Flipping the Classroom in First-Year Science Students using H5P Modules

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Abstract: Flipped Learning (FL) has emerged as an essential instructional approach in tertiary education. A common misconception is that FL is highly dependent on the use of video. Educators have the choice to flip content with learning interactions such as interactive slides, a timeline of events, infographics or even image sliders. H5P is an open-source platform for producing a variety of flipped subject content that is easy to learn and use. This paper reports the experience of using H5P to flip content in first-year science education (n=45). The methodology included the use of the Flipped Learning Comprehensive Model (FLCM) in conjunction with visual design and multimedia learning principles to guide the learning design and deployment of the modules. Students completed a 15-step online questionnaire at the end of the semester voluntarily. The survey contained demographic questions, as well as Likert-type scale items to measure student attitudes towards technology and perception of knowledge construction. Analysis of the data found that students had a positive attitude towards technology, and learnt the subject content by engaging in FL. Limitations of the study include sample size, and the lack of interviews to gauge an in-depth understanding of student views.

Keywords: Flipped learning, active learning, H5P modules, technology-enhanced learning, science education.

Introduction

Flipped Learning (FL) is becoming popular in tertiary educational settings (Reyna 2019). Although it is considered an emerging field of research, tertiary educational institutions are embedding FL in curricula (Karabulut, Ilgu, Jaramillo Cherrez, & Jahren, 2017). As a pedagogical model, FL has its challenges for implementation (Hew & Lo, 2018). For example, the development of tailored learning material is time-consuming and requires technical know-how such as using e-learning authoring tools, visual design principles, and video production techniques (Abbasian & Sieben, 2016). Furthermore, creating FL materials such as digital artefacts often involves the use of expensive software (Smith & Mader, 2015). These e-learning tools generally have a slow learning curve and require a high level of capability for using technology. Universities sometimes do not support most of these tools to create content. Therefore, they do not provide the appropriate training for academics.

The way students interact with online content (videos, presentations) is substantially different from a face-to-face lecture. Students online tend to focus less, especially if the material is not interactive (Croxton, 2014). When online content is longer than 15 minutes, completion rates decrease considerably, even if they offer interactivity (Geri, Winer, & Zaks, 2017). Therefore, to ensure impact, planning the creation of online content should follow a storyboard approach, just like any digital media product creation (Carroll, 2014). Writing storyboards to produce online learning content provides educators with the opportunity to ensure ideas flow, avoid redundancy, and personalise the message to the student. In general, a minute of online delivery is equivalent to 120-150 words (Stockman, 2011). When preparing FL material, educators should consider these basic rules of engagement.

Creating effective digital content for FL is not only about the technology but also encompasses pedagogies, instructional strategies, planning, visual design and aesthetics, multimedia learning principles, and communication with students (Reyna, 2015). Defining the pedagogical approach is the starting point for a successful educational intervention. In FL, active learning or learning-by-doing is the fundamental approach and aligns with constructivist learning principles (Bransford, Brown & Cocking, 1999). As students will need to prepare before their classroom engagement with online learning interactions, appropriate visual design and aesthetics are essential (Malamed, 2015). These principles are also called *content enablers* and include layout design, colour, typography, images, and video techniques (Reyna, Davila, & Meier, 2016). Applying relevant multimedia principles such as segmentation, redundancy and personalisation (Mayer, 2008) should promote student engagement with the content.

This paper aims to trial the use of an H5P platform to deploy learning materials to flip a first-year science course at a metropolitan university in Sydney, Australia.

