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You can teach old dogs new clicks - the importance of teacher use of online content in a blended higher education course in Singapore

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Abstract

Lecturers and teachers teaching in blended learning courses have myriad teaching strategies to employ and various online and face-to-face content at their disposal. There is still much we can find out about what and when to blend online and face-to-face components. In this study, we investigated the effects of the lecturer's synchronous use of online content in the physical class on the subsequent asynchronous online participation and performance of higher education students. We found that the teacher's use of the online content in the physical class has a positive effect on students' subsequent online participation out-of-class. The results illustrate that intentional and integrated online and face-to-face components have positive impacts on students' engagement and online participation. The results have implications for teachers, course designers, learners, and researchers of higher education blended courses.

1. Introduction

Blended learning is coming into a new era of understanding as a pedagogical strategy in its own right with numerous research studies and their meta-analyses being conducted (Bernard et al., 2014; Means et al., 2013). With the increasing adoption of blended learning year-by-year this century (Bliuc et al., 2011; Levy et al., 2011; McFarland et al., 2019; Means et al., 2013) and the most recent proliferation owing to the global impacts of COVID-19 (Crawford et al., 2020) the need for empirical research on the teacher and learning outcomes, student engagement and media mix of blended learning courses is an essential emerging body of literature (Surjono et al., 2019; Tham & Tham, 2011).

Blended learning is broadly defined as the systematic combination of online (web-based, internet) and face-to-face teaching and learning (Garrison & Kanuka, 2004; Bonk & Graham, 2006). There have been discussions about the definition relating to aspects such as the percentage of time spent in each mode in order to constitute as "blended" (Bernard et al., 2014), instructional methods, and media used (Bonk et al., 2006). As such, the integration of the online and established classroom pedagogies necessarily distinguishes blended learning from other mixed teaching and learning methods that may have embraced a variety of offline resources and myriad instructional methods (Bliuc et al., 2007).

Generally, literature on both student participation in online and blended learning, like educational technology literature (Bulfin et al., 2014), is wide-ranging in focus and methodology, answering Garrison et al.'s (2004) call to "explore the impact of blended learning in achieving more meaningful learning experiences" (p. 104). Investigations into the impact and quality of blended learning typically involve evaluating students' performance outcomes and academic achievements (Bernard et al., 2014; Akçayır & Akçayır, 2018; Surjono et al., 2019), the level of collaboration and interaction between learners (Borokhovski et al., 2016), and students' learning experience and engagement (Bliuc et al., 2007). It is perhaps not surprising to find that pedagogically sound blended course designs and intentionally designed activities that promoted collaborations can have positive effects on the abovementioned student outcomes (Bernard et al., 2014; Bliuc et al., 2007; Borokhovski et al., 2016; Bower et al., 2015). However, researchers call for further research on finer grain details, particularly in regards to "what mixes of classroom instruction and online conditions produce both deep and meaningful learning and more satisfying educational experiences" (Bernard et al., 2014, p. 116).

The purpose of this study is to find out what impacts the online participation and results of students in a blended economics unit. The study compares two groups enrolled in a blended learning course with access to online materials. During the physical face-to-face classroom lesson, the lecturer incorporated online materials synchronously for the experimental group, but not for the control group, although both groups had access to online materials and a scripted instruction to use them out-of-class asynchronously. The central Research Questions (RQ's) are:

RQ1: In a face-to-face (F2F) blended class, what is the effect of the teachers' use of online content in a physical classroom, students' gender and students' age on students' use of online content after the physical class?

RQ2: In a face-to-face (F2F) blended class, what is the effect of the teachers' use of online content in a physical classroom, students' gender and students' age on students' performances?

In an earlier study, Harris and Fu (2018) found a positive correlation existed between teachers' use of online content in the physical class and students' ages and their self-stated on-task time online. That study was based on a survey of students (n = 1,047) and used a Pearson Chi-squared test of independence to show that associations between the variables existed, but could make no claim to causality. Furthermore, the use of self-stated time online and self-stated understanding as dependent variables were not validated against analytics from the Learning Management System (LMS). This current research study is a follow up, using LMS analytics about students' online participation and their post-examination results.

2. Literature review

Defining blended learning

This research defines blended learning as the systematic combination of online (web-based, internet) and face-to-face teaching and learning (Garrison et al., 2004). As such, the "co-presence of the internet and established classroom forms" (Friesen 2012, p. 1) and the careful planning of same necessarily distinguishes blended learning from other mixed teaching and learning methods that may have embraced a variety of offline resources and myriad pedagogies (Masie, cited in Bonk et al., 2012). Indeed, this paper and the literature maintain the narrower definition of blended as planned combinations of online, both synchronously and asynchronously, and face-to-face teaching and learning for the one unit or course (Bliuc et al., 2007; Garrison et al., 2004; Garrison & Vaughan, 2008).

