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ILLUMINATIONS

Reimagining physiology education with interactive content developed in H5P

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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



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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)		
Twitter user feed (tutorial guide): Show your twitter feed using H5P		

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 activities 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

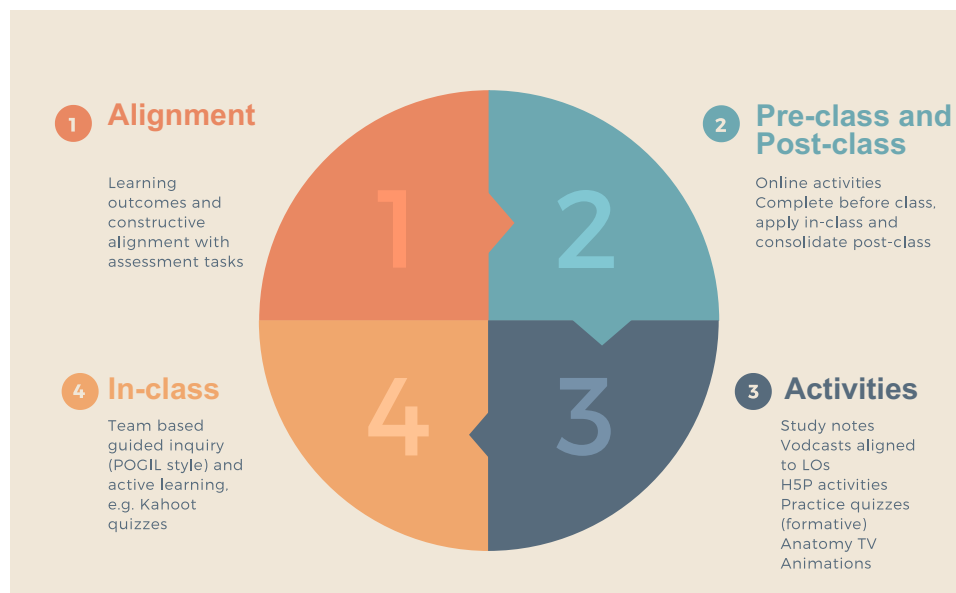


Figure 1. Mapping of H5P activities to learning outcomes, as part of blended learning strategy for Anatomy and Physiology (A & P) units.

A **ACTIVITY 1**

Introduction:
Define Resting Membrane Potential (RMP) and recognise the contribution that ion distribution across the membrane makes to RMP. Be able to predict the movement of sodium and potassium ions, across the cellular membrane in response to changes in permeability of the membrane to each of these ions.

To do: Please click on blue buttons for more information. Also, watch the video/animation and try to answer related questions

Hint: Please refer to your textbook, Chapter 11, pp421-444

Time taken to complete: 15 minutes

Learning Outcome
Define the Resting Membrane Potential
The value of the resting membrane potential is ____.

☐ -70 mV
☐ +30 mV
☐ -55 mV
☐ -100 mV

☒ Check

B

Introduction- Nervous System

Learning Outcomes

Slide 1
Introduction- Nervous System

Slide 2
Learning Outcomes

Slide 3
Membrane potential

Slide 4
Resting Membrane Potential

Slide 5
Resting Membrane Potential...

Slide 6
Quiz-concept check

Slide 7
Quiz-concept check

Slide 8
Quiz-concept check

Slide 9
Quiz-concept check

Drag and drop the labels to the correct positions on the diagram of the AP
Drag and Drop

The big picture
What does this graph show? During the course of an action potential (below), voltage changes over time at a given point within the axon.

Resting state
Depolarization
Repolarization
Hyperpolarization

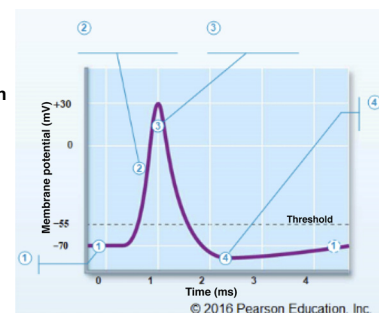
C **INQUIRY ACTIVITY (in class): NERVOUS SYSTEM**

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).

1. Consider the following diagram:
What is the state of the membrane at phase (1)?
- 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 AnatomyTV):

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?



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:

- **Introduction**—Provides a narrative to the activity and outlines specific learning outcome.
- **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 H5Ps 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 H5P academic development network that consists of academic and professional staff at VU sharing their practice.

RECOMMENDATIONS

H5P interactives incorporated into anatomy and physiology university programs can be innovatively designed

to support learning pedagogy through active learning. A future endeavor is to creatively adapt new content with the use of interactive videos and branching scenarios (advanced H5P activity). The interactive video H5P function allows staff to create their own video content embedded with interactive questions throughout to increase student engagement. Furthermore, as a new feature of H5P, branching scenarios can be useful to unpack clinical scenarios and case studies to encourage students to apply theory relevant to their practice in a controlled environment. We aim to continue this work within the next iterations of the Victoria University block model units (6), with hopes to build internal staff capacity through sharing, creating, and developing programs together (19) and strengthen resources already available in our online database. We intend to build communities of practice through sharing and collaboration of H5P content with colleagues at other institutes to encourage technological enhancement of teaching and learning across anatomy and physiology units and the wider university community.

