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A BLENDED SCIENTIFIC COMMUNICATION COURSE FOR UNDERGRADUATE STUDENTS: ADDRESSING THE CHALLENGES POSED BY THE COVID-19 PANDEMIC

Abstract

In institutions of higher education, there seems to be a growing interest in blended learning courses, particularly at present to address the challenges posed by the COVID-19 pandemic. Although a multitude of studies are available on converting content courses to blended courses, very few studies focus on incorporating online learning into English for Specific Academic Purposes courses. This study describes a blended communication skills course on scientific communication for undergraduates that was transformed into a technology-enhanced learning (TEL) course as part of the university's initiative to incorporate online learning into its courses. More specifically, the objective of this paper is to explain how pedagogical practices were implemented in the blended course for optimal student learning and engagement using multimodal content and activities. It is hoped that this paper will provide some useful guidelines to practitioners on transforming traditional courses to blended courses that optimize student learning, especially in times when face-to-face teaching is disrupted.

Key words

blended courses, technology-enhanced learning, pedagogical practices, multimodal content, optimal student learning.

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1. INTRODUCTION

Blended learning is becoming increasingly popular in institutions of higher education. It is fast emerging as a new method of teaching and learning that combines the traditional face-to-face and modern online methods of course delivery to improve the learning experience. While blended learning is an integration of face-to-face and online learning, it can fall anywhere between the cline of a fully face-to-face course in a classroom setting to a fully online course where all the teaching materials and interaction are transferred to an online platform. There are many different types of blended courses such as the rotation, flex, self-blend, and the enriched-virtual courses (Staker & Horn, 2012). In the first type, students switch between the different learning modalities of blended, face-to-face and online tutoring; in the second, the content is taught online but it is supported by individually tailored tutoring; in the third, students augment their traditional courses with a few online modules; and in the fourth, students split their time between physical classes and remote learning. In institutions of higher education, there seems to be a preference for designing courses that not only retain significant elements of face-to-face learning but also supplement them with appropriate online elements.

Online learning has gained even more popularity in recent times due to the COVID-19 pandemic that has seriously affected our usual teaching approaches. Depending upon the severity of the pandemic in different parts of the world, educational institutions are either switching to fully online or blended courses. A fully online approach is employed in those locations where a lockdown has been imposed on citizens, whereas a blended approach is preferred in those places that are practicing staggered student attendance. The blended approach presented in this paper would be more suited to the latter situation in which students attend classes physically on some days of the week and remotely on others. Although the blended learning course described in this paper was planned and implemented in pre-pandemic times to optimize student learning through different modes, it has implications for the present situation. It addresses some of the challenges facing educational institutions, students, and teachers, with computer-mediated learning becoming the fallback method for continued education in the present educational landscape.

The sections that follow provide a contextual background for the present study by elaborating on definitions, theoretical models, and research on blended learning, before introducing the motivation and objectives of the study. The rest of the article describes the traditional course, its transformation from a fully face-to-face to a blended course, as well as the pedagogical implications of this transformation.

2. DEFINITIONS AND THEORETICAL APPROACHES TO BLENDED LEARNING

Blended learning has been defined in many ways. Some definitions have been criticized as they seem to apply equally well to fully traditional or fully online courses as in the case of Oliver and Trigwell's (2005) definition claiming that blended learning is a fusion of different pedagogical approaches, media and tools. Yet, other definitions have been denounced for being too general when defining blended learning as a simple mix of conventional and online methods (e.g. Graham, 2006) or overly specific when stressing that a substantial amount of time (i.e. 30 to 79%) should be spent on online activities (e.g. Allen & Seaman, 2010). To avoid a perception that blended learning is a haphazard mixing of traditional and online approaches, scholars like Bliuc, Goodyear, and Ellis (2007) and Alammary, Sheard, and Carbone (2014) have introduced the words 'systematic' and 'thoughtful' in their definitions to convey that the integration of classroom activities with technology-mediated online learning requires concerted planning and reflection. Bliuc et al. (2007), for instance, describe blended learning as follows:

> Blended learning describes learning activities that involve a systematic combination of co-present (face-to-face) interactions and technologically mediated interactions between students, teachers and learning resources. (Bliuc et al., 2007: 234).

This definition has also been rejected on the grounds that it is quite narrow and other definitions have been proposed that encompass the key ideas of blended learning being a pedagogically based process as well as a combination of face-to-face and online components, as indicated in the definition below:

> Blended learning courses are courses that: (1) thoughtfully integrate different instructional methods such as: lecture, discussion group, self-paced activity; and (2) contain both face-to-face and computer-mediated portions. (Alammary et al., 2014: 443)

Although there is a lack of a universally accepted definition, it has been suggested that the ambiguity involved in defining the term *blended learning* points to its untapped potential (Driscoll, 2002) and the possibility of new interpretations of the term based on curriculum planners' own course designs within institutional contexts (Sharpe, Benfield, Roberts, & Francis, 2006).

Corresponding with the various definitions of the term *blended learning*, specific conceptualizations have been proposed to disambiguate the concept of blended learning. These include the inclusive, quality, and quantity conceptualizations (Hrastinski, 2019). As the terms imply, the first conceptualization corresponds with those definitions that are very general (e.g.