Scholars first held up blended learning as a solution to 'nullifying the lacunae' (Pillay & James, 2013, p. 255) of its two constituent pedagogical approaches: purely online and purely face-to-face (Rogers, 2001). In the case of online, researchers find the form lacked variously interaction, teacher feedback and assurance (Brown, 1996; Masie, cited in Bonk et al., 2012). Conversely, scholars question the relevance, efficiency and effectiveness to meaningful learning experiences of the traditional institutional lecture (Garrison et al., 2004; Heterick & Twigg, 2003; Schweizer, 2004; Twigg, 2003). Against this backdrop, Friesen (2012, p.1) advocates the ever-increasing array of opportunities resulting from this evolution for blended learning designers as the "range of possibilities presented by digital media." Bonk et al. (2012) further asserts that these possibilities could increase access to, flexibility and cost-effectiveness of blended courses, claims well supported in the literature (Harris, 2016; Levyet al., 2011; Van de Bunt-Kokhuis & Weir,

2013). However, Bonk et al.'s claims to the improvements to pedagogy found in blended learning courses are contested, particularly when compared to purely face-to-face courses and are also under-researched in Asia (Ferguson & Tryjankowski, 2009; Shimizu et al., 2019; Tham et al., 2011).

The Singaporean context

The literature provides a substantial case for more testing of the application of blended learning within the Asian context along the lines of cultural preferences. In a study of Singaporean polytechnic students in a blended course argued, Fang argues that "culture at national, ethnic, and cyber levels might influence what they find useful, enjoyable and effective" (2007, p. 1), a claim that is acutely important to test as Singaporean national policy agendas direct institutions more and more into the blended and online learning space.

Since 2016, Singapore has moved unilaterally to a lifelong learning, skills-centred model, known as Skillsfuture, that is disrupting traditional temporal and sectorial models of delivery affecting all levels of public education from the Pre-Tertiary Institutes of Technical Education and Polytechnics to the under- and post-graduate preserves of the autonomous universities (Ong, 2016). The main drivers of this systemic change to Singapore education are, firstly, a declining number of new entrants to the workforce year-on-year, which is acute in 2020 with only 20,000 new local entrants (pre-COVID-19) arriving into the employment marketplace, compared to 90,000 in 2015 (Tay, 2015). Secondly, a more protectionist policy born out of the 2015 election, concurrently means less foreign labour is being imported. These two policies combined create a labour crunch, with worrying consequences for employers. Thirdly, and further exacerbating employers, the much-heralded academically-driven Singaporean education system has come under criticism for not providing skills need in a rapidly changing world (Tay, 2015). When combined, these drivers result in a Skillsfuture policy tying the two pertinent Ministries of Manpower and Education together to make learning lifelong and more open to all, but at the same time, "more modular, more flexible, more blended and online and with deeper ties to industry" (Chan, 2015), intended to free up students to work and workers to study.

The drivers for change not only prescribe but have driven growth in opportunities for online and blended modes of delivery to prosper (Chan, 2015; Harris et al., 2018; Harris, 2016; Ong, 2015;). Add to this the impact of the COVID-19 pandemic prevalent at the time of writing in which most institutions "currently teaching fully online, while others pursue blended" (Crawford et al., 2020, p. 8) and localised studies within the context are timely and warranted.

In the aforementioned study that underpins this research, Harris et al. (2018) found that associations exist between Singaporean teachers' use of online, students' ages, and students' self-stated understanding of Commerce units with online learning time. The researchers use a Pearson Chi-squared test of independence and establish associations between these variables, associations which give the impetus for this study, and more so because their test could not prove causality. A description of the pedagogical context for the blended course at the centre of both that survey and this experimental study is given in the Methodology section.

Student and teacher perspectives on blended learning

However, generally, literature on both student participation in online and blended learning is largely Western in context and, like educational technology literature more generally (Bulfin et al., 2014) is wide-ranging in focus and methodology, generally answering Garrison et al.'s (2004) call to "explore the impact of blended learning in achieving more meaningful learning experiences" (p. 104). Too often such achievements are too readily assumed in the marketing hype that surrounds educational technology (Harris, 2012; Selwyn, 2016), and researchers should do well to stay objective. Indeed, a second order meta-analysis found high quality, thorough research evaluating the efficacy of particular approaches of blended learning to be rare (Tamim et al., 2011). Abeysekera and Dawson (2015, p.12) went further to insist on an approach otherwise lacking:

> For individual university teachers to be confident in the flipped approach, and university decision-makers to support them, the following types of investigations may be necessary: Small-scale localised interventions, including experimental studies: what is the efficacy of the flipped classroom approach in this discipline, this classroom, with these students?