Theoretical underpinnings

Flipped learning model

Flipped Learning (FL) models focus on what will happen before, during and after the classroom, and they tend to be either student- or educator-centred (Huelskamp, 2015; Karabulut-Ilgu, Jaramillo Cherrez, & Jahren, 2017; Moffett, 2015). The Flipped Learning Comprehensive Model (FLCM) (Reyna, 2019) blends two perspectives, those of the learner and the educator. The base of this model is the pedagogical approach followed by the planning stage and instructional strategies, and it incorporates self-regulation, motivation, usability and accessibility. It also considers the technology and the need to communicate to the students the rationale behind FL. Each stage of the model addresses possible student questions such as (i) the need to learn using FL; (ii) how the online content relates to classroom activities; (iii) what happens before, during and after the classroom; (iv) how to become successful learners using FL; and (v) how was the learning experience with FL. The literature on online learning has confirmed the importance of self-regulation skills for academic achievement (Sharp & Sharp, 2017). Self-regulation is a multifaceted construct that incorporates goal-setting, environment structuring, time management, task strategies, help-seeking and self-consequences, which are components that underpin student success in online environments (Barnard, Lan, To, Paton, & Lai, 2009). In FL, the success of the strategy depends on students preparing before the classroom. Preparing before the classroom requires self-regulation skills such as time management and task strategies. Therefore, FL is highly dependent on self-regulation. Motivation also has an essential role in self-regulation, and is considered the *sine qua non* of self-regulation processes (Artino & Stephens, 2009) and includes self-efficacy, task value, attribution to failure, and anxiety (La Marca & Longo, 2017). If students are to succeed in FL, they need to be capable of using the technology, attach a high value to preparation before the classroom, have learning predispositions and control their levels of anxiety. Educators can help students stay focused and motivated.

H5P platform

H5P.org is an open-access platform tool that is easy to learn and works across Windows, Macintosh and mobile platforms. There is no software to install, and the content creation occurs online; therefore, educators can share a link or embed it into the LMS (Wilkie, Zakaria, McDonald, & Borland, 2018). Learning Management Systems can connect with H5P, and student interaction will be trackable in the Grade Centre. H5P offers a wide range of learning interactions: interactive video, course presentation, branching scenario, infographics, and forty additional features (Rekhari & Sinnayah, 2018). Using these interactions is straightforward; there is no need for coding, H5P offers a What You See is What You Get (WYSWYG) interface, and it has dozens of tutorials and examples. The platform has usability and accessibility features embedded that are simple to follow. It has an excellent user interface design, and the content created can be easily updated as required. The effective creation of content using the H5P platform is not only about mastering its functionality, but also applying principles of visual design and aesthetics for maximum student engagement.

Visual design and aesthetics

Lacking the appropriate skills, educators outside the creative disciplines have generally neglected visual design in online learning (Bader & Lowenthal, 2018). Visual design and aesthetics can provoke emotions in learners. Thus the ways educators use layout design, colour, fonts, images (Williams, 2014), and video principles (Stockman, 2011) are crucial. Attention to these aspects can make the learning experience credible, unique, personal and memorable.

Layout design covers the arrangement of design elements (e.g., text, images) on the screen to promote user engagement. Symmetric layouts are well-balanced interfaces such that when cut in half, each side looks identical. This type of arrangement conveys professionalism and balance and is accessible to the eye. In contrast, a chaotic layout can confuse learners and impose unnecessary cognitive load because learners are trying to make sense of the interface, which means fewer resources in working memory (Cowan, 2010) are available for information processing and learning.

Colour creates moods, and we should combine them in online learning environments to achieve maximum impact. A colour clash occurs when bright colours are used together in an interface (Hashimoto & Clayton, 2009). For example, excessive use of red can cause students to underperform in exams (Elliot, Maier, Moller, Friedman, & Meinhardt, 2007). Ideally, a neutral colour scheme will make an interface accessible, elegant, and therefore credible.

Choice of fonts, or what is called typography, is also crucial for online learning (Williams, 2014). Use of font-faces that are easy to read has benefits, especially for learners with dyslexia (Kerr, McAlpine, & Grant, 2014). Sans-serif font types are the best choice for online learning (Malamed, 2015).

Images can trigger learner emotions and promote engagement and recall. Using images in learning material can complement the message and make a connection between theory and practice. For instance, using images in conjunction with voiceover may affect learning and retention.