Graham, 2006), the second with those that emphasize thoughtful planning (e.g. Alammary et al., 2014; Bliuc et al., 2007), and the third with those that focus on the amount of online content in a course (e.g. Allen & Seaman, 2010). Yet other conceptualizations suggested are synchronous and digital classroom conceptualizations, with the former referring to real-time online and face-to-face learning (e.g. Bower, Dalgarno, Kennedy, Lee, & Kenney, 2015), and the latter to an integration of digital technologies in the classroom (e.g. Çakır & Bichelmeyer, 2016). In the context of these conceptualizations, some scholars point out that blended learning is basically a fusion of different aspects of learning such as different contexts, goals, ideologies, modes and pedagogies of learning (Hrastinski, 2019; Oliver & Trigwell, 2005).

Apart from definitions and conceptualizations of blended learning, an attempt has also been made to propose different theoretical models and approaches for blended learning. One such model is the Community of Inquiry model with its components of cognitive presence, teaching presence and social presence as applied to online learning communities (Garrison, Anderson, & Archer, 2000). Central to this model is the belief that higher-order learning, whether face-to-face or online, takes place within communities with strong cognitive and emotional connections facilitated by a teacher. According to this framework, the three interdependent components are responsible for an effective and meaningful online learning experience for the student community. All three components need to be considered in the planning of an effective blended course.

Yet another model by Huang, Ma, and Zhang (2008) is a curriculum design model that focuses on the procedures involved in the pre-analysis, activity design, and assessment phases. At the pre-analysis stage, the suggestion is to analyze learner characteristics, learning objectives and learning environments to decide on the feasibility of using a blended learning approach. The next step is to plan the overall design, develop individual unit activities and organize resources appropriate for the online and classroom teaching contexts. The final step involves decisions about assessment of the learning outcomes focusing on formative rather than summative assessments. Furthermore, the activity model recommended for a blended learning activity has four phases for students: a 'lead-in' phase to learn about the activity, a 'planning' phase to prepare for the activity in groups, an 'acting' phase to complete the task, and a 'review' phase to share their work with others for feedback. In this model, the 'Virtual Learning Environment' with its learning support systems is in the middle and all the other components of lead-in, planning, acting and reviewing around it are dependent on it for content delivery and interaction. The current study also uses a phased approach with some overlap between the phases of the two blended learning models.

A blended learning model that is particularly interesting is Alammary et al.'s (2014) scaled model with a three-way classification of low-impact, medium-impact and high-impact blends based on changes made to existing courses. As the terms suggest, low-impact blends involve adding some online activities, medium-impact

blends involve replacing activities, and high-impact blends involve building the courses from scratch. Rather than making pedagogical judgements about the different types of blends, these authors share the benefits, challenges and recommendations related to each type of blend and suggest that before selecting an approach teachers take into consideration several factors such as their teaching experience, familiarity with technology, and institutional support. The advice given is that teachers should strive to move progressively from a low-impact to a medium- and high-impact approach as they gain more knowledge, confidence, and experience. This model is useful as it provides a scale on which blended courses can be placed, their design strategy explained, and their trajectory traced based on this three-way classification of blends.

3. RESEARCH ON BLENDED LEARNING AND RESERCH OBJECTIVES

Many common research trends on blended learning have been highlighted by researchers through structured literature reviews on the topic. A systematic web-based study by Torrisi-Steele and Drew (2013) revealed that there are three main categories of research focusing on students, academic practice, and case studies, though there are overlaps in these categories. The first category covers research related to students' responses (attitudes, perceptions, preferences, etc.) to blended courses, including research on student experience (Holley & Oliver, 2010; Lust, Vandewaetere, Ceulemans, Elen, & Clarebout, 2011; Mitchell & Forer, 2010; Salamonson & Lantz, 2005) and learning performance (Heba & Nouby, 2008; Hsu & Hsieh, 2011; Vernadakis, Antoniou, Giannousi, Zetou, & Kioumourtzoglou, 2011). The second category deals with factors that are barriers to adopting technology, strategies for facilitating adoption and professional development/support required for the implementation of blended courses (Brooks, 2010; Davis & Fill, 2007; Keengwe, Georgina, & Wachira, 2010; Kistow, 2009; Marek, Sibbald, & Bagher, 2007; Ocak, 2011; Thompson, Jeffries, & Topping, 2010). The third category involves both broad institutional level (Engert & von Danwitz, 2004) or programme level case studies (Salmon, 2000; Salmon, Nie, & Edirisingha, 2010) and technology-driven assessment of courses, specific tools and strategies (Luchoomun, McLuckie, & van Wesel, 2010; Purvis, Aspden, Bannister, & Helm, 2011; Shih, 2011; Wyllie, 2011). The course-specific case studies are mainly concerned with advantages of blended learning (e.g. flexibility, pace, and access) and the use of online tools (e.g. blogs, Wikis, learning management systems and online platforms). Yet other studies focus on the use of blended learning for addressing existing course challenges such as large classes (Shen, Wang, Gao, Novak, & Tang, 2009) and for improving certain discipline-specific competencies (Uren & Uren, 2009).