The literature demonstrates that such blended learning interventions and other forms of research on blended or flipped learning as those described have largely focused on the students' experience, demographics and motivations. Research concerning the age of students explores its effect on student self-reliance and persistence within blended or fully online courses (Harris et al., 2018; Hood, 2013, White & Selwyn, 2013; Xu & Jaggars, 2014, p. 647; López-Pérez et al., 2010) while other research looks at student intentions and motivations to use webinars in a blended learning course (Khechine et al., 2014). Similarly, in studies within the Singaporean context, the focus is on student participation, experience and outcomes rather than necessarily on that which the teacher does (Cheng, 2007; Latchem & Jung, 2009; Menkhoff et al., 2007, Tham et al., 2011).

Conversely, research focused on the teacher and blended learning has considered teachers' perceptions, beliefs, as well as broader institutional approaches to course design and research frameworks (Boelens et al., 2018; Bliuc et al., 2007; Garrison & Anderson, 2003; Jonassen et al., 1995; Meyer & Land, 2003). Teachers' beliefs have been found to be one factor upon which their teaching choices will be predicated (Garrison et al., 2003). Indeed, there can be a wide range of teachers' beliefs about blended learning and their teaching approaches in a blended learning environment. Boelens et al. (2018) interviewed 20 instructors in adult education about their beliefs and use of differentiated strategies in blended learning to meet the needs of a diverse group of learners.

They obtained a range of profiles from no additional support considered in blended learning arrangements, to completely redesigning and transforming blended learning arrangements to cater to students' needs. Both extremes require a participant learner who can transition from simply "assimilating information to constructing meaning and confirming understanding" independent of the instructor (Garrison et al., 2004, p. 98). As such, this echoes the prevailing Western view of the teacher's presence within blended learning courses echoes Garrison et al.'s (2004) view as one of the teacher as facilitator and guide.

However, just how or even if this "guide on the side" (Jonassen et al., 1995; King, 1993) notion is adapted to the "high teacher dependency" classrooms of Singapore (Tham et al., 2011) needs to be accounted for with more research. A study by Shimizu et al. (2019) concerning students in a blended problem-based-learning environment, for example, found that the pedagogy only amplified the dependency and that the Japanese students could be "very deferential towards tutors as authority figures; they fear confrontations with these authority figures and tend to be dependent" (p. 2). This resonates with Cheng's (1999) finding that the cultural preference of Asian students was to withhold their analysis of subject matter rather than exchanging views, an approach arguably not commensurate with a participant learner construct. Against these challenges, the problem remains then as to what role a teacher's activities should take to best enable student online participation in the Singaporean blended environment.

However, further complicating both teacher and student support for blended courses are criticisms of content and media choices within the environment not keeping up with technological advances. Studies from autonomous Singaporean universities concerned with course design, find the pedagogy of little concern to designers and an online learning experience that lacks interactivity, predicated on a perception of the online portion being supplementary rather than fully integrated into the course (Menkhoff et al., 2007; Teo & Gay, 2006; Tham et al., 2011; Thanasingam & Soong, 2007). This finding is supported by meta-analysis research on the use of mobile devices for teaching and learning, which found that mobile phones are "primarily used as a sort of reinforcement tool" (Sung et al., 2016, p. 253) rather than for more critical learning and reflection.

When technology and teacher are not fully integrated the premise on which blended is defined, that the whole course is greater than the sum of its pedagogical parts, is challenged. For example, case-study research found that these same supplementary and unintegrated approaches to online learning components of blended courses resembled a regression to the very issues with online learning, described here in the Introduction, which led to blended learning in the first place. The research instead argues that "designing for active learning" (Bower et al., 2015, p. 12) increased student satisfaction and learning outcomes. That research is also from Australian and New Zealand courses.

The problem to be addressed, therefore, concerns determining what teaching and learning activities affect the learning outcomes and participation of Singaporeans studying in blended learning courses. The significance of the research is that it enables comparisons with and challenges to the findings and assumptions present in Western literature on an Asian student population's participation and performance in blended learning courses.

3. Method

The problem identified was a lack of knowledge of the relationship between teaching and learning activities in a blended context in Singapore and the resulting online participation and performance of students. The literature further posited a gap in methodology calling for the use of quantitative methods in localised, experimental design settings that allowed for the researcher to utilize the latest techniques, such as learning analytics (Bulfin et al., 2014; Siemens, 2013).

Design

This study was conducted in a large private tertiary (post-secondary) higher education institute in Singapore, where students were undertaking a Diploma in Commerce (equivalent to AQF level 5 or UKQF4, first-year bachelor degree). Student participants in the research were enrolled in the blended Microeconomics unit, which was made up of 24 hours face-to-face lecturer contact time and between eight and 12 student self-paced learning hours online. An experimentally designed intervention was used to investigate the impact of the teacher's use (the intervention for the experimental blended group) or not (the control group) of the online resources in the physical class (synchronous) with the students' use outside it (asynchronous). Students' subsequent online participation was measured in clicks in the Learning Management System (LMS) Analytics (Bulfin et al., 2014) and their performance was measured via the pre (co-variable) and post-test quizzes (dependent variable) of the economics subject matter taught.

