedura's four-level SAMR (Substitute, Augment, Modify, Redefine) Model (Puentedura, 2013), that the use of technology to modify and redefine learning leading to previously inconceivable tasks, is more beneficial than its use to augment and substitute components of face-to-face teaching. The appropriate creation, selection and utilisation of pre-class and post-class activities scaffolded to assessments and learning outcomes to substitute, augment, modify or redefine in-class activities and face-to-face interactions – without bias as to which form of support deserves a higher value, remained central. We designed H5P learning experiences for the students rather than for the sake of using technology. At the heart of this Design process were students and their authentic learning experiences, focusing on guided learning (Knowles, 1980).

Additionally, learning activities that challenged students, actively engaged them and increased the likelihood of self-regulated learning (Nicol and Macfarlane-Dick, 2006) through formative and immediate feedback were essential; and as mentioned previously, the "check" option in H5P allowed for this. Self-testing, seen as a "low stakes" assessment, rather than a "high stakes" summative assessment task with fail/pass criteria (JISC, 2007) was crucial. These forms of low stakes assessment, particularly for first year students in their transition to university study (Nelson, Creagh, Kift & Clarke, 2014) are pivotal to successful student outcomes, hence were pivotal to our design of H5P activities.

Structure of H5P content

Students completed H5P learning interactives prior to attending face-to-face classes where they reviewed the content in an active learning mode, employing team-based guided inquiry. Students also had the opportunity to revise and practice these H5P learning interactives post-class. The structure of the learning activities was:

Pre-class online modules: H5P learning interactives were inserted into an "activities modules" in the unit LMS, where students were encouraged to complete these pre-class, revise them in-class and practice post-class.

In-class sessions: The F2F sessions employed an active learning approach using Process Oriented Guided Inquiry Learning (POGIL), which has been shown to significantly improve students' grades in Physiology (Brown, 2010). This study suggests that individual student performance in physiology is improved as a combination of engaging in problem solving and as a result of working in teams on a task. Thus the in-class activities reinforced individual learning gained from completing the pre-class H5P modules, and gave students the

opportunity to discuss their learning with their peers in team-based tasks (an example of this type of activity is provided in Appendix 3). This interaction with others along with the technology has been shown to increase user satisfaction (Bridgemohan et al., 2005).

Findings

At the end of semester 2 2017, students were asked to respond to an opinion-based survey with a mixture of closed and open-ended questions (Ethics Application ID: HRE0000025525 Impact of blended learning tools in first year anatomy and physiology). The survey was distributed via the university email system using the online survey platform, Qualtrics. All students enrolled in the unit (n=190) were invited to participant in the survey. Survey questions spanned demographic data and specific questions regarding the use of online technological tools (list of survey questions in Appendix 2). Students were enrolled in the Bachelor of Paramedicine at our university, and equal number of males and females responded to the survey. There was a variation in age, ranging from 19 to 45.

From the total number of students enrolled in A&P units (n=190), 29 students (15%) took part in the opinion-based survey. Results from student data (collected using the previously described H5P LTI integration with the LMS' Gradebook) in semester 1 2017 indicated a 30% uptake in completing interactives as extended homework, with rates of uptake increasing to 60% in the semester 2 2017 A&P unit.

The survey revealed that students feel 70% confident and competent in their knowledge of A&P. Students (96% strongly agree + agree) felt that A&P knowledge is an important knowledge base necessary for their chosen vocation (Paramedicine) (Figure 4).