Multimedia Learning principles

Multimedia learning principles (Mayer, 2008) also need to be considered when designing online content for FL. Drawing from Mayer's (2008) well-established and comprehensive multimedia framework, the most applicable principles to create online content are the segmentation principle, the spatial contiguity principle, the redundancy principle and the personalisation principle. These principles are relevant when creating PowerPoint presentations, online learning modules, infographics and other learning interactions.

In summary, using a well-rounded theoretical framework to inform FL, in conjunction with visual design, aesthetics and multimedia learning principles, could enhance the student learning experience. This paper aims to report the experience of using H5P to flip content in a first-year science cohort.

Methodology

The trial used a cohort of first-year, first-semester science students (n=45), blended mode, attending a large university, located in metropolitan Sydney, Australia The methodological approach used the Flipped Learning Comprehensive Model (FLCM) (Reyna, 2019). The first step was to identify the pedagogies, followed by the planning stage, instructional strategies, identification of content enablers, and technology selection. The final step was designing a communication strategy for the students to buy into the FL model of learning. The pedagogical approach was active learning, with students engaging before the classroom by completing four online modules created in H5P (Weeks 2, 4, 6 and 8), during the classroom by discussing in groups, and afterwards by completing a quiz and reflective journal. The planning stage ensured that there was a link between the preparation material and what would happen during the classroom. The content for the online module followed a storyboard approach to ensure it was concise and engaged students with the learning material effectively. The instructional strategies ensured that each module had higher-order thinking learning outcomes that were aligned to the learning activities and the assessment tasks.

Additionally, multimedia learning principles guided the design and production of the online modules, such as adding Table of Contents (Segmentation), avoiding redundancy and personalising the message (e.g., using 'you' rather than 'the student'). The content enablers enhanced usability and accessibility of the modules and were the visual design and aesthetics principles (layout design, colour, fonts, images, video principles), and applied to all H5P modules. The communication strategy used a set of Frequent Asked Questions presented in the classroom and uploaded into the LMS (Table 1).

Table 1: Frequently Asked Questions to communicate the FL model of learning to science students. Questions mapped against the Flipped Learning Comprehensive Model (FLCM) (Reyna, 2019).

Element	Question
Pedagogy	Why do I need to learn with the FL model?
Planning stage	How is the online content linked to what will happen in the classroom?
Instructional strategies	How am I going to work before, during and after the classroom?

Self-regulation	How do I become a successful learner using the FL model?
Content enablers	Is the FL online content usable and accessible?
Technology	What technology will I be using to learn with the FL model?
Communication	Why is it important to learn with the FL model?
Research and evaluation	How was the learning experience with the FL model?

The data collection used a questionnaire containing demographic questions and Likert Scale items (1 =Strongly Disagree, 2=Disagree, 3= Agree, and 4=Strongly Agree) to evaluate the student experience (attitude towards technology and knowledge construction) with FL and H5P modules (Table 2).

Table 2: Questionnaire to evaluate the student experience with the FL model that used H5P technology to deliver the content.

Topics	**Question**
Demographics	What is your gender?
	Which age bracket are you in?
	What is the highest level of education you have completed?
	Is English your first language?
Attitude towards Technology	I enjoy using technology for recreational matters
	I am confident using technology for recreational matters
	I have a positive attitude towards technology for recreational matters
	I enjoy using technology for learning
	I am confident using technology for learning
	I have a positive attitude towards technology for learning
Knowledge construction	I believe using online interactive modules helped me to understand the topic
	The online interactive modules helped me to develop critical thinking skills
	The online modules provided flexibility to my learning experience
	I believe interactive online modules are a good way to learn a subject topic
	I will encourage academics to use interactive online modules in other subjects

The software used to analyse the data was IBM SPSS Statistics for Windows, Version 24.0 (Armonk, NY: IBM Corp). The analysis included descriptive statistics (Mean, Standard Deviation, and Variance).

