

# Applying online and blended learning structure to teaching practice for STEAM Education

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**Abstract**—This Research to Practice Work-In-Progress Paper will investigate the application of common online or blended teaching and learning strategies with the pedagogy of the Creative Industries sector at University of the Sunshine Coast (USC), particularly focus on the Bachelor of Design - Serious Game Design. This highly interdisciplinary degree has unique challenges of balancing artistic vision, storytelling ability, technical knowledge, and collaboration skills when developing an effective learning environment compared to other subjects within the STEAM fields. The investigation will first outline the common mistakes when transforming face-to-face course design to the online and blended learning environment and introduce five core strategies that better facilitate the design of online or blended subjects in tertiary education. We will then compare and contrast these strategies with the summative learning feedback, which was collected by eVALU8 in the university's centrally supported learning management systems (LMS) at the end of semester 2, 2019 from the subjects conducted by face-to-face mode and the formative feedback, which were distributed by Microsoft Forms at the end of each class in semester 1, 2020 from the same subjects conducted by online and blended learning mode. Since the feedback does not include participant's age data, this paper will only focus on discussing the alignment of the critical components of the online or blended learning environment; the construction of consistent and effective learning experience with cognitive, social, and teaching presence with the existing learning model - Spike; and the opportunity of conducting formative evaluation at the end of each class or learning section in the online and blended environment to prevent learning intervention. These approaches provide insight into how online and blended learning can greatly facilitate the learning experience and teaching practice in STEAM education.

**Keywords**—Formative feedback, Constructive alignment Spike, Online learning, Blended learning, STEAM

## I. INTRODUCTION

Along with the development of information and communication technologies, the way of teaching, especially in higher education, has been gradually shifted the focus from providing the traditional in-person learning experience to the more efficient online or blended learning approach. Many researchers and institutions have started to make a thorough inquiry of the principles and models of this unconventional learning method due to its popularity and flexibility. For example, Kelly [1] has identified the common mistakes that appear in blended course design, including the adoption of an add-on model, the lack of coherence between online and face-to-face modes, and the attempt of direct conversion from one mode to the other. Reeves and Reeves [2] also unified five core strategies as the guideline of designing and teaching online or blended subjects for tertiary education to ensure that this approach reaches its maximum leverage. These include the importance of addressing pedagogy before technology;

the constructive alignment of course content; the construction of cognitive, social, and teaching presences; the selective of adopting new social media tool; and the engagement of systematic formative evaluation. They suggested that a well-planned online and blended learning environment should be pedagogy-oriented not technology-oriented, is begin with reviewing the core components of the subject rather than considering what technologies can be used; aligning the teaching context constructively with the expected learning outcome; using both constructivist and collaborative learning theory within the community of inquiry (COI) framework to maintain effective levels of cognitive, social, and teaching presences; taking the diverse age groups and potential pedagogical effectiveness into account for the selection of adopting new technologies; and engaging in formative evaluation for the continuous enhancement of existing blended subjects.

Although online and blended learning has been widely discussed, there is a lack of systematic analysis for the effectiveness of applying these strategies to game development courses. Questions arise on how to convert practical task-based teaching into the online and blended learning and whether online materials can boost the leaning efficiency have become the primary task and concern for course coordinators and facilitators when designing course structure and curriculum. This article will investigate the application of the above strategies by comparing and contrasting the previous courses using the summative teaching evaluations of semester 2, 2019 and the formative learning feedback of semester 1, 2020 from the converted curriculums provided by University of the Sunshine Coast (USC), particularly focus on the Bachelor of Design - Serious Game Design. This highly interdisciplinary degree has unique challenges of balancing artistic vision, storytelling ability, technical knowledge, and collaboration skills when developing an effective learning environment compared to other subjects within the creative sectors. The degree was transformed from 100% on-campus face-to-face teaching mode to a completely online and blended learning mode in semester 1, 2020 due to Coronavirus (COVID-19) pandemic. This transformation provides us with an opportunity to evaluate the effectiveness of online and blended learning in STEAM education.