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

P.S. conceived and designed research; P.S. performed experiments; P.S. analyzed data; P.S. interpreted results of experiments; P.S. and S.R. prepared figures; P.S. and A.S. drafted manuscript; P.S. and S.R. edited and revised manuscript; P.S., A.S., and S.R. approved final version of manuscript.

REFERENCES

1. **Anthony B, Kamaludin A, Romli A, Raffei AF, Phon D, Abdullah A, Ming GL, Shukor NA, Nordin MS, Baba S.** Exploring the role of blended learning for teaching and learning effectiveness in institutions of higher learning: an empirical investigation. *Educ Inf Technol* 24: 3433–3466, 2019. doi:10.1007/s10639-019-09941-z.
2. **Cason CL, Kardong-Edgren S, Cazzell M, Behan D, Mancini ME.** Innovations in basic life support education for healthcare providers: improving competence in cardiopulmonary resuscitation through self-directed learning. *J Nurses Staff Dev* 25: E1–E13, 2009. doi:10.1097/NND.0b013e3181a56f92.
3. **Dj N, Macfarlane-Dick D.** Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. *Stud High Educ* 31: 199–218, 2006. doi:10.1080/03075070600572090.
4. **Rekhari S, Sinnayah P.** H5P and innovation in anatomy and physiology teaching. In: *Research and Development in Higher Education: (Re)Valuing Higher Education*, edited by Wache D, Houston D. Hammondville, NSW, Australia: HERDSA, 2018, vol. 41, p. 191–205.
5. **Biggs J.** Enhancing teaching through constructive alignment. *High Educ* 32: 347–364, 1996. doi:10.1007/BF00138871.
6. **McCluskey T, Weldon J, Smalldridge A.** Re-building the first year experience, one block at a time. *Stud Success* 10: 1–15, 2019. doi:10.5204/ssj.v10i1.1148.
7. **Knowles M.** *Self-Directed Learning: a Guide For Learners and Teachers*. New York: Association Press, 1975.

8. **Garrison DR.** Self-directed learning: toward a comprehensive model. *Adult Educ Q* 48: 18–33, 1997. doi:[10.1177/074171369704800103](https://doi.org/10.1177/074171369704800103).
9. **Towle A, Cottrell D.** Self directed learning. *Arch Dis Child* 74: 357–359, 1996. doi:[10.1136/adc.74.4.357](https://doi.org/10.1136/adc.74.4.357).
10. **Wilkie S, Zakaria G, McDonald T, Borland R.** Considerations for designing H5P online interactive activities. In: *Open Oceans: Learning without Borders*, edited by Campbell M, Willems J, Adachi C, Blake D, Doherty I, Krishnan S, Macfarlane S, Ngo L, O'Donnell M, Palmer S, Riddell L, Story I, Suri H, Tai J. Geelong, VIC, Australia: ASCILITE, 2018, p. 543–549.
11. **Petty J.** Interactive, technology-enhanced self-regulated learning tools in healthcare education: a literature review. *Nurs Educ Today* 33: 53–59, 2013. doi:[10.1016/j.nedt.2012.06.008](https://doi.org/10.1016/j.nedt.2012.06.008).
12. **Sinnayah P, Rathner JA, Loton D, Klein R, Hartley P.** A combination of active learning strategies improves student academic outcomes in first-year paramedic bioscience. *Adv Physiol Educ* 43: 233–240, 2019. doi:[10.1152/advan.00199.2018](https://doi.org/10.1152/advan.00199.2018).
13. **Primal-Pictures.** Anatomy.TV . <https://primalpictures.com>, 2019.
14. **Pappas C.** 3 Chunking Strategies That Every Instructional Designer Should Know [Blog post]. Retrieved from <https://elearningindustry.com/3-chunking-strategies-that-every-instructional-designer-should-know>. 2013, June 3.
15. **Means B, Toyama Y, Murphy R, Baki M.** The effectiveness of online and blended learning: a meta-analysis of the empirical literature. *Teach Coll Rec* 115: 1–47, 2013.
16. **Marden NY, Ulman LG, Wilson FS, Velan GM.** Online feedback assessments in physiology: effects on students' learning experiences and outcomes. *Adv Physiol Educ* 37: 192–200, 2013. doi:[10.1152/advan.00092.2012](https://doi.org/10.1152/advan.00092.2012).
17. **Kift S.** Successful university teaching in times of diversity. *High Educ Res Dev* 37: 1315–1317, 2018. doi:[10.1080/07294360.2018.1467590](https://doi.org/10.1080/07294360.2018.1467590).
18. **Kift S, Nelson K, Clarke J.** Transition pedagogy: a third generation approach to FYE—a case study of policy and practice for the higher education sector. *Int J First Year Higher Educ* 1: 1–20, 2010. doi:[10.5204/intjfyhe.v1i1.13](https://doi.org/10.5204/intjfyhe.v1i1.13).
19. **Ambler T, Solomonides I, Smallridge A, McCluskey T, Hannah L.** Professional learning for academics teaching first-year undergraduate students. *Prof Dev Educ* 46: 845–857, 2020. doi:[10.1080/19415257.2019.1647272](https://doi.org/10.1080/19415257.2019.1647272).