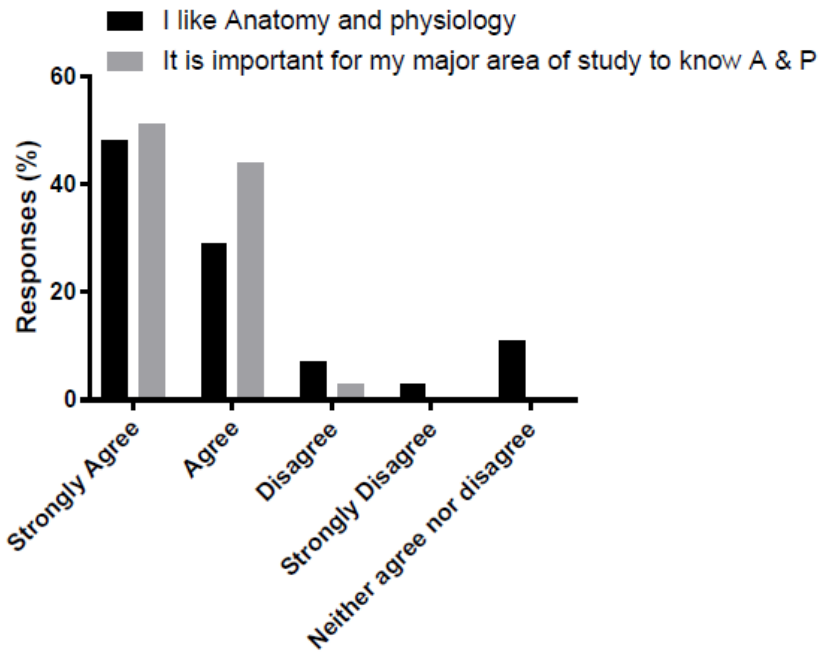

Figure 4: Knowledge of A&P content

Along with the H5P learning interactives, Pearson (textbook) online resources were also recommended to students as homework activities (self-directed learning) and were not assessed. Online quizzes, designed and deployed in the unit's LMS space, had a 7.5%

assessment grade allocated. The results show that students accessed the non-assessed H5P interactives at a similar rate to the assessed online quizzes and found interactives as helpful as the assessed online quizzes (Figure 5).

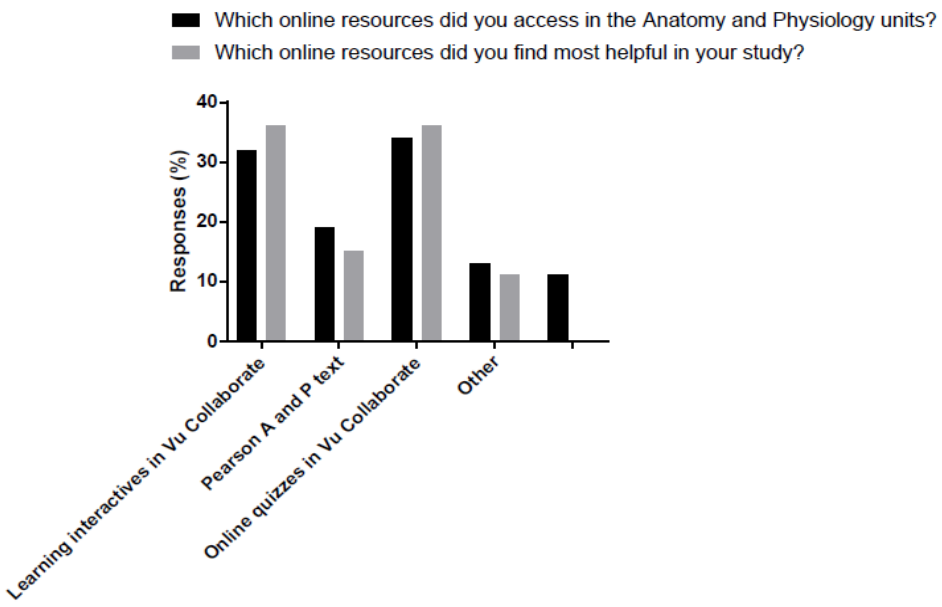

Figure 5: Student access to online resources

Moreover, this result shows a strong indication of student engagement in self-directed study. Of the 150 interactives embedded in units, students who attempted these interactives completed 70% of them consistently (not shown in Figure 5).

Student feedback indicates that students place high value in engaging in the online H5P learning interactives and 90% of student participants indicated that their level of improvement in A&P knowledge was significantly improved (Figure 6), despite the increased effort that is required (Figure 7).