## II. METHODOLOGY

The data used for this study consists of the summative learning feedback from 2 courses and a series of formative feedback from the same courses. The summative feedback was collected by eVALU8 in the university's centrally supported learning management systems (LMS) at the end of semester 2, 2019. Whereas, the formative feedback, which focused on the evaluation of the learning experiences of the online and blended environment were distributed by the

course coordinator using Microsoft Forms after completing an online quiz at the end of each class during semester 1, 2020. Since the online course delivery was started in week 4, there was totally 14 formative feedback conducted in these courses, 7 in each subject. According to Harrison et al. [3], learning feedback provides learners with a benchmark to determine if they are competent to progress to the next level, is one of the effective ways to identify learning effectiveness. However, since the feedback does not include participant's age data due to Equal Opportunity and Diversity Policy, the investigation will primarily focus on three aspects, the alignment of seven critical components (objectives, content, model of instruction, learner tasks, teacher roles, technology roles, and assessment) of the online or blended learning environment, which was proposed by Reeves and Hedberg [4] with the converted teaching practice; the construction of consistent and effective learning experience with cognitive, social, and teaching presence with the existing learning model - Spike; and the opportunity of developing formative evaluation to the blended learning environment.

### III. RESULT AND DISCUSSION

#### A. *The Alignment of The Critical Components of The Online or Blended Learning Environment*

Constructive alignment embodies a join of constructivist learning theory and intended learning outcomes, is the fundamental principle of any subjects. According to Cain, Grundy, and Woodward [5], in the information technology, engineering, science and game development related subjects, a constructively aligned curriculum and portfolio-based assessment provide a pathway for the learners without prior skill set to improve the learning experiences. They propose that the learning experience can only be enhanced by the effective learning activities, which are constructively aligned with the learning objectives and intended learning outcome. Ideally, game development education is a series of task-oriented courses, which consist of a large number of interdisciplinary subjects to support the curriculum. Each subject delivers knowledge, theories, and skills from different disciplines using a real synthesis of approaches. Thus, game developers are often described as cultural engineers who perform not only the activities of creation and innovation but the operation, project management, among others. However, Çakiroğlu and Öztürk [6] argued that a growing number of teachers spend too much time in the classroom to deliver trivial knowledge which can be absorbed by students themselves via electronic and online media outside the classroom. They pointed out that most students are willing to allocate extra time for the resources provided online with problem-based learning activities, which assist the participant to develop real-life problem-solving skills.

Currently, the USC game programming courses are provided by the traditional face-to-face workshops with the intention to deliver both theoretical contents and technical skills in class. According to the open comments in the student evaluations in 2019, the courses moved and spoke way too fast due to the time constraint event though the teacher has equipped with technical proficiency. One of the students comments specifically that:

***“Without the help of YouTube and classmates, there would not be a remote chance I would pass this course.”***

Another comment relating to this issue is:

***“The task description left a lot of room for questions to be asked about what to discuss in sections of the report.”***

Based on these commons, we believe that the development of constructive blended and online learning is essential, especially for the introduction of game scripting course in the creative industries sector. With this motivation, the teaching team has introduced Microsoft Sway into the technology-enabled learning (TEL) environment for creating a first-person interactive online learning materials and pre-recorded step-by-step video tutorials with 3 hours ZOOM online session, which was conducted each week during the pandemic. The learning materials were released on a weekly basis. The online sessions provide students with an opportunity to ask questions relating to the learning contents and assigned tasks. This creates a virtual flipped classroom model in which learners can move at their own learning pace, engage with the materials when they are most alert, and take breaks without disrupting others. Generally, the course aims to offer the knowledge of the specific programming language and concept that will be used in the game development areas for the learners with the lack of technical skills from the design and arts background. The online sessions create an active working environment to ensure they can apply their knowledge in a constructed learning group. This strategy has received positive learning feedback from the formative evolutions. These include but not limited to

***“Although we have had covered this in week 3 during the workshop, I couldn't catch up at the time until watching the tutorial video this week.”***

***“Sway things have helped me to drop my Anxiety levels as my casual job are pushing me for hours due to me be being only one of two available staff during Covid shutdown.”***

As can be seen from the above comments, a constructively aligned online and blended curriculum provides students with the flexible time to pursue more advance challenges. This echoes the critical components of constructive alignment stated by Reeves and Reeves [2] when developing blended and online learning structure that could benefit the technical game development subjects within the creative industries sectors.