The particular intervention involved two randomly assigned groups of first semester student participating in a separate two-hour face-to-face (physical) class within the previously mentioned unit, covering the threshold concept supply and demand. All student participants were in their first semester of blended learning with no known prior blended learning experience. The lessons were designed differently, with the control group receiving a 'traditional' offline lesson in which the teacher did not use online resources, as opposed to the experimental group, who received a face-to-face lesson involving the teacher's use of online resources synchronous with students' over the LMS (see Table 1 below).

The two separate lesson plans below (see Table 1) were designed in collaboration with the experienced economics lecturer who taught both the Experimental and Control Groups. The lecturer was chosen for his knowledge of and experience with both the traditional and blended lesson plans and practices used in the respective formats of teaching. In terms of validating the content, a second faculty member with subject expertise in economics reviewed the lessons and approved the accuracy and parity of the content

and level of difficulty, and the alignment to the post-quiz. The presage or design aspect of the experimental group's lesson reflects the "importance of designing for active learning" (Bower et al., 2015, p. 12) with the videos, games and quiz chosen for their interactive properties. Likewise, the control group, while utilizing more traditional forms of teaching and learning activities, also had active learning in place to mitigate potential for threats to internal validity (Creswell, 2014).

Table 1: Comparative table of teaching & learning lesson plans and materials used for the control and experimental (intervention) groups for the microeconomics lecture

Lesson Stages	Control Group (No-use)	Experimental Group (Use)
1.Pre-Lesson: (Start of class) 15 min.	-Pre-Test on basic economics supply & demand knowledge -Administrative check for LMS log-in activation	-Pre-Test on basic economics supply & demand knowledge -Administrative check for LMS log-in activation
2.During: (Introduction) 20 min.	-Lectured introduction using standardized PowerPoints -Allow questions	-Online Video introduction using animated 5-min. video -Allow questions
3.During: (Development) 30 min.	-'Chalk and Talk' using Visualiser (Overhead Projector) for graphs -Supply & Demand Graph activity	-Drag and Drop online Supply & Demand graphs - Online Quiz on Supply & Demand activity
4.During: 25 min.	-Discuss answers for 3.	Discuss answers for 3.
5.Consolidation 15 min.	-Study guide (text) activity -Teacher read scripted reminder re: student using LMS materials after class*	-Study Guide (text) activity -Teacher read scripted reminder re: students using LMS materials after class*
6.Post-Lesson (next lesson, one week later)	-Post-Test on supply and demand	-Post-Test on supply and demand

*Students' online learning use is monitored from end of lesson to beginning of next lesson

The topic chosen for the lectures, supply and demand, was necessarily troublesome for the novice participants (Swoboda & Feiler, 2016), a threshold concept of microeconomics, or one that "represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress" (Meyer et al., 2003, p. 1). The topic was also directly linked to summative assessment later in the course (and after the study). This was to ensure the lesson is of importance so the potential for a lack of extrinsic motivation to learn the content, a potential threat to validity based on 'selection', can be somewhat mitigated (Creswell, 2014, p. 305). When a student is motivated by an external reward like assessment marks and grades, they are said to be extrinsically motivated (Abeysekera et al., 2015, Brown, 1996). At the same, the topic would be covered again formally in their credit-bearing unit, to allow for the scenario, mitigated by the check and balance of the expert third-party curriculum moderation but nevertheless possible, that one group might have a more effective lecture than the other.

The economics subject matter was equivalent and the post-tests identical to both groups to ensure there was no perception of one group to the next of advantage and, given both groups rightly had access to online materials, the instruction to use them after class was also identical and scripted by the researcher to control for any unintended coercion of student to the LMS, which might have weakened the case for the cause of teacher use in RQ1. This control also complied with the aforementioned ethical requirement for the researcher to ensure the equity of student experience and opportunity. Furthermore, these design factors diminished the threat to validity posed by any "diffusion of treatments", which is likewise controlled by keeping the groups separate (Creswell, 2014, p. 305).

Participants

Student participants were recruited via email and information session, following ethics procedures required for the research study. Sixty-eight undergraduate students initially consented to participate in the study, but eight did not answer the post-quiz and were released from the study. Students were randomly assigned into two face-to-face lessons, conducted by the same lecturer/teacher, and had access to the same online materials in the LMS. The control group received a traditional face-to-face lesson on an economics topic, Supply and Demand, whereas the experimental group experienced the teacher's synchronous use of online video, online learning activities, games and quizzes during the lesson.