Results and discussion

Demographics

From the total class size (n=45), thirty-five students completed the questionnaire (78% response rate). Their gender distribution was 74% female and 26% male, and their ages were 18-29 (40%), 30-49 (49%) and 50-64 (11%). Among the students, 63% had a university degree, 21% were high school graduates, and 16% had trade/technical/vocational training. Native English speakers were 43%, while 57% had English as an additional language. The demographic characteristics of the participants highlighted adult learners rather than young adults.

Using the H5P platform

The H5P platform allowed the researchers to develop interactive learning modules to flip the classroom without being a time-consuming exercise. The H5P course module feature was intuitive to use, and it was possible to apply visual design and aesthetics by designing the slides in PowerPoint and saving them as JPEG images. Audacity audio recording and editing software helped to produce .MP3 files (narration). The process of uploading the images and linking to the audio recordings was straightforward. The WYSWYG interface has icons, such as an image icon and an audio icon, which the user clicks to upload the files into the presentation. Adding interactivity to the modules involved the MCQs functionality of the platform, and it was possible to provide feedback for each alternative the students could choose. Building the Table of Contents (TOC), to apply the principle of segmentation, was also uncomplicated. By clicking on the bottom left of the presentation, it was possible to edit the TOC labels directly. Generating the embedded code and copy-pasting it into the LMS was quick and easy. The only downside is that the LMS cannot support student tracking with these modules unless it is connected in the backend.

Attitude towards technology

The students have a positive attitude towards technology for recreational and learning activities (Table 3). This data indicated that the students on average were confident and had a positive attitude towards the technology, perhaps because most were adult learners who already had university degrees (63%). Also, most of the cohort was female (74%), contributing to an atypical first-year student cohort. Adult learners will have had work experience, using technology in their everyday tasks and independent learning activities. A study conducted in the USA with adult learners and FL found that participants showed less anxiety about using technology for language learning (Webb & Doman, 2020). Another study in Spain (also in language learning) found that adult learners have a positive attitude towards learning with technology (Arrosagaray, González-Peiteado, Pino-Juste, & Rodríguez-López, 2019). Our research results agree with these studies. However, other variables need to be considered: socio-economic status, sample size, discipline (languages vs. science), and context. Such an approach would require a large sample, and ideally, be longitudinal and across disciplines.

Table 3: Descriptive statistics for attitude towards technology among first-year, first-semester science students (n=35) who learnt subject content using the FL model.

	Min	Max	Mean	SD	Var.
I enjoy using technology for recreational matters	2	4	3.34	.684	.467
I am confident using technology for recreational matters	2	4	3.23	.731	.534
I have a positive attitude towards technology for recreational matters	2	4	3.43	.608	.370
I enjoy using technology for learning	2	4	3.34	.639	.408
I am confident using technology for learning	2	4	3.20	.719	.518
I have a positive attitude towards technology for learning	2	4	3.43	.558	.311
Mean	**2**	**4**	**3.33**	**.577**	**.332**

Knowledge construction

Students also held a positive belief that the modules were useful for knowledge construction. The highest value corresponded to the flexibility of their learning experience, followed by understanding the topic and intention to encourage academics to use the modules in other subjects (Table 4). Their positive attitude towards technology can explain these results (Table 3). Additionally, the evidence-based approach used to implement FL (theoretical framework, visual design and aesthetics, and multimedia learning principles) could lead to enhanced knowledge acquisition. Flipped learning can promote autonomous and personalised learning by engaging students in collaboration during the classroom (Zhou, Qiao, & Zhang, 2016). Although the data presented in this paper does not support this assumption directly, that could be another reason for positive student beliefs about knowledge construction. Student interviews would be required to gauge an in-depth understanding of their experience with the FL model of learning. A large sample would allow the research to find correlations between student attitude towards technology and knowledge construction.

Table 4: Descriptive statistics for knowledge construction in first-year, first-semester science students (n=35) who learnt subject content using the FL model.