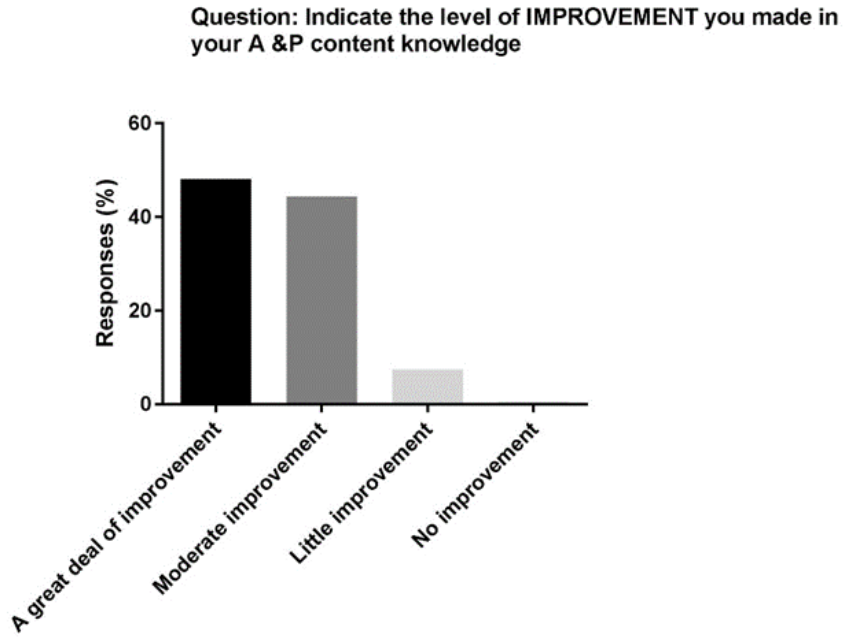

Figure 6: Levels of improvement of A&P knowledge

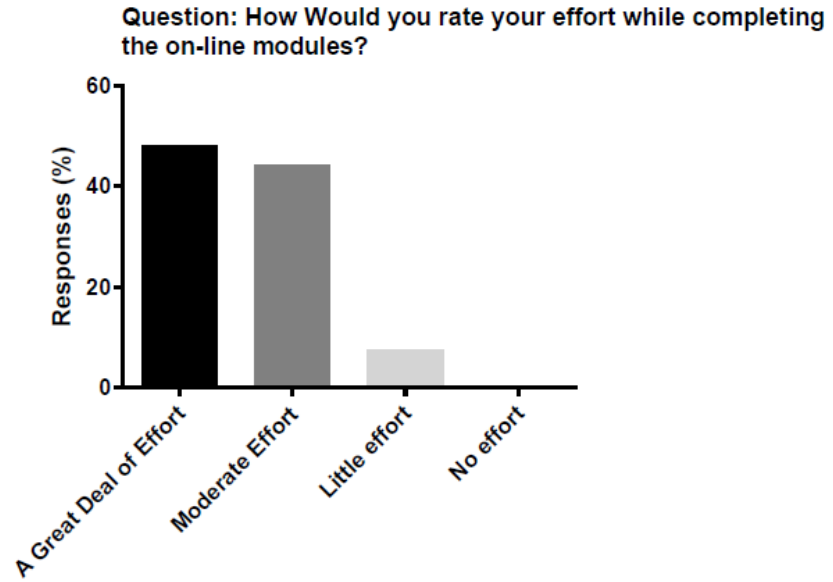

Figure 7: Rate of effort in completing A&P modules

100% of students stated that the acquired knowledge via H5P modules will be useful in future units (Figure 8). This reinforces our focus on strengthening self-directed and guided learning, in order to produce life-long independent learners.