Given the dictates of "true experimental design" (Creswell, 2014, p. 307), all consenting participants were assigned their university-style lecture and were asked to take notes and participate as usual. Therefore, the use of propensity score matching and other statistical techniques needed for comparing how an intervention impacts on groups with known between-group preexisting differences were not needed (Professor Helen Watt, personal communication, 27 March, 2017).

Data

The data collected using LMS analytics was interrogated along with the independent variable data on age and gender, using the Statistical Package for the Social Sciences (SPSS). For the impact of the multiple dependent variables and a concomitant co-variable, online participation and quiz results, non-parametric tests were applied because the data were not normally distributed.

Paired t tests were initially used to account for pre and post-test means and standard deviations. Different scores between pre-test (the co-variate) and post-test measures were standardised for use in further analysis on age and gender in SPSS. As presented in the Findings, the data was found to be abnormally distributed and non-linear, and so a non-parametric equivalent of the t-test, the Mann-Whitney U test was employed.

Given RQ1 and RQ2 both included a multiple number of independent (teacher's use of online resources, gender and age) and dependent variables (student's participation online in clicks and post-test results), the statistical procedure initially used was an F-test, specifically a Multivariate Analysis of Covariance or MANCOVA. According to Weinfurt (1995), a MANCOVA is "used to assess the statistical significance of the effect of 1 or more independent variables on a set of 2 or more dependent variables", controlling for a concomitant co-variable (p. 245). Therefore, this test addressed the

research questions pertinent to multiple variates in line with other like studies from within the education paradigm (Melendez & Melendez, 2010; Mathuranath et al., 2003; Fraenkel et al., 1993).

MANCOVA methods, held up by researchers as superior to other tests like mixed-mode ANOVAS because of the latter's vulnerability to sphericity violations from which MANCOVA are largely free are, nonetheless, based on their own set of mathematical assumptions which, when violated, may compromise the research. Two important assumptions, outlined below by O'Brien and Kaiser (1985), were considered and the ways and means of ensuring they were met were factored into this study:

Assumption 1. Homogeneity of variances and correlations – this could be an issue if sample sizes of the independent groups were unequal so the researcher endeavoured to arrive at parity or close to parity of the groups. Unfortunately, as the findings show, the main groups, originally with 34 consenting participants each, were only close to parity in the end (n = 28; n = 32), because of 8 students not attending the Post-Test, but homogeneity still ensued.

Assumption 2. Intersubject independence of observation of contrast variables – this was controlled for by the imposing of test conditions for the dependent variable, Post-Test results (to answer RQ2). However, as the earlier reference to t tests and the findings demonstrate, the requisite normally distributed data assumed for MANCOVA tests was not present and so the non-parametric equivalent, the Kruskall-Wallis test was employed (see Findings).

Limitations

The first limitation of this collection was that it did not account for the quality or depth of learning (Siemens, 2013) found in other research about, for example, time on content using video interactions (Kim et al., 2014) or discussion boards or blogs (Tang & Lam, 2014). This limitation was somewhat mitigated both by the use of post-test results as a proxy for student understanding and for the subsequent data analysis, as demonstrated in an earlier experimentally designed study on laptop multitasking in-class (Sana et al., 2013).

A second limitation was the sample size. The sample size reflected the difficulty in recruiting from a population of part-time students, largely working adults from which participant withdrawal (n=8) was due to work or personal commitments.

4. Findings

Summary of Statistics

For the purpose of analysis, subjects were grouped on the basis of gender (two groups), age (seven groups), and the use or non-use of the online learning materials in the classroom by the lecturer. Descriptive statistics in Table 2 show the means and standard deviations of these categories in terms of the number of clicks (a proxy for participation between the lecture investigated and the post-test) made in the online learning materials (addressing RQ1) and the means and standard deviation on the post-test (addressing RQ2). Table 2 also shows the summary of multivariate and other tests performed on the groups.

Table 2: Mean scores on pre-and post-test and number of clicks by categories

All Groups		Mean (SD)			
	n (M/F)	Age	Pre	Clicks	Post
Overall:	60 (26/33)	27.08 (1.22)	2.63 (1.22)	44.73 (20.88)	5.38 (2.21)
Gender:					
Male	26	27.31 (7.68)	2.69 (1.26)	39.04 (19.53)	6.23 (2.05)
Female	34	26.91 (4.80)	2.59 (1.21)	49.09 (21.98)	4.74 (2.15)
p		.818 [a]	.030 [b]	.001 [b]	.173 [b]
Age Groups:					
18-22	15	20.33 (1.23)	2.33 (1.05)	27.80 (7.27)	5.40 (1.77)
23-27	18	24.89 (2.06)	2.78 (1.31)	73.39 (21.83)	5.83 (2.43)
28-32	17	29.47 (1.86)	2.76 (1.15)	37.35 (16.41)	4.76 (2.46)
33-37	6	33.83 (1.17)	2.83 (1.72)	38.17 (12.76)	6.17 (1.84)
38-42	2	38.00 (0.00)	3.00 (1.41)	21.00 (8.70)	5.50 (2.12)
43-47	1	44.00	1.00	32.00	2.00
48-52	1	50.00	3.00	8.00	6.00
Use/Non-Use by Lecturer of Online Resources and Activities In-Class					
No Use	32 (13/18)	26.88 (5.80)	2.75 (1.14)	20.16 (25.46)	5.00 (2.19)
Use	28 (13/15)	27.08 (6.16)	2.50 (1.32)	72.82 (84.42)	5.82 (2.20)
p		.585 [c]	.322 [d]	.001 [d]	.162 [d]