	Min	Max	Mean	SD	Var.
I believe using the modules helped me to understand the topic	1	4	2.97	.747	.558
The modules helped me to develop critical thinking skills	1	4	2.89	.758	.575
The modules provided flexibility to my learning experience	1	4	3.34	.725	.526
I believe the modules are an excellent way to learn a subject topic	1	4	2.89	.867	.751
I will encourage academics to use modules in other subjects	1	4	2.94	.838	.703
Mean	**1**	**4**	**3.01**	**.644**	**.415**

This study presents several limitations, as noted previously. First, the sample was small, 35 questionnaire responses out of 45 students enrolled in the subject. A large sample (around 300) would allow the researchers to validate the questionnaire through Confirmatory Factor Analysis to ensure the items are measuring the intended constructs (Thompson, 2004). Second, the study did not utilise open-ended questions or interviews. Although the results are highly positive, it did not provide insights into student views on FL using the H5P modules. Finally, the student marks were not available to serve as an additional dataset to triangulate current data. Data triangulation increases credibility to research findings (Bekhet & Zauszniewski, 2012). Researchers recommend running a large-scale study to validate further results.

Conclusion

The design of FL material using H5P open platform in conjunction with a theoretical framework, visual design and aesthetics application, and multimedia learning seems to have a positive effect on student perception of knowledge construction. Although the results were highly positive, a larger sample and the inclusion of open-ended questions, interviews and student marks would be required to validate the findings. The use of H5P was straightforward, and researchers recommend the platform to develop modules to flip the classroom.

References

Abbasian, R. O., & Sieben, J. T. (2016). Creating math videos: Comparing platforms and software. Primus: Problems, Resources & Issues in Mathematics Undergraduate Studies, 26(2), 168-177. https://doi.org/10.1080/10511970.2015.1047916

Arrosagaray, M., González-Peiteado, M., Pino-Juste, M., & Rodríguez-López, B. (2019). A comparative study of Spanish adult students' attitudes to ICT in classroom, blended and distance language learning modes. Computers & Education, 134, 31-40. https://doi.org/10.1016/j.compedu.2019.01.016

Artino Jr, A. R., & Stephens, J. M. (2009). Academic motivation and self-regulation: A comparative analysis of undergraduate and graduate students learning online. The Internet and Higher Education, 12(3-4), 146-151. https://doi.org/10.1016/j.iheduc.2009.02.001

Barnard, L., Lan, W. Y., To, Y. M., Paton, V. O., & Lai, S.-L. (2009). Measuring self-regulation in online and blended learning environments. The Internet and Higher Education, 12(1), 1-6. https://doi.org/10.1016/j.iheduc.2008.10.005

Bekhet, A. K., & Zauszniewski, J. A. (2012). Methodological triangulation: An approach to understanding data. Nurse researcher, 20(2), 40-43. https://doi.org/10.7748/nr2012.11.20.2.40.c9442

Bergmann, J., & Sams, A. (2012). Flip your classroom: Reach every student in every class every day: Washington, DC: International Society for Technology in Education.

Bransford, J.D., Brown, A.L., and Cocking, R.R. (Eds.) (1999). How people learn: Brain, mind, experience, and school. Washington, D.C.: National Academy Press

Carroll, B. (2014). Writing and Editing for Digital Media. New York, NY: Routledge. https://doi.org/10.4324/9781315850818

Carter, M. (2012). Designing science presentations: A visual guide to figures, papers, slides, posters, and more: Academic Press.

Croxton, R. A. (2014). The role of interactivity in student satisfaction and persistence in online learning. Journal of Online Learning and Teaching, 10(2), 314.

Cowan, N. (2016). Working memory capacity: Classic edition. Psychology Press. https://doi.org/10.4324/9781315625560

Geri, N., Winer, A., & Zaks, B. (2017). A Learning Analytics Approach for Evaluating the Impact of Interactivity in Online Video Lectures on the Attention Span of Students. Interdisciplinary Journal of E-Learning and Learning Objects, 13(1), 215-228. https://doi.org/10.28945/3875

Hew, K. F., & Lo, C. K. (2018). Flipped classroom improves student learning in health professions education: a meta-analysis. BMC Medical Education, 18(1), 38. https://doi.org/10.1186/s12909-018-1144-z

Huelskamp, D. (2015). Flipping the Collegiate Science Classroom: A Review of the Research. Global Education Journal, 2015(1), 61-72.

