Reimagining physiology education with interactive content developed in H5P

P. Sinnayah,1,2 A. Salcedo,1 and S. Rekhari3
1First Year College, Victoria University, Melbourne, Victoria, Australia; 2Institute for Health and Sport, Victoria University, Melbourne, Victoria, Australia; and 3College of Science Engineering and Health, RMIT University Melbourne, Melbourne, Victoria, Australia

Abstract

The amalgamation of educational technologies in higher education is widespread and has become essential for contemporary practice on a large scale. Foundational anatomy and physiology knowledge is integral to all courses in health education. To tackle the volume and complexity of the content taught at the foundation level, the incorporation of online tools embedded within curricula provides a unique opportunity to engage students through active learning strategies in a blended design (Means B, Toyama Y, Murphy R, Baki M. Teach Coll Rec 115: 1–47, 2013). This article reports on the use of H5P as a platform to foster self-paced and self-directed learning, critically outlining the developmental process involved in scaffolding activities to learning outcomes. The H5P activities were embedded within the online learning management system, which enabled tracking of student access to these resources. Students were asked to complete an online survey about their perspectives on the effectiveness of H5P activities. This work is part of a comprehensive study evaluating the blended design for delivery of first-year physiology subjects.

active learning; blended learning; H5P; physiology education; self-directed learning

WHY H5P?

Anatomy and Physiology (A&P) are core units taken by ~1,000 first-year students studying health-related courses at Victoria University (VU). These units are offered to six different courses, including paramedicine, nursing, midwifery, speech therapy, dermal therapy, and health science, with varying entry and prerequisite subject requirements. Although foundational A&P knowledge is integral to all health courses, first-year students can find the volume and complexity of the concepts challenging. In addition, VU has a diverse student population of mature-age students with limited science backgrounds. In health science education, there is literature that supports the importance of self-directed learning (SDL) including the use of technology-enhanced learning, such as digital interactives in blended approaches to learning (1–3). To improve progression and retention of potentially hundreds of commencing students, across many health-related courses, we leveraged the use of the technologically enhanced interactive learning tool H5P, which allows staff to create mobile-friendly, interactive learning content in units of study, among other technology (4). Didactic learning was also seen in the majority of our physiology programs, and a clear way to resolve this was to build staff capacity to design and deliver courses with stronger links to student-centered, active learning (5). Connected concurrently with this was the use of a blended approach to design and support assessment activities that increased levels of student engagement and success. This article describes the iteration of the use of H5P in a block mode setting, implemented by VU at an institutional level in 2018 (6). In 2018, VU adopted its revolutionary “block model” of learning and teaching, where students undertake one subject over 4 wk, rather than four subjects concurrently over a semester (6). VU moved away from the didactic delivery of lectures and toward the use of small-group work with a strong contextualized online presence. The use of H5P learning interactives in the online space was pivotal to this and served as the tool to promote self-directed study and learning. Knowles (7) defined self-directed learning (SDL) as a process whereby individuals take the initiative to diagnose, identify, and formulate learning goals and choose and evaluate learning strategies and outcomes. Here we define SDL as an approach where learners progressively assume personal responsibility through self-monitoring (cognitive) and self-management processes (contextual), thereby constructing meaningful learning outcomes (8). SDL promoted through the use of H5P allows students to focus and direct their study in their own time and pace. Formative and immediate feedback provided by the H5P learning interactives enable self-reflection by students to monitor and adjust their own learning, which are key characteristics of SDL (8, 9).

In addition to promoting SDL, H5P provides an innovative solution to teaching staff seeking to create active learning opportunities for students and can be used to create and enhance any teaching material or assessment, scaffolded to
learning objectives for the discipline. Furthermore, H5P is mobile friendly and accessible on any mobile device at any given time, providing convenience for staff to create content or students to access content beyond university contact hours. The tool is free and open source and does not require technical expertise. Existing online tools can be expensive and technically complex; however, academics do not require software or technical proficiency to create content when using H5P, as there are no plugins or SCORM packages required.

H5P is an easy-to-use interactive content creator, giving users access to 39 different interactive content types including presentations, interactive videos, quizzes, multiple-choice questions, timeline, personality quizzes, flash cards, audio recorder, and many others, which can be viewed on https://h5P.org/. With 39 different interactive content types, H5P is highly adaptable and flexible and allows room for variety and creativity. Educators can easily gain proficiency in creating a simple content type such as “True or False” or “Fill in the Blanks” and then progress to advanced types. We have organized the H5P learning interactives into difficulty levels for creating the different H5P interactive content types. We recommend creating a learning interactive with an easy difficulty level and slowly advancing (Table 1).