Although a multitude of studies are available on the advantages, approaches and tools of blended learning courses, very few studies focus on a blended course that incorporates online learning into an English for Specific Academic Purposes (ESAP) course in higher educational settings, especially in the Southeast Asian context. As for existing case studies on blended learning, they tend to be context and course specific and as such, may not be generalizable to courses in other institutions. The objectives of this paper therefore are: (i) to describe the phases involved in transforming the undergraduate scientific communication course into a technology-enhanced learning (TEL) course at a Singapore university, and (ii) to discuss the pedagogical issues taken into consideration in the course design to ensure optimal student learning and engagement. One important motivation for the blended learning course was to ensure that the curriculum of the scientific communication undergraduate course could be completed within the stipulated 24 hours. Initially, the course was a three-credit course spanning 36 hours, with 12 hours of lectures and 24 hours of tutorials. However, the credits were reduced to two, with a corresponding decrease of 12 hours in the duration of the course. In this condensed course, blended learning seemed to present a perfect solution as it would not only enable the course designers to make up for lost time but also offer them an efficient way of covering the course content.

The scientific communication TEL course took the form of a microsite on the Blackboard platform called *NTULearn*, to complement face-to-face teaching. Developing this microsite involved behind-the-scenes collaboration between various stakeholders – the communication skills faculty, science professors, the university's IT department and external content developers. As blended courses are fast becoming the standard offer at educational institutions, it is hoped that this paper will provide instructional designers and faculty with some guidelines on transforming traditional face-to-face communication skills courses into blended courses that make student learning more effective and enjoyable. The next section describes the scientific communication course as the microsite was developed to complement this course.

4. DESCRIPTION OF THE TRADITIONAL COURSE

The undergraduate scientific communication course (HW0128 Scientific Communication I) was developed at the language center in the university. It is a one-semester, two-credit, foundation course for science students in the School of Biological Sciences (SBS) and School of Physical and Mathematical Sciences (SPMS). The aim of the course is to enhance students' ability to recognize and employ the conventions used by scientists in their fields for communication in academic settings. In this course, the emphasis is on micro-skills in scientific communication, such as using appropriate scientific language, searching academic databases, critically reading scientific texts, citing from sources, composing scientific

arguments and making effective presentations. A course guide was developed for this course, which contains important information on the course schedule, content, tutorial activities and assignments (Bolton et al., 2019). It has the following six units:

Unit 1: Writing for a specialist/non-specialist audience
Unit 2: Reading scientific texts critically
Unit 3: Searching databases and writing from sources
Unit 4: Composing scientific arguments
Unit 5: Writing and revising a review paper
Unit 6: Defining and explaining scientific concepts

The study units have a common format consisting of: Introduction, Learning outcomes, Content (including activities), Summary, List of references, and Appendix (where necessary). The citation conventions used in these materials follow the CSE style format as it is a common format used across science disciplines. The materials have been designed to enable students to communicate effectively in academic settings, using internationally acceptable standards of English in terms of structure, style and expression.

There is no end-of-semester examination for this course; continuous assessment is used for student evaluation instead. It was felt that this mode of assessment is particularly suited for communication courses as it takes into account the development of students' skills in written and oral communication throughout the semester. The assignments include written assignments (Annotated bibliography and Review paper), individual presentations (Presenting a key scientific issue/concept), and class participation (including microsite activities). These assignments focus on the course objectives of imparting basic foundation skills in scientific communication to students such as reading critically, writing from sources and presenting arguments effectively.

5. COURSE MICROSITE

In line with the university's direction for more technologically integrated learning, the three authors, as curriculum developers of the course, transformed the *Scientific Communication I* course into a TEL-blended course in 2017-2018. The outcome of this project was an interactive microsite comprising narration, video recordings of interviews with professors as well as activities, all of which complement the course content set out in the course guide. The entire project lasted about a year and involved three phases – the preparatory phase, materials development phase, and the implementation phase.

5.1. Preparatory phase

The curriculum developers from the language center met with personnel from the university's Centre for Information Technology Services (CITS) and the designated external vendor Hewlett-Packard Enterprise (HPE) Education Services to discuss the microsite activities and filming of the anchor videos and interviews with the science professors. During the initial meetings, the curriculum developers conveyed the main curricular directions and requested that the content be organized according to the units outlined in the prescribed course guide (Units 1 through 6). To make the microsite interactive, they also suggested integrating into the microsite the anchor videos, video clips of interviews with the professors as well as online activities. The first two authors prepared and emailed the online content for the six units to HPE who incorporated it into the microsite. The third author, who is also the anchor, focused on the filming of the unit introductions as well as interviews with the professors for three of the units. Throughout the entire project, the first two authors gave feedback to HPE on the microsite, requesting relevant changes to improve it.

5.2. Materials development phase

5.2.1. Anchor videos and interviews

Each online unit of the course is introduced with a short video lecture, which conveys the unit's key concepts and prepares students for the related activities. Once the authors had determined the topic, activities and overall content for each unit, a script of each lecture was prepared and given to HPE. In consultation with the anchor, HPE arranged for a film crew and recording site, and created storyboards for each lecture, including transitions and supplemental animations to be inserted during green screen filming. As seen in Figure 1 below, the use of the green screen allowed the anchor to seem to interact physically with these animations, achieving a higher level of interactivity than that afforded by standard visual aids in a typical face-to-face lecture. During filming, the animations were displayed on a monitor, allowing the anchor to choreograph appropriate movements while delivering the lecture. While a script was prepared for planning and filming purposes, each lecture was delivered extemporaneously to allow for a more conversational tone. Several takes of each lecture were recorded and spliced together in postproduction, during which subtitles were also added. The videos were edited for length by removing content that was not directly related to the learning objectives and activities of the units and subsequently, the clips were interwoven sequentially into openings for the different units. Captions and sub-titles were included in the videos to make the content accessible to first-year

undergraduate students, foreign students whose first language is not English, and students with special needs.

