A Study of Students' Engagement on the Zoom-based Synchronous Online-teaching

Ka Man Pang, University of Wollongong College Hong Kong, Hong Kong

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Abstract
The outbreak of the COVID-19 created a chaos of global health crisis and campus health. To avoid class suspended, the Wollongong College Hong Kong (UOWCHK) has shifted most classes to a Zoom-based synchronous online learning environment. It includes one of my taught modules named 'Introduction to Programming'. However, there is a lot of problems specific to online learning having been discussed in diverse studies. It includes that learning comes to be 'passive', 'isolated' and 'unengaged'. Along with these problems, a study was organized concerning whether students can mentally engage with the Zoom created new learning environment stably across all the learning topics of this module. This study used a rating scale and anchoring survey method to collect quantized qualitative data on students' feelings with five bipolar mental specifications, 'Boring–Stimulating'; 'Did Not Learn Much-Learned Much'; 'Not Engaged in Learning Process-Engaged in Learning Process'; 'Not Much Work Done-Much Work Done', and 'Could not Experience Good Learning- Experienced Good Learning'. Students were asked to rank against these mental specifications in 1-7 bipolar points upon completion the teaching weeks of week-2, week-5, week-9, and week-12. The responses on this study were analysed with the one-way repeated measure ANVOA and mean analysis descriptive methods. The outcome of this research is inspiring. It shows that students could stable engage to all major learning topics with a positive engagement. This result significantly provide evidences that students in this module were not restricted by using the Zoom to learn, and also the use of synchronous online teaching could be a supplementary learning approach and provide a flexible approach for instructional design.

Keywords: Zoom, Synchronous Learning, Online-teaching, Learning Engagement, Learning Environment, Introductory Programming, Pedagogy, Repeated Measure ANVON

Introduction

There is a lot of problems specific to online teaching including diverse mental engagement problems having been discussed in diverse studies. While there was one of my teaching modules named 'Introduction to Programming' adopted to use Zoom-based synchronous online teaching, this paper reports a research focused on students' learning with this teaching mode. It particularly concern of students' mental engagement on using Zoom to teach. The targeted module is a year-one module offered in two two-year associate degree programmes, named 'Associate of Science in Information Software Development' and 'Associate of Science in Network and System Administration'. This module consists of thirteen 3-hour teaching weeks aiming to provide students basic knowledge on computer programming, including the topics of variables/constants, decision/looping controls, array, program modernization and object-oriented programming concept. They are all major contents introduced in the introductory programming.

Background of this Study

This study focuses students' mental engagement to a new created Zoom-based synchronous online learning environment. This focus is defined based on the concern of there is a lot of learning mental problems specific to online teaching particularly in learning of introductory programming. For example, regard to effective of instructional design, online teaching is difficult to be achieved as it requires substantial changes on the scaffolding to maintain students' engagement which could be pursued in normal teaching approach (Adedoyin & Soykan, 2020; Best, 2020; Breivik, 2016; Joshi, 2020). As reported by many studies, engagement to the learning environment is a major property for motivating students to learn, reducing the mental difficulties on the learning processes, while a new software, environment is used (Belland, Kim, & Hannafin, 2013). Moreover, in an online teaching environment, teachers are limited by the poor capacity of creating an effective communication channel to regulate the learning process, facilitate collaborative learning, group discussions (Adedoyin & Soykan, 2020; Joshi, 2020). It consequently comes up those teachers feel the learning process will be 'out-of-control'. It gives a great challenge on instructional delivery (Sarikas, 2018), and also adversely affect the process of developing formative assessment, class collaborative activities, and provide pertinent helps for students (Shabani, Khatib, & Ebadi, 2010).

The mental problems specific to online teaching also includes students feeling of isolation (Iskander, 2007; Kats, 2010), frustration, low involvement, and discouraging with poor student-teacher communication to get immediate helps (Best, 2020; Boulos, Maramba, & Wheeler, 2006). This outcome of mental difficulties specifically affecting students' achievement while they are highly required to visualize the abstractive of programming logics, semantics to be an understandable model in their mind. As pointed by Gomes and Mendes (2007), the reasons of students' poor understanding on the complexities of program semantics are mainly due to their poor taxing mental efforts. This mental problem is caused by the incapability of learning activities that could not encourage learners positively engage to the learning environment when software based online learning tool is used.