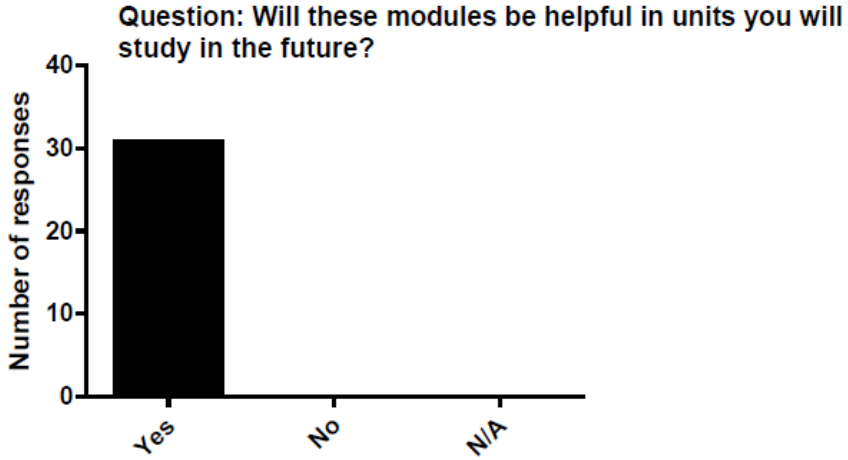

Figure 8: Usefulness of modules to future study

In answer to the question of the class activity that most helped in improvements to A&P knowledge (Figure 9), students highly ranked the H5P learning interactives amongst other resources available to them. A weighted perceived learning value for each resources was assigned. A single ranking for each resource was determined by calculating the weighted average response for each resource at a particular rank (weighted average was calculated by assigning a top ranking of 5 and a bottom ranking for the value of 1 and multiplying the % respondents at that rank by the assigned value).

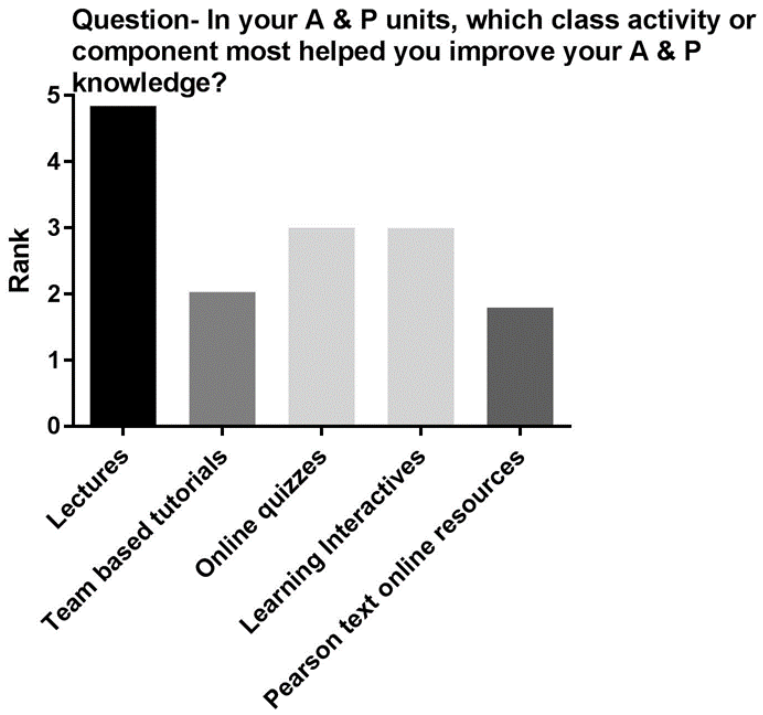

Figure 9: Activities contributing to improving A&P knowledge

In their responses, students rated lectures most highly as a useful F2F activity, which could be an indication of different learning styles and perhaps reluctance with some students to engage with new learning technologies. This is similar to other research (Moule, 2002) which points to varied learning styles and preferences and the suitability of technologically enhanced learning material for all students. Upon reflection, we consider this as a chance for improvement in scaffolding techniques, where students see the relevance of H5P learning modules with the F2F lecture material. This may not have been carried out consistently by the teaching team, who themselves may be unfamiliar with learning technologies, particularly if they have not created or used H5P content previously.

Other open-ended responses to the survey suggested improvements to H5P interactives such as 'Drag and Drop', which students found intensive, alluding perhaps to reaching cognitive load as multiple 'Drag and Drop' activities were created for the unit content. Since A&P content lends itself to a visual medium, in future, this is something for the teaching team to consider. In addition, students found the multiple H5P interactives linked to Gradebook as useful but confusing. This will be rectified by creating categories of H5P learning interactives in Gradebook, rather than a randomised list. Within each category, students will be able to see their activity completion, and follow their own progress.