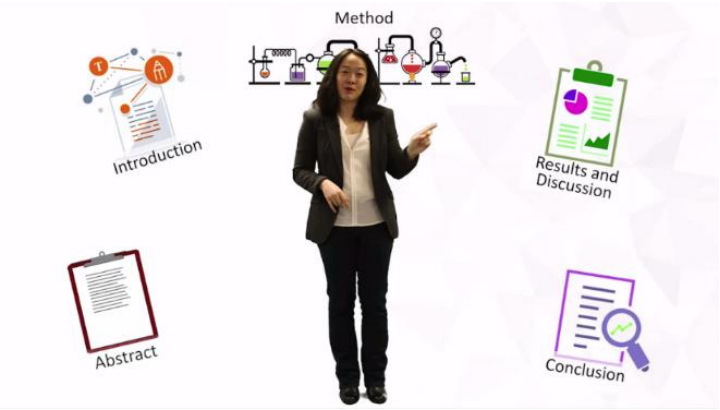

Figure 1. Video still from anchor video of Unit 2: Reading scientific texts critically

Interviews with three professors from SBS and SPMS were also recorded for students to view. The rationale behind this was to allow students to hear directly from scientists in their disciplines about real concerns scientists must consider when communicating for and about their work. Before filming, a list of questions was prepared to elicit conversation about specific communication concerns related to three units, namely Unit 1: Writing for a specialist/non-specialist audience, Unit 4: Composing scientific arguments, and Unit 6: Defining and explaining scientific concepts. Table 1 below gives an example of some of these questions. While certain concepts were pre-identified as important for each unit, the exact outcome of each interview was not predefined or scripted. This was to ensure a certain spontaneity and naturalness in the interviews. Unstructured interviews allowed for more authentic responses, but this also required more postproduction editing of the footage, which although abundant, was not always suitable for the purpose of the course. Of the three interviews, for example, only two were found to be appropriate for first-year science undergraduates. Snippets from these two interviews were later excerpted and spliced together to form three subtitled videos, one for each unit.

Unit 1: Writing for a specialist/non-specialist audience
1. What is the role of scientific communication in today's world?
2. How does scientific communication differ from everyday communication?
3. Why is it important to communicate scientific research to different audiences (experts and non-experts)?
4. What are the key differences between scientific communication addressed to experts and non-experts?
5. Could you highlight some key differences between scientific writing and presentations?

Table 1. Sample list of interview questions for Unit 1

5.2.2. Background information on topics and activities

As mentioned earlier, the microsite units are aligned with the units in the prescribed course book. Students are informed about the microsite in the opening section of the course book as part of the course description and the microsite follow-up activities in the course book are indicated by an appropriate symbol as shown below:

> This course has a microsite that is accessible through the main course site on *NTULearn*. The microsite complements the six units in this course guide and is an integral part of this course. You are required to watch the videos and attempt the activities in the microsite before coming to class as there will be a discussion of these in class. In this course guide, the microsite follow-up activities are indicated by this symbol  . (Bolton et al., 2019: 1)

Unit 1 covers the topic of 'Writing for a specialist/non-specialist audience', and one of the key objectives is to identify the salient differences between scientific writing and speech. To this end, the microsite activity requires the students to watch a YouTube video of a scientific documentary. Subsequently, they have to complete an activity by indicating the presence or absence of a list of linguistic features (contracted forms, long and complex sentences, passive voice, phrases, references to the scene, repetitions, short sentences, subjective language, and use of questions), and note down some specific examples. This task raises student awareness about changing their communication style according to different communication modalities.

Unit 2 focuses on the topic of 'Reading scientific texts critically' and contains two activities. The first activity 'Reading a text closely' imparts the lesson of reading and making careful judgements. Students read a short passage and are asked to choose a 'tick', 'cross' or '?' next to a statement of observation to indicate whether it is true, false, or unclear, respectively. The next activity 'Identifying the different sections of a journal article' requires students to read various excerpts from a journal article and match them to the research article sections of 'Introduction', 'Methodology', 'Results', 'Discussion', and 'Conclusion'. This activity aims to increase the students' awareness of the genre of the research article (RA), which they will read for their two written assignments for the course.

A key writing skill that students need to master at the university is learning how to incorporate published material into their writing. This is the overarching aim of Unit 3 'Searching databases and writing from sources' and it has three activities. The first two activities require students to select a tick or a cross next to statements on academic practices and the citation of information. The third activity requests students to sequence the three specific steps involved in paraphrasing information, a skill that they will be using for their first assignment on the 'Annotated Bibliography'.

Unit 4 introduces students to scientific argumentation, based on the Toulmin model of argumentation, a common framework used in the sciences (Toulmin, 2003). The components of the Toulmin argumentation model (Claim, Qualifier, Grounds, Warrant, Backing and Reservation) are provided alongside their descriptions in the microsite. Students are subsequently asked to watch a YouTube video clip of a song and identify the various components in the song lyrics containing spurious scientific information. This activity functions as a light-hearted precursor to their tutorial activities of identifying logical fallacies in scientific arguments and using an appropriate argument structure when developing their own scientific arguments.