Another study from Piteira and Costa (2013) provides similar conclusion. This study claimed that the major reason of students' low performance in online teaching is due to students' paucity of the abstract thinking in programming logics. While the isolation of teacher and students causes a lot of difficulties to establish an effective way, this problem of paucity cannot be easily improved. Study from Piteira and Costa continuingly pointed out that such poor mental

engagement problem comes up to be a major reason of high drop-out rate in year-1 Computer Studies (CS1). This study aligns with the findings from Mhashi and Alakeel (2013), it indicated that the high drop-out rate in introductory programming is due to students' frustration from the poor supportive learning engagement, in which they feel isolated and boresome by lacking pertinent helps immediately. This problem eventually highly restricted students' achievements on the learning.

Methodology

This research applied the quantized qualitative research method. Students were required to rank from 1 to 7 against to the two polarities of five bipolar mental specifications, which were defined with referencing some practical works and studies focused on effectiveness of instructional delivery for learning computer programming (Tsai & Chiang, 2013; Tsai, Shen, & Fan, 2013). The specifications are sp1: Boring – Stimulating; sp2: Did Not Learn Much – Learned Much; sp3: Not Engaged in Learning Process – Engaged in Learning Process; sp4: Not Much Work Done – Much Work Done, and sp5: Could not Experience Good Learning – Experienced Good Learning at four surveyed points, which are the teaching weeks of week-3, week-5, week-9, and week-12. By curriculum, these teaching weeks are focused on the topics of 'basic concept', 'program controls', 'array and file data structure' and 'object-oriented concept' respectively. These topics are presented at different difficult levels in introductory programming, therefore data collected at these points can be reflected students' engagements varying at different times with the learning difficulties corresponding to the topics.

These mental specifications also focus on students achievements corresponding to the mental difficulties on learning computer programming in an online teaching environment (D. R. Garrison, 2006; D. Randy Garrison & Cleveland-Innes, 2005). The use of bipolar rating scale can minimize the disruption to students by allowing them to make generic ranking on every surveyed teaching week while it would not quizzed or required students spending time to complete a long survey (Robert et al., 2009). Students' responses on the specifications in all surveyed teaching weeks were analysed with one-way repeated measure ANOVA (Mhashi & Alakeel, 2013; Spector, Lockee, Smaldino, & Herring, 2013). It is an effective data analysis method for repeatedly comparing the variation of a set research variables (Field, 2012). For this study, the major goal is to show the variances on students' responses on all surveyed teaching weeks being not significantly. It means most students can stably, mentally engage to the Zoom created new learning environment across the module. Otherwise, the high variances on the engagements to all surveyed teaching weeks may show students are restricted by the Zoom-based asynchronous online teaching.

Data Analysis and Discussio

The outcomes analysed by one-way repeated measure ANOVA provides evidence that students are possibly engage to the module's learning activities. The detail result of individual specifications is presented in the follows.

sp1. Boring – Stimulating

The Mauchly's Test of Sphericity for the specification 'Boring-Stimulating' is observed. It shows that the sphericity can be assumed with the Mauchly's value of W=0.954, $X^2(5)=3,632$, p=0.604 (>0.05).

The Test of Within-subjects' Effects is illustrated in the Table 1. It shows that with the F-value is F(3, 234)=1.532, p=0.207 (>0.05), the variance of students engagement between the surveyed teaching weeks is not significant.

Source		Type III Sum of Squares	df	Error (df)	Mean Square	F	Sig. α=0.05
Students Responses	Sphericity assumed (X^2(5)=9.54, p=0.604)	7.823	3	234	2.663	1.532	0.207

Table 1. The Test of Within-subjects' Effects on the Specification 'boring to Simulating' (n=80).

sp2. Did Not Learn Much – Learn Much

The Mauchly's Test of Sphericity for the specification 'Did Not Learn Much-Learn Much' is observed. It shows that the sphericity can be assumed with the Mauchly's value of W=0.934, X^2(5)=5.148, p=0.398 (>0.05).

The Test of Within-subjects' Effects is illustrated in the Table 2. It shows that with the F-value is F(3, 231)=2.391, p=0.069 (>0.05), the variance of students engagement between the surveyed teaching weeks is not significant.