Conclusion

A key aspect of this curriculum redesign, based on encouraging active learning through the use of H5P modules, was the experience of students in A&P units. For effective progression through a university degree and subsequent student retention (Tucker 1999) the first year units are key. As such, the active learning strategies proposed in this project are an important consideration in the design and delivery of first year university A&P units for underperforming students, so that students are engaged "through the intentional integration and sequencing of

knowledge, skills and attitudes" (Kift, 2010). Early findings point to the need for including interactive low stakes guided content that students use to revise sometimes overwhelming A&P content. H5P can assist in teaching in this environment, particularly teaching to cohorts of students from diverse backgrounds, motivation and destinations. Along with textbook material, it can assist in maintaining suitable academic standards against the pressure to sustain student satisfaction and simply pass students.

As the project and the redesigned A&P units enter their second year of delivery, long term tracking of student outcomes and attitudes to H5P learning modules are planned. Early findings already point to the need for interactive self-directed learning tools that can enhance the quality of asynchronous and synchronous learning. Since student engagement can be variable, impact on learning must be measured in a multimodal way. "The current higher education environment means that educators cannot remain stagnant in the ways that they teach and innovative methods need to be developed in line with the changing demands on resources and curriculum delivery" (Petty, 2013). Through this project it is hoped that conversations about innovative teaching practices can be created and sustained.

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Appendix 1: Comparison of H5P and other eLearning authoring tools

Criteria	H5P	eLearning Authoring Tools (SCORM based)
Platforms		
Windows	✓	✓
Mac	✓	✓
Linux	✓	✓
Browsers		
Internet Explorer	✓	✓
Google Chrome	✓	✓
Mozilla Firefox	✓	✓
Apple Safari	✓	✓
Supported Specifications		
Tin Can API	✓	✓
SCORM 1.2, 2004 (2nd 3rd 4th Edition)	✓	✓
Interactions		
Flash-based	✓	✓
HTML5	✓	✓ (with some restrictions)
Passive (only linear navigation to next screen)	✓	✓
Simple (click, drag & drop, etc.)	✓	✓
Adaptive Navigation	✓	✓
Branching	✓	✓
Fully adaptive learning paths	✓	✓
Interactive Templates Gallery	✓	✓
Interface		
Interface Customization	✓	✓
Preview as published	✓	✓
Customizable Toolbars	✓	✓
Mobile friendly	✓	✓ (with most content)
Assessment		
Quizzes	✓	✓
Customizable Quizzes	✓	✓
Variety of Question Formats	✓	✓
Shuffle Responses	✓	✓
Automated Tracking Options	✓	✓
Automated Feedback Options	✓	✓
Adaptive Assessment	✓	✓
Branching Scenarios	✓	✓
Flexible Scoring	✓	✓
Grading Rubrics	✓	✓
Deployment		
Web based	✓	✓
Self-hosted	✓	✓
Desktop application/software required	✓	✓
Easy to use and little additional training required	✓	✓

*Adapted from eLearning industry Authoring Tools comparison criteria.

Appendix 2: List of Survey Questions

- Which undergraduate course are you enrolled in?
- What is your gender?
- What is your age?
- Is English your first language?

1. Which one of the following was your main study or employment activity in the 5 years prior to beginning this course?
    a. Secondary School in Australia
    b. Secondary School overseas
    c. TAFE
    d. university study
    e. post secondary study overseas
    f. Working in Australia
    g. Working overseas
    h. not working or studying

2. What year did you complete secondary school?

3. Where did you complete secondary school?

4. Which best describes the subjects in your highest level of study?

5. What range was your ATAR in?

6. On a scale of 1-10; 0= no importance; 10 = very important Click and Drag the slider to the appropriate place.
    - How confident are you with your Anatomy and Physiology knowledge?
    - How competent are you in your Anatomy and Physiology knowledge?

7. How do you agree with these statements?Please tick appropriate answer
    - I like Anatomy and physiology
    - How do you agree with this statement: “It is important for my major area of study to know A & P.”