Unit 5 covers the topic of 'Writing and revising a review paper'. The three microsite activities centre on revising and editing skills. This microsite unit first introduces students to some common cohesive devices (anaphoric references, paragraph linkers, repetition of keywords, and signal markers). Subsequently, the three activities focus on asking the students to identify cohesive devices, signal markers, and appropriately revised statements from a list. These activities help students to refine their writing for their second assignment on the review paper.

The final unit, Unit 6, 'Defining and explaining concepts', aims to help students write and present scientific concepts effectively. Activity 1 draws students' attention to the basics of presentation slide design (e.g. font type, font size, layout) and the meaningful use of animation (e.g. using the zoom animation to illustrate the concept of growth). The second activity introduces students to the various paralanguage features of 'articulation', 'engagement', 'fluency', 'gestures', 'pace', and 'volume'. The aim is not only to raise students' awareness about the importance of delivery features in presentations but also to encourage them to apply these to their own and their peers' presentations in Assignment 3 'Oral Presentation'.

5.3. Implementation phase: Integration with face-to-face teaching

The abovementioned elements of anchor videos (all units), interviews with professors (Units 1, 4, and 6), and microsite activities complement the face-to-face classroom teaching. In the face-to-face teaching of *Scientific Communication I*, the instructor is expected to cover the classroom activities in the prescribed course guide. For the microsite, students are told by the course coordinator and instructor through online and classroom announcements that they are expected to watch the microsite videos, complete the activities and be prepared to discuss them in class according to the course schedule (see Table 2). The anchor videos provide students with an interesting preview to the topics and highlight some key points while the videos showcasing interviews with professors illustrate how scientific concepts are applied in the real world. The microsite prepares the students for the

more detailed activities in the course guide and this is demonstrated in the context of Unit 1.

Unit	Tutorial topic	Microsite	Assignment
1	Writing for a specialist/non-specialist audience	Anchor video, interviews with professors & an activity	
2	Reading scientific texts critically	Anchor video & activities	
3	Searching databases and writing from sources: - Searching academic databases - Writing from sources	Anchor video & activities	Assignment 1: Annotated bibliography
4	Composing scientific arguments	Anchor video, interview with professors & an activity	
5	Writing and revising a review paper: - Writing a review paper - Revising a review paper	Anchor video & activities	Assignment 2: Review paper
6	Defining/explaining scientific concepts: - Written communication - Oral communication	Anchor video, interview with professors & activities	Assignment 3: Oral presentation

Table 2. Course schedule showing tutorial topics, microsite activities and assignments (Bolton et al., 2019: 2)

Unit 1 centers on writing for a specialist or non-specialist audience. The microsite anchor video provides an overview to the unit, showing that learning how to write and speak about the sciences is equally important as learning science and that many famous scientists were eloquent writers and storytellers. In line with this overarching message, the professor from SPMS also highlights how it is vital to use the right register of communication according to whether the audience consists of experts or laymen. These videos align well with the opening activities (Activities 1.1 and 1.2) during the face-to-face tutorial, which focus on comparing the language features in two extracts, one taken from a medical website and the other from a research article. As such, the microsite videos prime the students for the main tutorial activities.

In addition, students are also expected to submit a saved PDF file of the completed microsite activities to a folder in *NTULearn*, which contributes partially to their class participation grade. The microsite activities are meant to be

completed before the relevant lesson and students are prompted to be ready to discuss their answers in class. When a globe-with-arrow icon appears alongside the words 'Microsite activity' in the Student's Course Guide, it indicates a suitable juncture where the instructor could discuss the microsite activity in class. For example, the microsite activity on 'Identifying language features in a documentary' appears after the abovementioned Activities 1.1 and 1.2, giving students an opportunity to discuss and clarify their doubts on the topic with the instructor.

Microsite activity

Identifying language features in a documentary

Before the class, you will have watched Michio Kaku's BBC documentary on Time and attempted the microsite activity. Be prepared to discuss your answers in class by providing specific examples of language features used in the documentary. Indicate whether the video is aimed at a specialist or non-specialist audience.

(Bolton et al., 2019: 11)

The microsite activities serve as a versatile tool, blending well with the classroom teaching. In Units 1 and 4, students are required to watch YouTube videos and complete some thought-provoking activities before class. Watching the video beforehand frees up classroom time, enabling tutors to focus on class discussions on the topic. At other times, microsite activities can serve as intriguing lead-ins to the unit proper. Unit 2, for instance, begins with a microsite activity which features a short fictitious incident and questions to test students' comprehension and reading skills. Before delving into evaluating academic texts critically in the tutorial, this activity serves the purpose of showing students, in a light-hearted manner, how ambiguities in a text can influence comprehension. The microsite activities in the blended course serve as an interactive yet meaningful learning experience as well as complement the more serious content work required during the tutorial activities.

6. BLENDED COURSE DESIGN AND PEDAGOGICAL ISSUES

The blended learning course that was designed for the science undergraduates was thoughtfully planned by taking into consideration the input of the curriculum planners, IT personnel and the content developers. In technology-related projects, there can be an inadvertent tendency to let the technology take center stage; however, the project team worked toward making the microsite student-centered with accessible scientific content as well as a clear presentation of ideas.