Source		Type III Sum of Squares	df	Error (df)	Mean Square	F	Sig. α=0.05
Students Responses	Sphericity assumed (X^2(5)=5.148, p=0.398)	14.163	3	231	4.721	2.391	0.069

Table 2. The Test of Within-subjects' Effects on the Specification 'did Not Learn Much-learn Much' (n=80)

sp3: Not Engaged in Learning Process – Engaged in Learning Process

The Mauchly's Test of Sphericity for the specification 'Not Engaged in Learning Process – Engaged in Learning Process' is observed. It shows that the sphericity can be assumed with the Mauchly's value of W=0.889, X^2(5)=9.118, p=0.104 (>0.05).

The Test of Within-subjects' Effects is illustrated in the Table 3. It shows that with the F-value is F(3, 237)=0.048, p=0.986 (>0.05), the variance of students engagement between the surveyed teaching weeks is not significant.

Source		Type III Sum of Squares	df	Error (df)	Mean Square	F	Sig. α=0.05
Students Responses	Sphericity assumed (X^2(5)=9.118, p=0.104)	0.312	3	237	0.104	0.048	0.986

Table 3. The Test of Within-subjects' Effects on the Specification 'not Engaged in Learning Process – Engaged in Learning Process' (n=80).

sp4. Not Much Work Done – Much Work Done

The Mauchly's Test of Sphericity for the specification 'Not Much Work Done - Much Work Done' is observed. It shows that the sphericity can be assumed with the Mauchly's value of W=0.942, $X^2(5)=4.631$, p=0.463 (>0.05).

The Test of Within-subjects' Effects is illustrated in the Table 4. It shows that with the F-value is F(3, 237)=5.169, p=0.002 (<0.05), the variance of students' engagement between the surveyed teaching weeks is significant.

Source		Type III Sum of Squares	df	Error (df)	Mean Square	F	Sig. α=0.05
Students Responses	Sphericity assumed ($X^2(5)=4.631$, p=0.462)	27.575	3	237	9.192	5.169	0.002*

Table 4. The Test of Within-subjects' Effects on the Specification 'not Much Work Done - Much Work Done' (n=80)

sp5. Cannot Experience Good Learning – Experience Good Learning

The Mauchly's Test of Sphericity for the specification 'Cannot Experience Good Learning – Experience Good Learning' is observed. It shows that the sphericity can be assumed with the Mauchly's value of W=0.957, $X^2(5)=3.364$, p=0.644 (>0.05).

The Test of Within-subjects' Effects is illustrated in the Table 5. It shows that with the F-value is F(3, 237)=0.048, p=0.986 (>0.05), the variances of students engagement between the surveyed teaching weeks is not significant.

Source		Type III Sum of Squares	df	Error (df)	Mean Square	F	Sig. α=0.05
Students Responses	Sphericity assumed ($X^2(5)=3.364$, p=0.644)	0.179	3	237	0.060	0.038	0.990

Table 5. The Test of Within-subjects' Effects on the Specification 'cannot Experience Good Learning – Experience Good Learning' (n=80).

In summary, the outcome of the specifications Boring - Simulating (p=0.207<0.05)', 'Did Not Learn Much - Learn Much (p=0.069 > 0.05)', 'Not Engaged in Learning Process - Engaged in Learning Process' (p=0.986 > 0.05), and 'Cannot Experience Good Learning – Experience Good Learning (p=0.990 > 0.05)' is able to indicate students being generally engaging to the Zoom created new learning environment across the learning of this module. However, as indicated in individual specification, there are still some concerns, as discussed in the follows.

The major purpose of one-way repeated measure ANVOA can identify the level of stability of students' engagement upon using the Zoom-based synchronous online teaching. However, it is unable to identify whether this engagement is positive or not. To know of it, a further analysis on the means of students' responses on individual specification in all surveyed teaching weeks is used. The result is presented in the Table 6 in below.