#### B. *The Construction of Consistent and Effective Learning Experience with Cognitive, Social and Teaching Presence*

Garrison, Anderson, and Archer [7] expanded and applied the concept of the community of inquiry (COI) framework, which constitutes three essential elements: cognitive presence, social presence, and teaching presence into the online subjects for creating meaningful learning experiences. They asserted that, by introducing constructivist learning theory and collaborative learning theory into the framework, this model can act as a tool to support collaborative learning in the online and blended environment. Despite the effectiveness of the approach in online and blended learning, some challenges have emerged after decades of implementations. Anderson [8] observed several learning developments supported by the COI model and identified the

common challenges. He concluded that challenges such as technological issues, lack of familiarity, and less than enthusiastic adoption can drop the learning experience dramatically. He also pointed out that maintaining an effective teaching presence plays a vitally important role to increase the efficiency of the learning, which can be achieved by creating a learning environment that is direct influence by cognitive and social processes. Reeves and Reeves [2] defined three strategies to establish teaching presence in online or blended subjects, which include identifying the agreement and disagreement of the subject topic; providing direct instruction where necessary; and providing encouragement and feedback to maintain teaching visibility. These strategies provide a visible guideline for the teaching practice in the creative industries sectors at the USC.

#### 1) Spike in STEAM education

At the USC, some game development courses applied Spike as the learning model, which aims to help learners constructing meaningful knowledge and relevant skill using an agile software development technique. This technique is a loose collection of software engineering methodologies that uncovers potential solutions by running separate time-boxed investigation using the simplest possible program. The term Spike is an analogy of driving a piton into the cliff while climbing. The action itself does not stir climbers to the peak but a series of pitons creates a path for future climbing. Based on this concept, Spike in education provides a novel approach that allows students to think like a developer by focusing on a topic and digging as deep as they can in the projected time allocation. It gives them the ability to investigate the problems, close the gaps and reduce the risk [9]. Although the adoption of Spike intends to maintain the social presence by offering students with an opportunity for a self-disclosure activity, it neglects the establishment of the cognitive presence, which emphasizes on clarifying the structure of the learning environment for the learners. Despite the fact that online discussing and collaboration channels were created as the solutions for the participants to engage with the teacher and others during the off-class time, they are not actively implemented due to the courses are offered in-person. This falls into the common mistakes of designing blended learning course asserted by Kelly [1] that a disconnection between face-to-face and online modes can be caused by the adoption of an add-on model. He stressed that students tend to participate in the activities less if they could not see the connection between the two modes. It potentially reduces the learning experience, as a number of arguments have reflected in the course feedback that some students were unable to follow the instruction due to the lack of technical background, for example:

***“The Amount of work and difficulty of tasks to achieve in the course overall is unrealistic I needed more time for this course than all my other courses including third year courses combined and not only by a bit it is as though the tasks are for someone with no social live, job, kids or other university courses and the learning curve is to extreme and could easily be split into multiple courses with task being to restrictive with what can be used and done”***

***“I liked the Discord for asking for help in theory, but often I wouldn't know the words or the code jargon to ask for help in a way that someone could understand via text alone. So, I wouldn't know what***

***is wrong with my code, and therefore couldn't formulate what question I needed to ask, even though I know how to ask questions well. Not sure if this is just something I've missed, or something that isn't covered. Would be a useful skill to have though.”***

Apart from the above issue, timely feedback was also unable to deliver when the instruction needs to be clarified. These include but are not limited to:

***“It would be useful to have more clarity on which parts were required to be C++, which parts were required to be Blueprints, and which parts you could do with either”***

***“I think having a conversation at the very start of the course about how we can all engage in the classroom space would be really useful.”***

Based on the above comments, it can be suggested that the inclusion of the teaching presence in Spike for the above subjects will potentially improve the course structure and boost the learning efficiency. With this strategy in mind, the teaching team has applied breakout rooms for small groups discussion during the ZOOM session in semester 1, 2020. We have also introduced Padlet as the online discussion forum for each group to develop the concepts, identify the tasks and instruction, and share the ideas of each Spike Plans between the members. Since all students' name are displayed on the screen, the contribution of each participant can also be acknowledged instantly during class time. These transitions have received great success on the formative feedback. One student describes her experience as:

***“I feel a bit surprise when the teacher knows and call my name on the class. I think people will be more conscious on the class since you never know when he is going to call you again.”***

Another student also compared the indirect experience received from his friend who took the same course in semester 2, 2019 with the online and blended learning model that was introduced in semester 1, 2020. He pointed out that:

***“I thought the class will be really dry as my mate took the same class last semester, but it turned out to be really fun and engaging. The private room is a good idea, at least I don't need to work alone.”***

This feedback provides strong supports of applying cognitive and social presences to the teaching presences for improving online learning isolation and learning efficiency, as stated by Carroll [10], a principle of effective teaching is by discussing questions and issues than simply being told.

#### C. Developing Formative Evaluation to The Blended Learning Environment

A systematic evaluation can be described as a quality control report, is an important strategy for maintaining robust online and blended subjects. An effective evaluation can be preceded by either formative or summative ways. Hattie [11] highlighted in his studies that formative evaluation is one of the best methods to improve the learning environment. He

suggested that consistent ongoing feedback should be provided for instructors or teachers to monitor their performance and student's learning progress during the period of teaching. These can be obtained through conducting a series of brief surveys between each module of a subject; consulting with the colleagues who have similar experiences; or inviting advance students to serve as mentors in contribution the opinions of learning and teaching activities [4]. Since most of the game development courses at the USC adopt summative evaluation as the way of gaining students feedback through eVALU8 in the university's centrally supported LMS - Blackboard, these approaches offer alternative and proactive solutions to improve in-person, online, and blended learning environment. For example, a small evaluation can be distributed between the quizzes of each section to prevent learning intervention. This will help teachers to make timely adjustments for their teaching and maintain a quality learning environment by identifying and addressing the concerns relating to the learning atmosphere as the below example, which was raised by a student at the end of semester 2, 2019:

***"I found it quite isolating being in the classroom. People got angry about their code a fair bit, and they would also talk a lot. If we can for example, telling people they can wear headphones for most of the class but not at the very start when instructions are given, telling people how they can speak and vent about their frustration with their code and stuff. I'm not sure. I generally enjoy the atmosphere of programming classes, but this one I continually felt very out of place and wasn't enjoying myself."***

Reeves and Reeves [2] purposed that "The potential of online and blended subjects is not merely to extend access to higher education, but to increase the effectiveness of the subjects". For reaching this expectation, the teaching team has decided to deploy the formative evaluation strategy into online learning structure during the teaching period in semester 1, 2020. The evaluation was deployed into two sections using Microsoft Forms at the end of each class. The first section was proceeded by multiple-choice, which focuses on the identification of the learning outcome. The second section consisted of two questions, which attempt to gain an overall learning experience of the class. The first question was a rating question ranging from 0 ~ 10, from very easy to very difficult focusing on the level of difficulty scale of learning content. The second question was an open-end question looking for student's feedback for the future improvement of the class. There was 14 feedback collected by 2 courses. The purpose of this feedback was to determine how the transition to technology-enabled learning and teaching has been experienced by our students.

The results of the second section were used by the teaching team to timely adjust the learning content and teaching style for the following classes and as the dataset for this study. Comments relating to the formative evaluation are:

***"These quizzes are just like the summary of the class; I don't think I need to take note anymore"***

***"Too easy, 10 questions in 10 seconds."***

***"It would be good to have some introduction on how to accept the invitation to join the group discussion room. I was failed to connect a few times."***

Some interesting feedback was also gained when the adjustments were taken place during the semester. For example:

***"I don't know the school really check this feedback. If so, perhaps I shouldn't write something random"***

#### IV. LIMINATION AND FUTURE STUDY

There are some limitations and challenges when conducting this study due to the transition of course structure affected by sudden COVID-19 pandemic. First, the data collection of this study for semester 1, 2020 was not completed. The online formative evaluation was taken place in week 4 after the decision made by the university to pause all coursework activities for a week to enable the redesign of face-to-face teaching and assessments to modes which do not require students' personal attendance on campus. As the workshops are designed to run 10 weeks in each course during the semester, the feedback of the first 3 weeks was not included in this study. However, since the authority has announced the arrangements of learning and teaching for Semester 2, 2020 will remain unchanged due to the uncertainty of the government regulation, a complete and comprehensive formative evaluation will continue to be deployed and the result will be monitored for further analysis. Second, the learning material was not converted completely to the online and blended mode due to the time constraints. Although learners can still access all materials via Blackboard, some online learning and teaching techniques were not deployed at the beginning of the transition, such as interactive whiteboard and Padlet. However, we believe that this limitation will be well-addressed in the coming semester.

#### V. CONCLUSION

Teaching and learning are an endless progressive process of discovery. This article provides the insight and solutions in creating and maintaining online and blended learning environment for the highly interdisciplinary subjects by investigating the current in-person teaching practice provided by the Bachelor of Design - Serious Game Design in the School of Creative Industries at the USC. Through this study, some interesting phenomena are revealed, first, according to the feedback, learners are more engaged with the online contents provided by blended mode than the traditional teaching method for the units which intend to provide intensive programming skills. Second, according to the response rate, students are more willing to contribute time for a series of short formative assessments than a long summative evaluation. With these explorations, it can be suggested that a well-developed interdisciplinary online and blended subject should carefully construct the leaning actives that aligned with the learning outcome for the more advance challenges; effectively maintain teaching presence by providing opportunities of exploring the agreement and disagreement of the subject topic, timely direct instruction, encouragement, and feedback; and constantly make timely adjustments by conducting formative evaluation in learning activities for ensuring the efficiency of their teaching.

## REFERENCES

- [1] R. Kelly, "Recommendations for Blended Learning Course Design," *Online Classr.*, pp. 1–3, 2011.
- [2] T. C. Reeves and P. M. Reeves, "DESIGNING ONLINE AND BLENDED LEARNING," in *University Teaching in Focus: A Learning-Centred Approach*, L. Hunt and D. Chalmers, Eds. Routledge, 2012, pp. 1–330.
- [3] C. J. Harrison, K. D. Könings, L. Schuwirth, V. Wass, and C. van der Vleuten, "Barriers to the uptake and use of feedback in the context of summative assessment," *Adv. Heal. Sci. Educ.*, vol. 20, no. 1, pp. 229–245, 2014, doi: 10.1007/s10459-014-9524-6.
- [4] T. C. Reeves and J. G. Hedberg, *Interactive Learning Systems Evaluation*, Illustrate. Educational Technology, 2003.
- [5] A. Cain, J. Grundy, and C. J. Woodward, "Focusing on learning through constructive alignment with task-oriented portfolio assessment," *Eur. J. Eng. Educ.*, vol. 43, no. 4, pp. 569–584, Jul. 2018, doi: 10.1080/03043797.2017.1299693.
- [6] Ü. Çakiroğlu and M. Öztürk, "Flipped classroom with problem based activities: Exploring self-regulated learning in a programming language course," *Educ. Technol. Soc.*, vol. 20, no. 1, pp. 337–349, 2017.
- [7] D. R. Garrison, T. Anderson, and W. Archer, "Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education," *Internet High. Educ.*, vol. 2, no. 2–3, pp. 87–105, Mar. 1999, doi: 10.1016/S1096-7516(00)00016-6.
- [8] T. Anderson, "How Communities of Inquiry Drive Teaching and Learning in the Digital Age," *Teachonline*, 2017.
- [9] C. J. Woodward, J. Montgomery, R. Vasa, and A. Cain, "Agile development spikes applied to computer science education," *Proc. 2013 IEEE Int. Conf. Teaching, Assess. Learn. Eng. TALE 2013*, no. August, pp. 699–704, 2013, doi: 10.1109/TALE.2013.6654527.
- [10] J. B. Carroll, "Presidential Address of division 15: On learning from being told," *Educ. Psychol.*, 1968, doi: 10.1080/00461526809528955.
- [11] J. Hattie, *Visible Learning - A Synthesis of Over 800 Meta-Analyses Relating to Achievement*, 1st ed. London, UK: Routledge, 2008.