The five-step process involved in the planning of this course included (1) selecting an appropriate design; (2) integrating face-to-face and online learning; (3)

combining different modalities and task types; (4) providing stress-free online assessment; and (5) obtaining feedback from users. These key aspects along with the specific learnings will be elaborated in the following sections.

6.1. Selecting an appropriate design

The course materials for the scientific communication course were designed in 2013 and the course was offered to students in Academic Year 2014-2015 for the first time as a face-to-face course of 24-hour duration, with 2-hour classes held weekly. Prior to this, the course was a 36-hour course with a lecture (one-hour weekly) and tutorial (two-hour weekly) format. The plan was to introduce online learning to make up for the loss of 12 hours. However, this could not be achieved initially as there was a schedule for transforming courses into technology-enhanced courses and the scientific communication course was second in line for this transformation. As the curriculum team was aware of this, the materials were designed in such a way that certain activities would be ready for migration to the online platform in the future. As the team intended to transform the course into a blended course from the design phase itself, the activities were aligned to the overall course and specific unit objectives/outcomes from the outset, and the microsite activities were also designed in advance for migration to the online platform at a later date. Due to this advance planning, the course actually falls between a medium-impact and high-impact blend based on Alammary et al.'s (2014) three-way classification of low-impact, medium impact and high-impact blends.

As for the choice of platform, the university's IT department and the external vendors shared several options with the curriculum team, some of which had been implemented in different departments at the university. The curriculum team made an informed decision to adopt the *NTULearn* platform for two specific reasons: one was to be consistent with the microsite platform used by the engineering communication course, and the other was to ensure that students had easy access to the microsite as it was housed in the main course site of the scientific communication course (see Figure 2). This enabled the curriculum team to present a consistent and cohesive image for the online components of our courses at the language center.

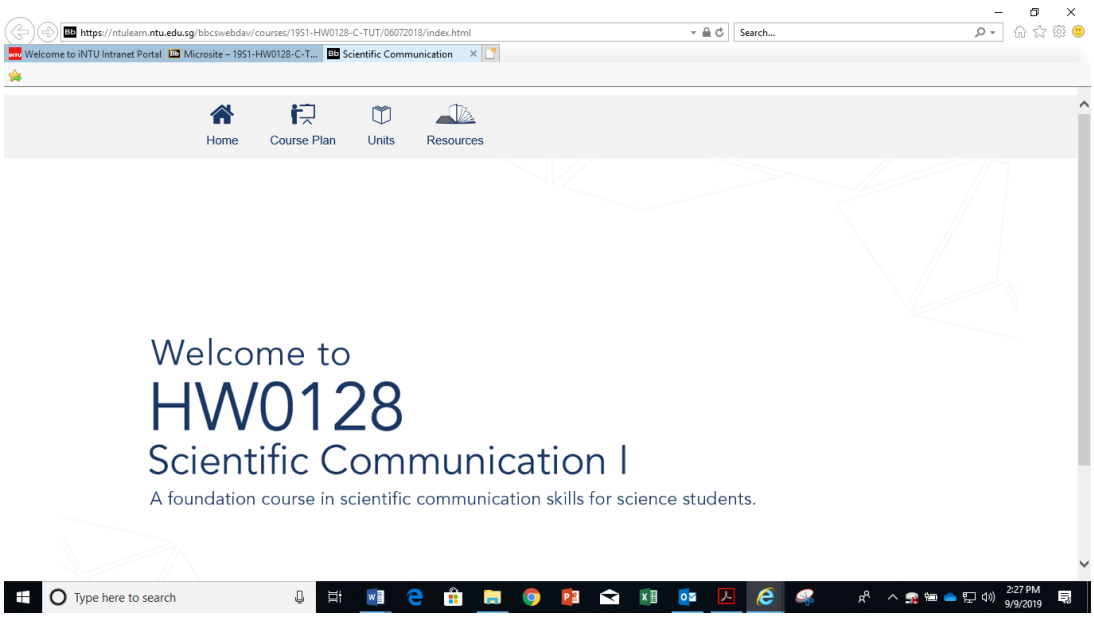

Figure 2. Screenshot of the course microsite

6.2. Integrating face-to-face and online learning

In defining blended learning, some scholars have defined it in terms of the amount of time spent online and others have cautioned that a low-impact course which only adds online work to a traditional course without reducing in-class time leads to the risk of producing two separate courses – one of which is online, and the other, face-to-face. Others have proposed that for a course to be truly blended, the course should mix face-to-face learning (space of learning) as well as synchronous and asynchronous activities (time for learning) so that the two characteristics of space and time complement each other and promote learning (Singh, 2003). Expanding on this, Osorio Gómez and Duart (2012) propose a teaching-learning continuum which reflects a continuity of space-time, where face-to-face and online learning activities are delivered in such a way that they add value to each other in a continuous process to meet the learning outcomes of the blended course.