Mental Specification	Week-1 M (SD) (n=80)	Week-5 M (SD) (n=80)	Week-9 M (SD) (n=80)	Week-12 M (SD) (n=80)	Average of All Means
s**p**1. Boring – Stimulating (n=79)	5.00 (1.30)	4.77 (1.35)	5.22 (1.31)	4.96 (1.42)	4.98
s**p**2. Did Not Learn Much – Learn Much (n-78)	5.40 (1.24)	4.86 (1.51)	5.01 (1.49)	5.28 (1.34)	5.13
s**p**3. Not Engaged in Learning Process – Engaged in Learning Process (n=80)	5.01 (1.35)	4.93 (1.60)	4.96 (1.59)	4.98 (1.22)	4.97
s**p**4. Not Much Work Done - Much Work Done (n=80)	4.81 (1.31)	4.94 (1.48)	5.23 (1.37)	5.58 (1.25)	5.14
s**p**5. Cannot Experience Good Learning – Experience Good Learning (n=78)	5.12 (1.32)	5.06 (1.32)	5.13 (1.33)	5.10 (1.36)	5.10

Table 6. The Descriptive Statistic Outcomes on All Specifications' Mean Value on All Study Points.

The Table 6 shows that all the means of the specifications for individual surveyed teaching week are over 4.77, and up to 5.58 (the columns of week-1, week-2, week-9 and week-12). Besides, together with the outcome shown in the last column, 'Average of All Means', that values are range at 4.97~5.14, the overall outcome presented in table 6 could be seen is positive. In this view, it could be concluded that the outcome of students' engagement indicated by one-way repeated measure ANVOA is positively presented.

Regard to students' responses on the specification 'Not Much Work Done - Much Work Done', while this specification indicates variance between all surveyed teaching weeks are significantly different ($p=0.002 < 0.05$), as show in the Table 4. It needs a more insight on why this significant difference presented. Focus again to the Table 6, in the row of 'sp4. Not Much Work Done - Much Work Done', the means of this specification in all surveyed teaching weeks are 4.81, 4.94, 5.23, 5.58 for week-1, week-5, week-9 and week-12 respectively. It shows a pattern on the differences which is stably increasing from 4.81 to 5.58 from week-1 to week-12. This outcome can be interpreted as students' achievement during learning in this module, as this specification relates to 'Much Work Done' instead of to be an adversely effect of students' stability of engaging to the learning environment. These responses perhaps are expected in a learning module.

Conclusion

Although the one-way repeated measure ANVOA shows significant variance on sp4 'Not Much Work Done – Much Work Done' across the surveyed teaching weeks, however with the positive responses on other specifications, the sp1, sp2, sp3 and sp5, this research can be concluded that students were able to engage positively, mentally to learning environment throughout the whole module while use the Zoom-based asynchronous online teaching. In this view, although students used Zoom to learn, and lecture used the Zoom to teach, students were still willing to spend time on learning, able to positively engage most learning processes, and stably across all major topics in this module. They were also experienced a good learning approach. More importantly, this research focused on mental engagement, while it is a crucial factor to students on developing their understanding on programming logics (Belland et al., 2013; Linnenbrink & Pintrich, 2003). The result of sp1 'Boring-Stimulating' therefore importantly providing evidences the use of online teaching does not restricted students' interest,

and boresome on learning computer programming while they both are major reason of students' frustration on learning computer programming.

This research does not intend to suggest a scaffolding on synchronous online teaching. Instead, it is to evaluate whether the use of synchronous online teaching with the Zoom created environment will deteriorate students' learning achievement owing to the poor mental engagement to this environment. This finding is crucial as a positive outcome, as indicated in this research, can provide ideas for teachers considering an alternative way for instructional delivery by rethinking the application of a mix-mode teaching approach, while resume to normal class learning when Covid-19 comes to be controllable, or may be use it as a supplementary teaching approach to provide a more flexible instructional and scaffolding design. However, base in this research, there are some gaps need to be concerned. Firstly, the pros and cons of mix-mode approach have been discussed in many studies while there is not conclusive theory provided (e.g.,Sooriamurthi, 2009; Teague, 2011). Moreover, many of these studies were not defined based on the background of Covid-19 outbreak. In this sense, further research relating to this study's outcome are recommended to wider the focuses on extending students' achievements in respect to different subject areas by using empirical studies. These works are valued, as class suspension due to some reasons like Covid-19 outbreak in this time is foreseeable in the future. We need strategy to cope with it by introducing an effective new and alternative learning approach to academic learning.

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Contact email: kmpang@uow.edu.au