Note: M/F, males/females; SD, standard deviation; [a]Independent Sample t-test; [b]Kolmogorov-Smirnov test for normality; [c]Wilks' Lambda three-factorial MANCOVA; [d]Kruskal-Wallis test.

The statistics in Table 2 above demonstrate the limitation of the population researched for multivariate analyses, even at a cursory glance. Of obvious concern in any test of normality are the number of outliers. Indeed, the final population (n = 60) is small for this type of analyses (Creswell, 2014, p. 145) and further complicated by wide and small distributions of sub-group numbers, in particular for age, which had seven groups (see Table 2). This was in a large part due to the timing of the Post-Test as necessarily one week after the lecture, meaning some participants (n=8) were absent for the test and survey and were thus deemed invalid, an unanticipated flaw from the research design not accounting for the part-time and working status of the subjects (See Conclusion). Nevertheless, the data was tested for assumptions of normality, linearity, and homogeneity.

Results of tests of assumption for multivariate analysis

For verifying normality, Komogorov-Smirnov's two-sample test was run on the dependent variables of clicks and post-test results as well as for the co-variable, the Pre-Test, collected and analysed to account for any prior learning and knowledge. Komlogorov-Smirnov's test was chosen for its

applicability to small data sets. The resulting significance scores (sig. <0.05) reflect data sets not normally distributed, and also reflects non-linearity, a finding confirmed by proofing of histograms and stem-and-leaf-plots of clicks and post-test results. However, the one exception is the relationship of significance between the intervention of the teacher using the online in class ("Use") and the post- test results as this is normal (p= 0.173). The pre-test shows both groups came in relatively normally distributed (p= 0.30 and p= 0.17) but the 'no use' against post-test results were not normally distributed and clicks have no significance regardless of the treatment; no case exists for normality and linearity across the data sets.

The final assumption for discriminant tests like MANCOVA and other multivariate procedures, especially vital when the design is unbalanced as is the case here, assumes that the individual group covariance matrices are equal or homogeneous across the different groups. Box's M test was performed across the 4 factorials and showed the covariance matrix of post-test scores and recorded clicks are equal across Gender, Age, Teacher Use/Non-Use, and the pre-test. As displayed in Table 3, the result shows homogeneity (p =0.09).

Table 3: Box's test of equality covariance matrices[a]

Box's M:	59.606
F:	1.826
df1:	24
df2:	1208.638
Sig.	.09

Note: [a]Design: Intercept + Teacher_Use + Gender * Age * PreTest

Results of MANCOVA tests

Homogeneity aside, the running of multivariate tests as expected showed no significance across factors using Wilks' Lambda (p = 0.585). An application of Pillais' Trace, usually reserved for larger samples, also expectedly revealed nothing of significance (p = 0.599). In simplest terms, it proves the inapplicability of the unbalanced data to MANCOVA tests.

The data reflected an almost bi-modal distribution, in particular for the Group in which the Teacher did not use the online materials in class ('No Use'). Whilst this failed any test of normality or linearity required for the intended MANCOVA analysis, the homogeneity warranted some investigation of the data using non-parametric tests. Therefore, rather than t-tests, which required the assumption of normal distributions, the Mann-Whitney U non-parametric test was applied.

Results of Non-Parametric Tests of Mean

Given the aims of the research were to investigate the effects of three factors on the dependent variables of clicks and post-test scores, Mann-Whitney U tests were run on each factor against each of these two variables and independent samples. As expected from earlier testing, and despite accounting for abnormal distributions, the findings were that no significant differences in the U rankings scores occurred when the effect of Age was tested against each of post-test and click scores. This was likewise the case when the factor of the teacher Use or No-Use of online materials in class was tested against post-test (despite a higher, if not significantly so, average mean on post-test for Use group, shown in Table 3) and pre-test results. However, clicks in the Use group were statistically significantly higher than clicks in the No-Use group (U = 233; p = 0.01) as shown below.