Karabulut-Ilgu, A., Jaramillo Cherrez, N., & Jahren, C. T. (2017). A systematic review of research on the flipped learning method in engineering education. British Journal of Educational Technology. 49(3), 398-411. https://doi.org/10.1111/bjet.12548

La Marca, A., & Longo, L. (2017). Addressing student motivation, self-regulation, and engagement in flipped classroom to decrease boredom. International Journal of Information and Education Technology, 7(3), 230. https://doi.org/10.18178/ijiet.2017.7.3.871

Malamed, C. (2015). Visual Design Solutions: Principles and Creative Inspiration for Learning Professionals. Hoboken, New Jersey: John Wiley & Sons. https://doi.org/10.1002/9781119153801

Mayer, R. E. (2008). Applying the science of learning: evidence-based principles for the design of multimedia instruction. American Psychologist, 63(8), 760-769. https://doi.org/10.1037/0003-066X.63.8.760

Moffett, J. (2015). Twelve tips for 'flipping' the classroom. Medical Teacher, 37(4), 331-336. https://doi.org/10.3109/0142159X.2014.943710

Rekhari, S., & Sinnayah, P. (2018). H5P and Innovation in Anatomy and Physiology Teaching. Paper presented at the 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.

Reyna, J. (2019). Surfing the Open Oceans of Flipped Learning: A Comprehensive Student-Centred Model to Implement Flipped Classrooms. Paper presented at the Society for Information Technology & Teacher Education International Conference 2019, Las Vegas, NV, United States. https://www.learntechlib.org/p/207925

Reyna, J., Davila, Y., & Meier, P. (2016, 2016/07/14/). Enhancing the Flipped Classroom Experience with the Aid of Inclusive Design. Paper presented at the EdMedia: World Conference on Educational Media and Technology 2016, Vancouver, Canada.

Reyna, J. (2015). Exploring a framework to design desktop recording lectures (DRLs). Paper presented at the EdMedia: World Conference on Educational Media and Technology 2015. Association for the Advancement of Computing in Education (AACE). Montreal, Canada.

Smith, B., & Mader, J. (2015). Flipping tools for the science classroom. Science Teacher, 82(3), 8-8. https://doi.org/10.2505/4/tst15_082_03_8

Sharp, J. H., & Sharp, L. A. (2017). A Comparison of Student Academic Performance with Traditional, Online, and Flipped Instructional Approaches in a C# Programming Course. Journal of Information Technology Education: Innovations in Practice, 16, 215-231 https://doi.org/10.28945/3795

Stockman, S. (2011). How to Shoot Video That Doesn't Suck: Advice to Make Any Amateur Look Like a Pro. New York, NY: Workman Publishing.

Thompson, B. (2004). Exploratory and confirmatory factor analysis: Understanding concepts and applications: American Psychological Association. https://doi.org/10.1037/10694-000

Webb, M., & Doman, E. (2020). Impacts of flipped classrooms on learner attitudes towards technology-enhanced language learning. Computer Assisted Language Learning, 33(3), 240-274. https://doi.org/10.1080/09588221.2018.1557692

Wilkie, S., Zakaria, G., McDonald, T., & Borland, R. (2018). Considerations for designing H5P online interactive activities. Open Oceans: Learning without borders. Proceedings ASCILITE, 543-549.

Williams, R. (2014). The non-designer's design book: Design and topographic principles for the visual novice. San Francisco, CA: Pearson Education.

Zhou, Y., Qiao, X., & Zhang, H. (2016). A Study on Non-English Majors' Cognitive Adaptation and Learning Performance in Flipped Classroom. Paper presented at the International Conference on Blending Learning. https://doi.org/10.1007/978-3-319-41165-1_16