Following this concept of blended learning, the scientific communication course attempted to integrate the online activities with the face-to-face activities by informing the students about the online platform, the course microsite, in the first face-to-face class as well as in the course guide. In addition to this preliminary note and course schedule (see Table 2) in the introductory course description, students are also prompted at appropriate places in the microsite and the book units to be prepared to discuss the microsite activities in class. Furthermore, detailed answers to the microsite activities and discussion points are provided to the tutors in the Teacher's Course Guide. As the course guide has six units, the microsite was

planned in such a manner that there was at least one online activity that complemented each of the units and was specifically designed to align with the topic and learning outcomes of each unit. This enabled a smooth integration of online activities into face-to-face classroom discussions in a continuous process to achieve the learning objectives of the course.

6.3. Combining different approaches, modalities, and task types

Another characteristic of blended courses highlighted by scholars is the multifaceted nature of these courses in terms of technology, modalities, and teaching approaches. Driscoll (2002) in particular identified that blended learning combines different modes of web-based technology, pedagogical approaches, and instructional technology for optimal learning outcomes. In the scientific communication course, an attempt was made to combine both in-class collaborative and self-paced online activities using different modalities such as anchor videos, interviews with science professors, scientific documentaries, PowerPoint slides and excerpts from texts to accomplish the course objectives. The classroom and online activities were also varied in terms of activity type, including different formats ranging from closed-ended questions such as fill-in-the-blanks, true-or-false questions, multiple-choice questions and sequencing tasks on the microsite platform to open-ended discussions of these in the classroom environment. As mentioned earlier, some of the microsite activities functioned as precursors to concepts covered in the classroom whereas other activities provided opportunities for reflection on important concepts. These variations in classroom and online activities are particularly useful for engaging students and optimizing their learning as well as providing alternative paths for learning according to their preferred modes of learning.

6.4. Providing stress-free online assessment

Assessment plays an important role in blended courses as it is instrumental to student participation, ownership and motivation (Gerbic, 2009). However, it is essential to strike a balance between learning and assessment in an online learning environment so that students do not feel unduly pressured to obtain high grades. Since the students have an unlimited number of attempts at obtaining the correct answers in the microsite activities for the scientific communication course, it is not a high-stakes or face-threatening learning setting. The microsite activities focus on participation and getting the students engaged with the learning, rather than on scoring high marks. It should be noted that for all the microsite activities (except for incorporating an animation in Unit 6), students can input their answers and check them upon completion, against the answers stored in the system. They can

also attempt the activities for an unlimited number of times. The only course requirement is that students attempt all the microsite activities and the grading is based on the completion of tasks rather than on correct answers. The completion rate of the microsite activities has been generally high through the semesters, indicating that the microsite activities provide an accessible and interactive pedagogical means by which instructors and students are able to enrich their teaching and learning of scientific communication skills.

6.5. Obtaining feedback from users

Any attempt at course design is incomplete without feedback from students and faculty. Feedback on a course can be gathered at various stages of course development whether it is before completion, during its pilot run or at the end of the process. A review of literature shows that feedback surveys have been conducted in many past studies to obtain student responses on their experience with blended courses (e.g. Holley & Oliver, 2010; Lust et al., 2011; Mitchell & Forer, 2010; Salamonson & Lantz, 2005). For the scientific communication course, feedback was collected from students and tutors after completion of Unit 1 of the microsite. This unit was piloted before designing the other units and feedback was collected from our students using a pre-unit and post-unit survey (see Figure 3) as well as from tutors by means of a discussion on the microsite.

The questions in the pre-unit survey focused on obtaining student responses to their past experiences and thoughts about online learning whereas the post-unit survey questions were more specifically related to the current online platform, technology used, delivery of content and follow-up activities. Two open-ended questions were also included to find out what respondents liked most about the online content as well as what their suggestions were for improvement. In preparing the microsite activities for the five remaining units, suggestions from students and tutors were incorporated into the course design by the IT personnel, curriculum designers and content developers.

Based on feedback received from the stakeholders, including curriculum developers, students, teachers, and the departmental head, the following improvements were implemented on the microsite:

- The videos were split into three separate clips of under 5 minutes to appeal to millennials with limited attention spans. While the anchor videos served as introductions to the activities in each unit, the interview videos with the professors from the two major science divisions at the university were placed in the opening of each unit to capture the interest of students from these divisions.