Table 4: Mann-Whitney U Test, effect of teacher use/non-use of online materials on post-test scores, clicks[a]

Chi-Square	1,957	10.312
df	1	1
Asympt. Sig. (2-tailed)	.162	.001

Note: [b]Grouping Variable: Use/Non-Use

This result confirmed the descriptive statistical findings (see Table 2), which showed significant differences in the means of clicks for Use and Non-Use groups, in particular for males, but multivariate analysis revealed insufficient normality of gender data to prove a multi-factor relationship between use, gender and test scores. This is despite higher amounts of average mean clicks and percentage improvement across scores for males and females in the treatment group, comparatively speaking. For the variable of Gender, no significant differences in the U rankings scores occurred when tested against click scores, although Post-Test Scores might survive a less stringent threshold than 0.05 (p = 0.09) and warranted exploration with a bigger sample (see Table 3).

Table 5: Kruskall-Wallis Test for effect of teacher use/non-use of online materials on post-test scores and clicks[b]

	Post-test	Clicks
Chi-Square	1,957	10.312
df	1	1
Asympt. Sig. (2-tailed)	.162	.001

Note: [b]Grouping Variable: Use/Non-Use

From the Kruskall-Wallis results above, p = 0.001, the Null Hypothesis could be rejected and there is a greater than chance probability of student clicks after class being related to whether or not the Teacher Used it in class. A further interrogation (Franke et al., 2011) of the Chi Square Score (Chi-Square/ n – 1; 10.312/ 59 = 0.17) revealed that 17% of the variability in rank scores for clicks was accounted for by Use or Non-use of the online materials by the lecturer in class. Outliers in the data set for both groups notwithstanding, the effect was clear, as Figure 1 shows, with the Median for clicks in the Use group in line with the upper range for Non-Use.

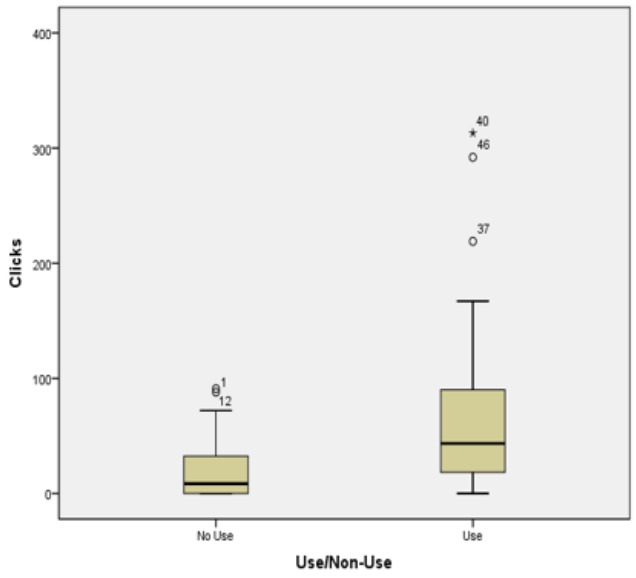

Figure 1: The effect of teacher use of online content in a face-to-face class on student online participation out-of-class

5. Discussion

As described under Method, the experiment took place in a natural setting, the lecture theatre, thus cannot lay claim to major contributions to learning theories or pedagogical precepts predicated as might larger and/or longitudinal studies. However, the research did heed the call to expand the methodological capacity of educational technology research with more localized, contextualized interventions (Bulfin et al., 2014). The research also answered Abeysekera et al.'s challenge of endeavouring to find the efficacy of blended learning for "this discipline (in this case economics), this classroom (higher education), with these students (part-time working Singaporean adults)" (2015, p. 12). In this way, the research made a contribution both to expanding the breadth of methodologies embraced within the broader discipline of educational technologies and within the context of part-time higher education students in Singapore, a group the Literature Review shows is increasingly enrolling in blended learning programs.

The specific aim of this experiment was to investigate the effects of the teacher's use of online learning materials on the subsequent out-of-class online participation, measured in clicks, and test scores of students enrolled in a blended learning course. Regarding RQ1, the research does find for an original discovery concerning the effect of the teacher's use or non-use of the online material in class (synchronous) on the student's subsequent use out-of-class (asynchronous). Indeed, the research lays some claim to corroborating a monkey-see-and-do-monkey-do response from students in terms of their out-of class online participation, which supports Bower et al.'s (2014) recommendation for curriculum designs incorporating active learning as crucial to blended learning efficacy. However, the effects of age and gender on learning activity were found to have little or no significance, but the data sample size was limiting here with disparate sizes among age categories. Indeed, the positive correlation between age and factors like persistence and self-reliance as found in literature (Khechine et al., 2014; Harris et al., 2018; Xu et al., 2014) would warrant further research with larger and more equally distributed samples.