8. Which online resources did you access in the Anatomy and Physiology units?
    - Learning interactives in Vu Collaborate
    - Pearson A and P text
    - Online quizzes in Vu Collaborate
    - Other

9. Which online resources did you find most helpful in your study?
    - Learning interactives in Vu Collaborate
    - Pearson A and P text
    - Online quizzes in Vu Collaborate
    - Other

10. How would you rate your effort while completing the online modules?
    - A great deal of effort
    - Moderate effort
    - Little effort

11. In your A & P units, which class activity or component most helped you improve your A & P knowledge?
    - Lectures
    - Team based tutorials
    - Online quizzes
    - Learning Interactives
    - Pearson text online resources

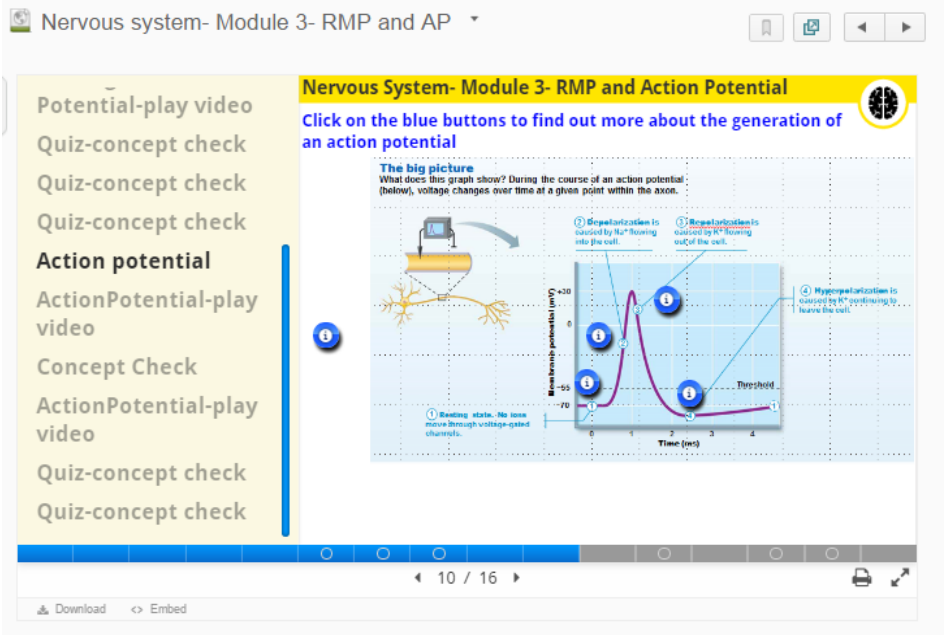
12. As a result of accessing learning interactives, please indicate the level of IMPROVEMENT you made in your anatomy and physiology knowledge
    - A great deal of improvement
    - Moderate improvement
    - Little Improvement

13. Open ended- What suggestions do you have to improve the on-line modules, such as, the learning interactives?

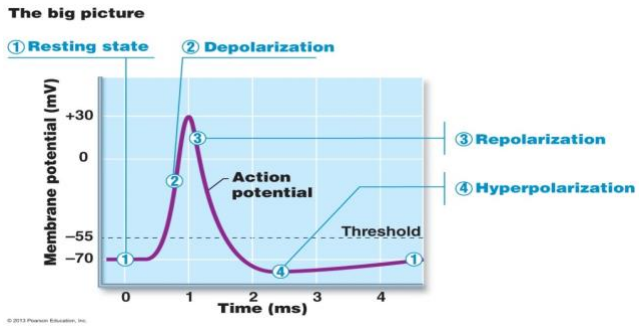
14. Open ended- Will the learning interactives be helpful in units you will study in the future?

Appendix 3: Example of online H5P content and in-class activity/practice

Online H5P learning interactive: Course presentation content type on Nervous System



F2F in-class activity/practice: Discussion questions for team activity



a. **What is the state of the membrane at phase (1)?**

b. **Describe or name the ion channel that underlies the sharp increase in membrane potential seen in phase (2).**

c. **What two events are necessary for the sharp fall in membrane potential seen through phase (3)? (Be as specific as possible.)**

d. **What ion is flowing, and in which direction, to explain the changes in membrane potential through phase (4) (you will likely need the aid of your textbook to answer this question.)**

e. **How is the concentration gradient of ions on either side of the membrane restored after an action potential?**