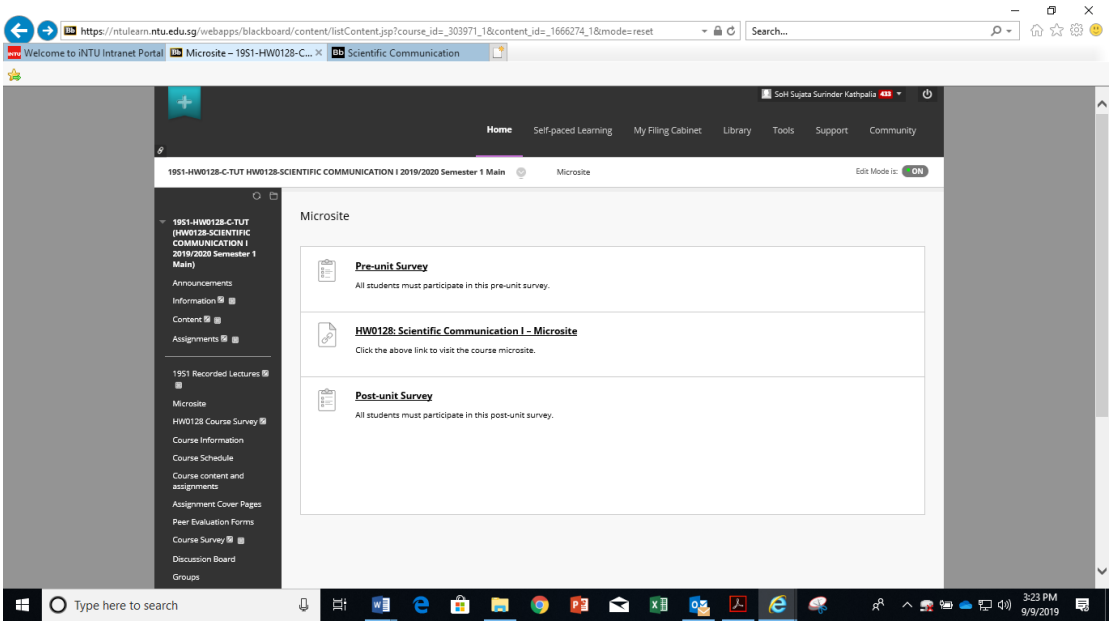

Figure 3. Screenshot of the microsite survey page

- The interview videos with the professors were edited to ensure that the content addressed the learning objectives of the unit and matched the activities in the microsite units; any superfluous content that did not match the topic of the unit was therefore deleted.

- External content was replaced by original content for the activities to ensure originality and continuity, particularly to overcome the problem of discontinued content and videos on the internet.

- The textual content in the microsite was edited to make it reader-friendly and inclusive.

- Some images were replaced to ensure that they matched the content and conveyed meanings clearly and consistently. The overuse of animation, colours and images was reduced to ensure that slides do not have the opposite effect of distracting students.

- Captions and notes were included in the videos to make the content accessible to first-year undergraduate students, foreign students whose first language is not English and students with special needs.

- An answer key was included for all activities with closed-ended questions to promote independent self-regulated learning and preparation for the face-to-

face classes. To facilitate access to answers, a downloading function was enabled so students could bring their answers to their classes for discussion and upload them in a folder on *NTULearn* for grading purposes.

- To encourage stress-free student participation, a small fraction of the course marks was awarded to students for completing the microsite activities rather than for correct answers.

These amendments improved the overall quality and effectiveness of the course microsite and promoted a high degree of participation from the students with respect to attempting the activities as well as contributing to classroom discussions of these in the blended course.

The five-step process is highly recommended to curriculum planners keen on transforming traditional face-to-face courses to technology-enhanced courses. The learnings from this section on the scientific communication blended course reveal that there is no perfect course design for a blended course but curriculum planners need to make decisions about different aspects of the course depending upon the course objectives, needs of the stakeholders, and demands of the situation. What is proposed is to select a course design that integrates face-to-face and online learning by using a variety of learning approaches, modalities and tasks depending upon institutional goals and technological support. Furthermore, the course should incorporate assessment that promotes learning and the course activities should be planned or redesigned based on feedback that is collected periodically from the end users. A good strategy is to pilot online components of a blended course at some stage of the designing process. The learning from the pilot run is usually invaluable as it enables course designers to preempt problematic issues and fix them before implementing the blended course. As for specific choices related to integration strategies, learning approaches, modalities, and tasks, these can be changed from one course to another depending on the learning context.

As for the implementation of a blended learning course, there could be many challenges for students, teachers, and educational institutions (Rasheed, Kamsin, & Abdullah, 2020). From the students' perspective, these challenges could take the form of a lack of self-regulation, technological literacy and competency, access to technology, and/or experience with technological complexity. As for teachers, they may have to overcome issues related to technological literacy and competency, technological operationality as well as their anxiety about technology. Educational institutions therefore play a critical role when courses are transformed from traditional to technology-enhanced courses. Institutional support is particularly important for the success of these courses and should take the form of providing relevant technology, training students and teachers, and hiring personnel for seamless technological implementation and operation. As blended learning becomes the new normal, both students and teachers need to be trained to use new technologies and be willing to invest time and effort into learning these

technologies. Furthermore, their training needs to be context-specific as blended courses are configured differently even within the same department. Similarly, technological resources and tools tend to be unique to institutions and require resource-specific technicians for their smooth application.

7. CONCLUSION

This paper describes how an undergraduate scientific communication course was transformed into a blended course by developing a microsite that complements face-to-face teaching. Developing this microsite for the blended course on the *NTULearn* platform involved behind-the-scenes collaboration between various stakeholders – the communication skills faculty, science professors, the university's IT department and external content developers. In this article, the preparatory, materials development, and implementation phases are described, and information related to course design, format, multimodal activities, assessment, and feedback is discussed in detail. This article highlights the message that there is no perfect course design for blended learning, but course designers have to adapt their strategies depending upon the course objectives, needs of the stakeholders, and the demands of the situation.

Although each course is unique, it is hoped that this article will provide instructional designers and faculty with some useful guidelines on transforming traditional face-to-face communication skills courses into blended courses that make student learning more effective and useful, especially in difficult times. Apart from optimizing learning in normal times, blended learning will be able to come to the rescue of students, teachers, and educational institutions during epidemics or other natural disasters when in-class education is either disrupted or comes to a complete standstill. In such situations, students, teachers, and educational institutions need to be prepared in advance with skills, tools, and infrastructure necessary for the smooth operation of online learning.

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