While several studies (López-Pérezet et al., 2010; Swoboda et al., 2016), have found differences in the participation of blended students in comparison to students in face-to-face classes, the originality here is found in the investigation of the role the teacher's instructional choices play within blended-only courses. Indeed, while studies have supposed the importance of supportive (Goh & Scarri, 2016), active (Bower et al., 2014), and open-minded faculty within course designs (Harris, 2012), this study sought to compare the actual effect of a lecturer who used the online materials synchronously in class against the effect of the same lecturer when he/she did not use the online materials in class, but where both groups had equal access to online materials out of the physical class. The subsequent finding, when the data was tested non-parametrically to allow for inherent issues of non-linearity and abnormal distribution, was that the lecturer's use of the online in class impacted the students' participation outside of the physical class in a statistically significant way.

However, in terms of the latter variable, the effects of time spent online and the blended learning format, the findings cannot make claims to efficacy of the synchronous blended approach on test score performance, as set out in RQ2. This is despite (statistically insignificant) higher post-test average scores by 8% for an experimental group (M = 5.82, compared to the control group's M = 5.00, out of a possible score of 10) that came in despite comparatively lower pre-test score averages (respectively M = 2.50, M = 2.75, see Table 2).

To borrow from Abeysekera et al. (2015), the effect of the teacher's use in this class for this group of students should not be generalised, but should rather open up questions pertinent to the context. For example, consider the milieu around the role of teachers in Asian and blended learning classes. Whereas the finding of students following their teacher's lead, may be seen as further proof of the "high teacher dependency" of students asserted by Tham et al., (2012), it also may show how integration of online curriculum within the same physical class and away from its once "supplementary" role (Menkhoff et al., 2007; Teo & Gay, 2006; Thanasingam et al., 2007) only reinforces the position of the teacher as a figure of authority. With more research, this could inform change management (Bower et al., 2014) and other institution-wide practices for the introduction of technology into curriculum and learning spaces now increasingly a necessity (Crawford et al., 2020). For the purposes of this report, the principal finding is that the grouping of participant students into classes in which the teacher used or did not use the online curriculum in the class accounted for 17% of the variance of clicks by students out of class (Table 6). Moreover, this fact about participation along with the, albeit statistically insignificant, relatively greater improvements to average test score of both male and female students on the post-test in the class where the teacher used the online materials together offer a case for larger, longitudinal studies to see if these hitherto disparate

variables are significantly related within a synchronous blended learning design.

From a research design and participant perspective, the greatest challenge was in the recruitment of part-time working adult students to participate in a study which required them to be present in two consecutive lessons, the lecture class itself and the subsequent post-test class. Nevertheless, the significance of the results for RQ1 suggest a bigger sample size from across institutions is warranted.

6. Conclusion

The major finding in this study, that of students' online participation being dependent on whether or not the teacher uses the online content of the blended course in class ($p = 0.001$), is novel for the focus on a teacher's instructional choices of online learning within a blended-only course, but resonates with earlier studies that relate student participation in blended courses to the level of integration of the online and face-to-face components (Bower et al., 2014; Friesen, 2012; López-Pérez et al., 2010). Nevertheless, this was a 'local study' and so its implications are conclusive only for the context in which it was performed (Abeysekera et al., 2015; Bulfin et al., 2014). Indeed, it is argued that the most successful blended and other teaching and learning models are ones which best meet the challenges and requirements of a local setting (Holkner et al., 2008). Within those boundaries, it can be argued that teachers of economics with part-time cohorts in Singapore within a blended course design should consider the integration of online content synchronously in the physical class, rather than designating it supplementary as has been the Singaporean norm (Gay, 2006; Menkhoff et al., 2007; Sung et al., 2016; Tham et al., 2011; Thanasingam et al., 2007).

In conclusion, future research directions should include more of these localized, controlled, random experiments that consider the integration of the lecturer in blended learning designs as a counter-point to the many studies cited here that look at the integration of technology. Moreover, discoveries like the one in this study of the impact of the lecturer on the out-of-class participation of students, may have positive consequences for the uptake of and research into educational technologies among educators (Bulfin et al., 2014), now even more critical in a more socially and educationally distanced post-COVID-19 world of higher education (Crawford et al., 2020). The one challenge to mitigate in future studies is in the recruitment of part-time students, so future applications should increase the sample size by repeating the experiment through multiple cohorts over time.

By way of post-script, in summarizing their experimental research concerning laptop use in class, Sana et al. (2013) argue for the provision to lecturers of "resources to help them create enriching, informative and interactive classes" (p. 30). Of course, adoption should not be for its own sake, instead it should be with learning, pedagogy, and the dual academic missions of great teaching and research in mind. For it still remains to be disproven for blended as it does for traditional courses in Higher Education that while students are accountable for their own learning, "enthusiastic instructors can influence how students choose to direct their attention" (Sana et al. 2013, p. 30), in and out of the physical classroom.

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