There are three types of H5P integrations: 1) direct link or embed from H5P.com, 2) H5P via learning tools interoperability (LTI) integration, and 3) H5P plugins. At our university, we chose the second option. Using an LTI integration within the university learning management system (LMS) allowed our teaching teams to easily create H5P content within online teaching spaces. The main advantage of the LTI integration was the ability of teaching staff to view student progression and link learner analytics to VU gradebook systems, enabling formative and summative assessment.

### Table 1. H5P activities organized into levels of difficulty for creation (see H5P.org for guides)

| Easy | Moderate | Advanced |
|------|----------|----------|
| Accordion (no guide): Vertically stacked expandable text and url | Documentation tool (tutorial guide): A series of text, questions, input fields, and goals that can be exported as a text document | Impressive presentation (tutorial guide): Create 3-D presentations |
| Agamotto (no guide): A sequence of images shown sequentially | Drag and drop (tutorial guide): Drag and drop questions using text or images | Personality quiz (no guide): Create personality quizzes |
| Arithmetic quiz (no guide): Time-based arithmetic quiz | Essay (no guide): Essay question with immediate feedback using keyword triggers based on found and missing text | Branching scenarios (tutorial guide): Create learning materials that branch to different paths based on user’s answers |
| Audio (tutorial guide): An audio recording for your students to listen to | Memory game (tutorial guide): Create a classic image pairing game | |
| Audio recorder (no guide): A tool for students to record their voices to be exported as a wav file | Questionnaire (no guide): Create a questionnaire to receive feedback | |
| Chart (tutorial guide): Generate interactive charts | Timeline (tutorial guide): Create a timeline of events with multimedia | |
| Collage (tutorial guide): A collage of multiple images | H5P: Multiple interactives in one | |
| Dialogue cards (tutorial guide): Responsive flip cards with images or audio | Column (no guide): Create multiple interactives vertically | |
| Drag the words (tutorial guide): Drag and drop text question | Course presentation (tutorial guide): An interactive presentation with multiple interactives | |
| Fill in the blanks (tutorial guide): Fill in the blanks with text question | Interactive video (tutorial guide): Videos enriched with multiple interactives | |
| Find multiple hotspots (tutorial guide): A question on finding specific locations on an image | Quiz (question set) (tutorial guide): Create a sequence of various question types | |
| Guess the answer (tutorial guide): Create an image with a question and answer | Single choice set (tutorial guide): Create questions with one correct answer | |
| Image juxtaposition (no guide): Compare two images interactively, either vertically or horizontally | | |
| Image pairing (no guide): Drag-and-drop image-matching game | | |
| Image sequencing (no guide): Place images in the correct order question | | |
| Image slider (no guide): Create a slider of images | | |
| Mark the words (tutorial guide): Create a task where user highlights words | | |
| Multiple choice (tutorial guide): Create flexible multiple-choice questions | | |
| Speak the words (no guide) | Answer questions using voice (Chrome browser only) | | |
| Speak the words question set (no guide): Answer a series of questions using voice (Chrome browser only) | | |
links. The LTI encourages sharing of content across the university, as staff can access the university database of already existing H5P content with a click of a button. This function enables academics to embed already developed content and easily make amendments to suit unit learning outcomes specifically. This integration allows for the development of new content easily within the teaching space, with many H5P templates to choose from and suited to their chosen topic. To encourage capacity building and technological enhancement across anatomy and physiology units within the university, existing H5P interactives within the LTI database system were categorized according to “college” and “discipline” and tagged with descriptive keywords in order to search and share with other colleagues and the wider educational community (4, 10).

**H5P CONTENT DESIGN IN ANATOMY AND PHYSIOLOGY CURRICULA**

H5P interactives were strictly aligned with the learning outcomes of our anatomy and physiology units to enhance and support curriculum design (Fig. 1). The curriculum design process involved unit mapping to distinguish daily learning objectives, activities for face-to-face sessions and self-study, as well as assessments and other activities such as clinical case studies. The curriculum map that was created at the end of this process mapped activities and resources in a grid of preclass, in-class, and postclass activities aligned to weekly learning outcomes. These mapped activities involved substituting passive learning materials with H5P modules such as interactive videos embedded with discussion questions for in-class learning. To encourage self-directed and active learning, the design of the curriculum ensured fluidity among online activities and the classroom, along with incorporating a combination of H5P interactives in computer laboratory “in-class” sessions (11).

The unit was divided into weekly folders that were subcategorized into “Pre-class” and “In-class” folders containing chunked H5P interactives (Fig. 2A). Pre-class online modules were designed for students to complete before attending face-to-face classroom sessions (In-class). In-class activities involved the review of content with a facilitator via team-based learning to encourage and reiterate peer learning (12). Students then had the opportunity to revise and practice these activities “Post-class” in their own study time. H5P activities were not set as assessment tasks and were not incentivized. The alignment of H5P activities to face-to-face (F2F) team-based inquiry learning was a critical element used in the curriculum design process (Fig. 2, B and C).

**INDIVIDUAL H5P DESIGN: CHUNKING**

H5P can be used to produce “chunked” learning information that is intellectually stimulating and buildable in complexity. Chunking is defined as the method of breaking a component into smaller “chunks” of related information (14). Chunking reduces students’ cognitive load and provides meaning and context to information, making it easier to remember. Christopher Pappas identified three common methods of chunking information: this includes classifying and prioritizing, grouping, and organizing (14). Chunking is used in situations where content can be broken apart into smaller categories or grouped to improve clarity in meaning. This is especially useful when used on content students identify as being difficult to understand. H5P tools such as “Accordian,” “Image Hotspot,” and “Image Sequencing” can be peppered throughout the course to actively engage and stimulate students with an asynchronous teacher presence. These chunks can then be interspersed in a course to engage students to learn actively without the presence of an educator. To actively engage first-year students and address the large amount of conceptual content in anatomy and physiology units, our H5P interactives were designed as practice

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**Figure 1.** Mapping of H5P activities to learning outcomes, as part of blended learning strategy for Anatomy and Physiology (A & P) units.
self-directed activities. To promote better student outcomes, it was crucial to create H5P interactives that stimulated critical thinking through succinct thought-provoking content and to promote acquisition of knowledge (15).

Within the unit space, students navigate between different topics to find "chunked" H5P modules with instructional text immediately preceding them (Fig. 2A). Each chunked learning interactive utilized the following information scheme:

**INQUIRY ACTIVITY (in class): NERVOUS SYSTEM**

1. Consider the following diagram:
   a. Name the ion channel that underlies the sharp increase in membrane potential seen in phase (2), and describe the change in cell permeability.
   b. What two events are necessary for the sharp fall in membrane potential seen through phase (3)? (Describe ion movements and permeability)
   c. What ion is flowing, and in which direction, to explain the changes in membrane potential through phase (4)?
   d. How is the concentration gradient of ions on either side of the membrane restored after an action potential?

Application (adapted from Anatomy TV): Lisa, a 22-year-old student, was traveling in Bali during a gap year. Lisa was rushed to hospital after trying puffer fish, a fish known to contain tetrodotoxin, in a local village restaurant. Lisa had numbness in her mouth and all over her body. At hospital, Lisa was diagnosed with tetrodotoxin poisoning and died 3 hours later from cardiac arrest. Tetrodotoxin blocks fast voltage-gated sodium channels in nerves and cell membranes. Using your knowledge of the role of voltage gated Na channels in generating action potentials, explain the effect of tetrodotoxin on the generation of action potentials in Lisa’s nerves?

Figure 2. A: chunking activity. B: example of online H5P content and in-class activity/practice. C: face-to-face (F2F) in-class inquiry-based team activity, with adaptation from Anatomy TV (13).
Introduction—Provides a narrative to the activity and outlines specific learning outcomes.
- To do—Gives explicit instructions on what the task is and how to complete it.
- Hints—Links task to textbook or lecture material within the course for assistance.
- Time taken to complete—Lets the learner know how much time they will need to set aside to complete this task.

The second element to creating a chunked H5P is the use of feedback. The use of feedback is learners’ major mechanism to check their progress within a learning task (16). Feedback is critical at the first-year level to encourage learning via trial and error in a controlled and low-stakes environment (16–18). Most H5P learning interactives also allow learners to check their understanding on the particular concept. The “check”, “retry,” and “show solution” options provide immediate feedback to reinforce and guide learning. The H5P activities were not linked to any assessments for the units and were not mandatory to complete. In this instance, H5P activities were purely available for self-study and review. As the H5P platform evolves, it may be possible to assign students to create their own HSPs as part of their assessments portfolio.

RESULTS

A survey (Ethics Application ID: HRE17-192) conducted at Victoria University was extended to 250 students enrolled in block mode in 2019 (n = 50 respondents). The learning analytics data from the online learning management system showed that 60% of students in block mode (n = 250 students enrolled) who attempted the H5P interactives completed them consistently, which is an indication of student engagement in self-directed study. Eighty percent of students [Likert 5-point scale on survey with “strongly agree” and “agree” responses combined, mean = 2.75 (SD 1.04)] felt that the completion of H5P activities was time consuming and required greater effort than, for example, completing online formative practice multiple-choice questions. Despite the increased learning effort, 90% of student participants [mean = 2.38 (SD 1.13)] agreed that their knowledge in anatomy and physiology was enhanced by repeated practice with H5P activities and it helped with keeping up with the block mode of study. Anecdotally, staff felt that it increased their capacity in using technology to scaffold activities aligned to learning outcomes. A “network of H5P staff” supported each other in the design and development of H5P interactives for physiology, which were then shared across the university with staff from varying disciplines, who cloned activities and contextualized them to their disciplinary content. The network built local academic champions and fostered the development of an HSP academic development network that consists of academic and professional staff at VU sharing their practice.

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